OREA 1

Western Anatolia before Troy

Proto-Urbanisation in the 4th millennium BC?

Proceedings of the International Symposium held at the Kunsthistorisches Museum Wien
Vienna, Austria, 21–24 November, 2012

Barbara Horejs,
Mathias Mehofer (Eds.)

Austrian Academy of Sciences Press

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Preface by the Series Editor

These conference proceedings launch the new publication series Oriental and European Archaeology, OREA, initiated by the series editor after the institute of the same name was founded at the Austrian Academy of Sciences. It was endorsed by the publishing committee of the philosophical-historical class of the Academy as part of its canon of publications. The scientific quality of the new series is ensured by international peer review and integration into an active scientific environment. The new publication series is intended to mirror the supra-regional networked research at the Institute for Oriental and European Archaeology and present it as a consistent collection.

OREA deliberately considers the core zones of cultural developments in Europe and the Orient to act not as counterpoints, but rather as a common cultural bracket, in which undoubtedly very different dynamics and processes influenced the most important developments. The advanced specialisations of the various branches of archaeology and their corresponding regional foci are reflected in their publication cultures. The new series aims to achieve a cross-regional readership and authorship from both European and Oriental archaeology to consider and discuss these cultural areas as they relate to one another. In accordance with the research profile and expertise of the institute, the series concentrates on the prehistoric and early historical periods in human history. The series is open to all scientific approaches, as long as they support topics and discussions of basic archaeological research in this area. Monographs, primary publications of excavations, detailed studies, interdisciplinary and archaeometric analyses as well as conferences and manuals are equally welcome.

The OREA series starts with this volume, Western Anatolia before Troy. Proto-Urbanisation in the 4th Millennium BC?, which arose from the homonymous symposium in Vienna in 2012. The articles within constitute a first basic overview of new archaeological data from the 4th millennium BC – before the start of the Bronze Age in western Anatolia – in the context of the neighbouring regions of south-eastern Europe and the Aegean up to the Caucasus. The authors of this volume discuss fundamental cultural, ecological and economic issues. The compilation sheds new light on this period and highlights its importance for future research; it reflects the intense and insightful discussions during the symposium, for which I would like to thank everyone involved.

My sincere thanks go to the co-editor of this volume, Mathias Mehofer, the *Kunsthistorisches Museum* in Vienna, and all the organisers of the event, in particular the team of the ERC project Prehistoric Anatolia. Financial support for publication was provided by the Austrian Academy of Sciences, the University of Vienna and the European Research Council (ERC). The rapid production was enabled by two people: Angela Schwab, who designed the layout of the contributions, and Estella Weiss-Krejci, who oversaw the general editing. I would like to take this opportunity to acknowledge their commitment. I intend that this new series about Oriental and European archaeology will attract interested and avid readers as well as numerous active authors with innovative and pioneering research.

Vienna, 19 November 2014
Barbara Horejs
Series Editor
Director of the Institute for Oriental and European Archaeology

Introductory Remarks

This volume presents the scientific results of the international symposium *Western Anatolia before Troy – Proto-Urbanisation in the 4th Millennium BC?,* which took place in Vienna from November 21 to 24, 2012.

The initial idea for this conference emerged whilst discussing the role of metals in the Copper Age in western Turkey during our excavations at Çukuriçi Höyük. On the one hand, due to the sparse archaeological data published for the 5th and 4th millennia, further conclusions seemed premature. On the other hand, the archaeological picture of western Anatolia has changed fundamentally in the last decades, as there are long-term excavations in place that have been contributing new and important information to this old debate. The time seemed right to bring together specialists of western Turkey and the neighbouring regions to discuss new data in the light of socio-cultural processes in the period before Troy. Furthermore, following the results of the ERC research group (ERC project *Prehistoric Anatolia*), it appeared high time to focus on this period as it had been frequently neglected in the recent dynamic prehistoric research in western Turkey. The intermediate millennia between the archaeological focus on the Neolithic (and early Chalcolithic) of the 7th and 6th millennia BC with ground-breaking results and publications on the one hand and traditional research on the Early Bronze Age in the 3rd millennium BC with new input from important key sites on the other, remained more or less neglected.

The symposium in Vienna was organised with a narrow chronological focus on the 4th millennium BC in mind to initiate a first step in refreshing the scientific debate on this period. A circle of international experts in the field of archaeology, archaeozoology, archaeobotany, archaeometallurgy and climatology were invited and discussed various cultural phenomena, some of which stretch from across the Balkans to Mesopotamia. Moreover the contributions included a vast amount of new archaeological data and inspiring ideas about how to deal with this yet so nebulous period in the future.

Important key sites at the central Anatolian Aegean coast are presented and discussed in this volume, offering insights into the results of new excavations and ground-breaking new data for the 4th millennium BC. The western Anatolian sites discussed in detail include Çukuriçi Höyük (B. Horejs), Miletus I and Heraion/Samos (O. Kouka), Bakla Tepe (V. Şahoğlu – R. Tuncel) and Çine-Tepecik (S. Günel). In addition, the site survey at Alacalıgöl is presented and embedded in the middle and late Chalcolithic Troad (S. Blum), meanwhile B. Weninger and D. Easton discuss the Early Bronze Age chronology of Troy on the basis of pottery seriation and radiocarbon results. The Carian region is discussed by a re-evaluation of data previously recorded from Iasos (C. Gerber). This new collection of western Anatolian sites demonstrates convincingly that the region was permanently settled and indicates that the main developments of the following Early Bronze Age period were rooted in local, regional and intra-regional processes taking place in the 4th millennium BC in western Anatolia (Fig. 1).

The symposium aimed to shed light on these developments and focus in particular on the formation of centres of regional and supra-regional importance that emerged in western Anatolia and its neighbouring regions. It was therefore more than enlightening to discuss our region in relation to the broader geographical context of the Balkans, the Marmara Sea, the Greek mainland and Crete. The gap of knowledge about the 4th millennium BC (and the second half of 5th millennium BC) in eastern Thrace is reviewed by M. Özdoğan in the context of a complex research problem on a macro-regional scale. Integrated in a crucial critical discussion of data, he suggests that maritime contacts between central Anatolia and the northern Balkans might have taken place through the

Fig. 1 Archaeological sites in Turkey whose excavations results are presented in detail in this volume. Adjacent areas also discussed are shaded green (design: M. Börner).

Black Sea, being quite aware of the chronological discrepancies. The western Pontic area in 5th millennium BC is characterised by well-organised rural societies, although a ranking of sites with one dominating centre cannot yet be established, as A. Reingruber argues. She identifies the high impact of craft specialisation on social transformations, the application of innovative technologies and intensified communication in the lower Danube region. This specific cultural package might be comparable to western Anatolia in the succeeding millennium. The general dynamics of this period are discussed in broad terms by S. Hansen, who characterises the "second half of the 4th millennium BC as one of the most significant chapters in the history of mankind by an expansion of power unknown until then". A cluster of key technical and social innovations can be observed in the Near East and western Eurasia. Future research in western Turkey could pick up Hansen's results and discuss the various elements of this bundle of innovations that were perhaps adapted and partially combined to a socio-cultural structure that finally lead to the Early Bronze Age homogeneity. The Balkan-Carpathian region in the 4th millennium BC is discussed by R. Krauß in the context of the Baden and Corded Ware cultures with new data from the site Foeni-Gaz.

The role of the Aegean in the 4th millennium BC and the current state of knowledge are analysed and debated in several contributions which include a range of new data from northern Greece to Crete. Recent chronological studies by Z. Tsirtsoni offer a re-evaluated and clear order of the transformation that took place in the Aegean. It includes problematising visibility in archaeology – an important aspect that should also be included in future discussions of western Anatolia. E. Alram-Stern adds an important focus on the distribution of pottery technologies and styles as well as on metallurgy to describe an already established Aegean network in that particular period. She furthermore points out the probable expansion of social organisation visible through fortifications and wells in Late Chalcolithic times. The role of Crete in the emergence of long-distance trade networks is pointed out by Y. Papadatos and P. Tomkins. Their interpretation of Kephala Petras as early gateway community offers ground-breaking new insights for understanding the role of coastal sites and their strategies of raw material procurement. P. Tomkins furthermore offers a broad overview of essential cultural developments and their chronological order in Crete from the Neolithic to the Early Bronze Age II.

The third main aspect of the symposium was the integration of archaeological data from the different regions with environmental and climate data as well as the reconstruction of subsistence strategies and high impact technologies. A broad geographical synopsis of climatic and environmental changes in the 4th millennium BC is provided by S. Riehl, K. Pustovoytov and H. Othmanli. Their diachronic analyses of archaeobotanical data of various sites lead to agricultural models for the period with a long-term shift from a protein- to a carbohydrate-dominated plant diet, probably related to an increase in aridity. Additional information about subsistence on regional levels in this volume is offered by A. Galik. His comparison of new faunal data revealed regional disparities in livestock management on the Late Chalcolithic sites of Barcın Höyük and Çukuriçi Höyük that are interpreted as being caused by the differing natural environments at the Marmara Sea on the one hand and the Mediterranean coast on the other. The important large cemetery of İkiztepe is discussed in the light of mobility, social organisation and integration by examining isotopes. L. Welton not only provides new radiocarbon data for this already intensively discussed necropolis, but also new evidence for transhumant pastoralism and its role in the social economy. I. Gatsov and P. Nedelcheva summarise lithic technology and raw material procurement strategies by presenting their lithic studies of various sites in the Balkans, the Marmara region and the east Aegean. U. Schoop draws our attention to the potential role of textile production in Late Chalcolithic Anatolia and its presumed socio-cultural impact in terms of economy and personal prestige. The development and role of metallurgy is discussed in both a broad and a narrow chronological and geographical context. E. Pernicka presents a broad geographical overview of the current state of early metallurgy between Mesopotamia, Asia and continental Europe including recent evidence dating to the 5th and 4th millennia BC. M. Mehofer provides new data from Çukuriçi Höyük, revealing intensive metallurgical activities in the 3rd millennium BC that are probably rooted in the Late Chalcolithic period.

The symposium was organised by the ERC project *Prehistoric Anatolia* and the Vienna Institute for Archaeological Science (VIAS) of the University of Vienna. For the financial and organisational support we want to express our gratitude to the ERC starting grant *Prehistoric Anatolia*, the Institute for Oriental and European Archaeology (OREA) of the Austrian Academy of Sciences, the Austrian Archaeological Institute (ÖAI), the Vienna Institute for Archaeological Science (VIAS) and the IDEE – Forum for Interdisciplinary Dialogue, University of Vienna. We would like to thank Sabine Haag and Georg Plattner for the friendly hosting of the symposium in the Art History Museum of Vienna (KHM) as well as Anton Kern for the interesting tour through the Natural History Museum of Vienna (NHM). The professional assistance by Christoph Schwall, Felix Ostmann, Johanna Traumüller and Maria Röcklinger ensured a perfectly organised symposium. Further editorial and linguistic work for the publication of the conference proceedings were carried out by Silvia Hack, Maria Martinez, Katharina Rebay-Salisbury, Estella Weiss-Krejci and Doris Würtenberger. We also would like to express our thanks to all anonymous reviewers for their valuable comments and suggestions.

Finally we warmly thank all authors and discussants for their inspiring contributions, which greatly enhanced our knowledge about the complex cultural processes and interactions that took place in the 4th millennium BC. We hope that this volume will both offer a rich variety of new data and models of interpretations for a broad audience and will inspire further investigations into the Late Chalcolithic period in western Anatolia and beyond.

Barbara Horejs, Mathias Mehofer
Vienna, 12 May, 2014

Western Anatolia

Proto-Urbanisation without Urban Centres? A Model of Transformation for the Izmir Region in the 4th Millennium BC

Barbara Horejs[1]

Abstract: The former absence of sites dating to the 4th millennium BC in western Anatolia represented an artificial lacuna produced by the lack of scientific research. This gap is gradually being filled with data from new annual excavations and surveys. Although we still have to get by with limited amounts of archaeological data, the Late Chalcolithic period has recently been presented in handbooks and wider studies as a crucial period of cultural development in Anatolia. Predating the relatively well-researched Early Bronze Age, with its organised central sites, the 4th millennium BC could be understood as a period during which the processes began that led to the developments that defined the Early Bronze Age. This contribution debates the multi-layered process of proto-urbanisation as a socio-cultural phenomenon in the context of *longue durée* development in the crucial period of the 4th millennium BC. Based on recent excavation results obtained from Çukuriçi Höyük and other sites, the paper examines different archaeological indicators to define the broad region of western Anatolia, and the centre of the Anatolian Aegean Coast in particular, before Troy. Based on Kemp's model for pre-dynastic Upper Egypt, this distinct region is considered from the perspectives of basic economy, functional diversity and specialisation. The results are discussed as cultural transformations and process of consolidation of communities and their functional differentiation in the use of land and resources. The paper concludes with a model of proto-urbanisation for the centre of the Anatolian Aegean Coast in the 4th millennium BC.

Keywords: Turkey, western Anatolia, Çukuriçi Höyük, Proto-Urbanisation, Late Chalcolithic, socio-cultural development, prehistoric economy, model of transformation

Western Anatolia is a well-integrated region between the inner Anatolian, Mesopotamian and Levantine world on the one hand and the Aegean, Balkans and the Black Sea on the other. Cultural interaction forms a conceptual backbone for understanding all of prehistory in western Anatolia. Examining general cultural developments from a broader perspective, we are dealing with the concept of connectivity from the earliest Pottery Neolithic up to the end of the Bronze Ages (and beyond). In this supra-regional cultural context, it appears significant to ask *why* it seems so difficult to connect western Anatolia, the region in our focus, with its cultural neighbours in the millennium before Troy and *how* we should understand the explosion of Early Bronze Age sites around the beginning of the 3rd millennium BC.

Excavation results from Çukuriçi Höyük reveal archaeological remains and materials dating to the 4th millennium BC or the Late Chalcolithic period that we can, for the first time, link with general processes that took place in other cultural areas. The intensive metallurgical production in the following Early Bronze Age at Çukuriçi[2] brings us back to the old debate of which role metals played for the development of social systems in the periods of early copper and arsenic bronze production. Since the late 1960s when C. Renfrew developed his model of a possible independent emergence of metallurgy in the Balkans and the Aegean-Anatolian world,[3] the archaeological picture has changed several times, most recently because of the re-dating of the early Varna

1 OREA – Institute for Oriental and European Archaeology, Austrian Academy of Science; email: barbara.horejs@oeaw.ac.at.

2 Horejs et al. 2010; Horejs et al. 2011.

3 Renfrew 1969.

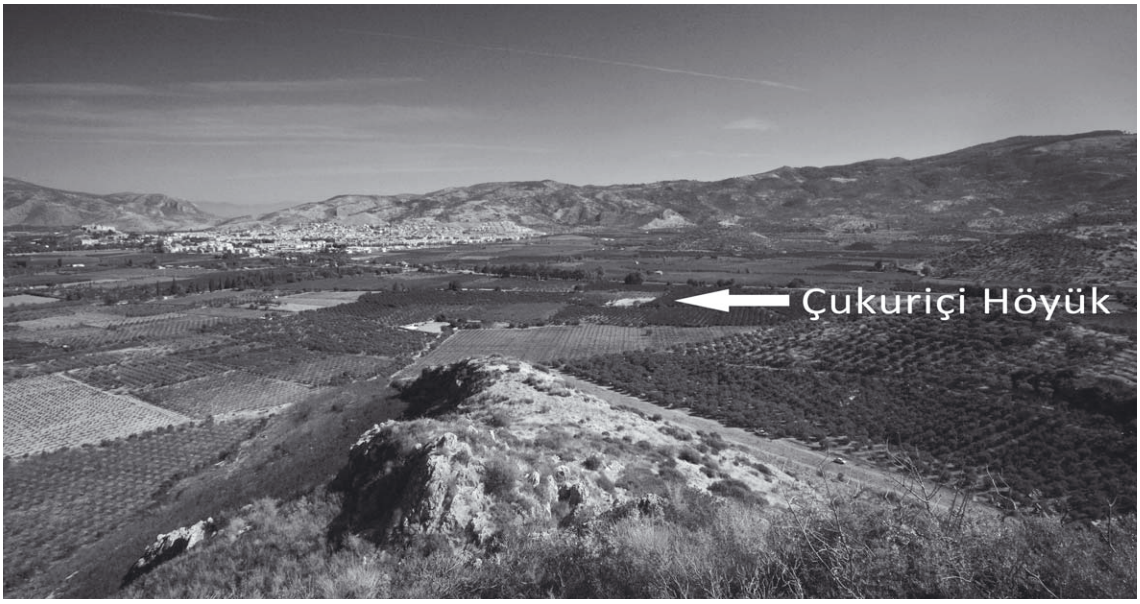

Fig. 1 Location of the site Çukuriçi Höyük in the alluvial basin, view from the west (photo: N. Gail; design F. Ostmann/ERC Prehistoric Anatolia).

Horizon,[4] the access to other very early dates for Balkan and East Mediterranean metallurgy[5] and new excavations at sites of the 5th and 4th millennium BC in the Aegean and Anatolia.

While the role of metals and their socio-cultural impact is discussed by E. Pernicka and M. Mehofer in this volume, the following contribution focuses on another general phenomenon usually summarised as the 'process of urbanisation' that can for the first time be observed in the 4th millennium BC in other cultural regions, but *not* in fact in western Anatolia. Although urban centres as nuclear parts of this phenomenon have not been identified from that time in the region of our focus, some social and cultural processes usually linked with urbanisation are observable. It is therefore possible to discuss western Turkey in the 4th millennium BC using a socio-cultural model, already developed and analysed in other regions, not least in modern social geography[6] and cultural sociology.[7]

'Proto-Urbanisation' as a Useful Socio-Cultural Model for Prehistory?

Complex urban systems represent a final point in the long-term transformation of human ways of living,[8] a multi-layered process of the *longue durée*[9] and not necessarily linear and 'successful', which probably includes various stages and phases. Following different studies of social geography and demography, the phenomenon of urbanisation not only includes the development of urban centres and their expansion; the quantity, size and number of inhabitants increased in relation to the rural population.[10] It also comprises the distribution and intensification of urban ways

4 Krauß et al. 2012 discusses the latest radiocarbon-dates in the context of different material analyses, archaeological and anthropological research at Varna.

5 Borić 2009; Radivojevic et al. 2010; Garfinkel et al. 2014.

6 E.g. Lichtenberger 1998.

7 For terminologies of towns and rural sociology as discussed in sociology see e.g. Sombart 1983.

8 Compare the basic essay of M. Weber about key definitions of an urban town and its variation through times and regions in the world (Weber 1920–1921) and more recently Lichtenberger 1998; s. also Düring 2011a, 253–254.

9 Braudel 1977.

10 Bähr 2011.

of life, economy and behaviour to integrate both dynamic processes and their social impact.[11] In this social and economic context, the simple dichotomy of urban and rural areas does not suffice to describe all ways of living; agricultural ways of living in modern cities or urban behaviours in agricultural communities in the country may be added.[12] The relation of a city and its subsistence base is, as M. Weber pointed out, not at all clear, illustrated by the variability documented from Classical antiquity until the Middle Ages in Europe.[13] E. Lichtenberger created a model of changing urban-rural relations from the Feudal system until present times that also reflects changing social and economic structures of societies.[14] Even though studies of present or classical societies can of course not be transferred directly to prehistory, the phenomenon of urbanisation and its complexity offer precious information for modelling prehistoric processes.[15] Conversely, analyses of prehistoric data to reconstruct concepts of urbanisation could extend the range of sources to understand the principles of this phenomenon, add chronological depth and substantially expand the notion of urbanisation by contrasting and comparing different aspects.

As demonstrated, for example, by B. J. Kemp for pre-dynastic Upper Egypt, the transformation from egalitarian communities to agricultural towns in the 4th millennium BC formed the crucial basis of the first city states in the Old Kingdom.[16] Based on landscape and archaeological data, he could differentiate stages of transformation from small egalitarian communities with low population density, farming villages and neighbouring zones of direct exploitation to the next level of agricultural towns with high population density, farming villages in the country (whist other settlements were abandoned) and regular exchange with villages along the riverbank. Kemp's second stage model shows a structured territory with functionally differentiated villages of farming on the one hand and settlements for exploitation of river sources on the other, both dependent on each other and connected through regular contacts. This functional division forms the main basis of his third stage of incipient city states in early dynastic times with fortified towns of regional power, water channel systems for systematic land cultivation and organised ports at the riverbank. Kemps convincing model of prehistoric Egypt demonstrates the necessary preconditions for the transition to urban centres that represent a crucial link between agricultural communities with simple subsistence economy and organised societies with urban regional power.[17]

Integrated in this context, the model of 'proto-urbanisation' is understood in this paper as a distinct phase of cultural transformation that is definable as a social process of consolidation of communities and their functional differentiation in the use of land and resources in western Turkey. Archaeological indicators to argue for this functional diversity can be traced at individual site studies by looking at exchange systems, craft specialisation, architectural diversification, infrastructure and the concentration of functional buildings as well as social interaction.[18] In accordance with the urbanisation studies mentioned above, archaeological data about basic economy, including use and access to raw materials as well as agricultural supply of a site, could play an important role in defining the way of life of communities. Functional diversity of archaeological sites within a region could additionally represent a cultural transformation from egalitarian small farming villages to another level. Western Anatolia in the 4th millennium BC appears to reflect one stage in this transformation process that can, in my view, be integrated into a more general model and will therefore be discussed as *process of proto-urbanisation*, illustrated by the example of the region and landscape of the central Anatolian Aegean coast in the conclusion of this paper.

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[11] Yakar 2011, esp. 330–338.
[12] Lichtenberger 1998, 65; Bähr 2011.
[13] Weber 1920–1921, in particular 627–629.
[14] Lichtenberger 1998, 63–65.
[15] Cf. also Gogâltan 2010.
[16] Kemp1989.
[17] See also Papadatos – Tomkins 2013.
[18] Cf. e.g. the 'dynamic model of urbanisation' discussed for Manching in central Europe by Ellert et al. 2012.

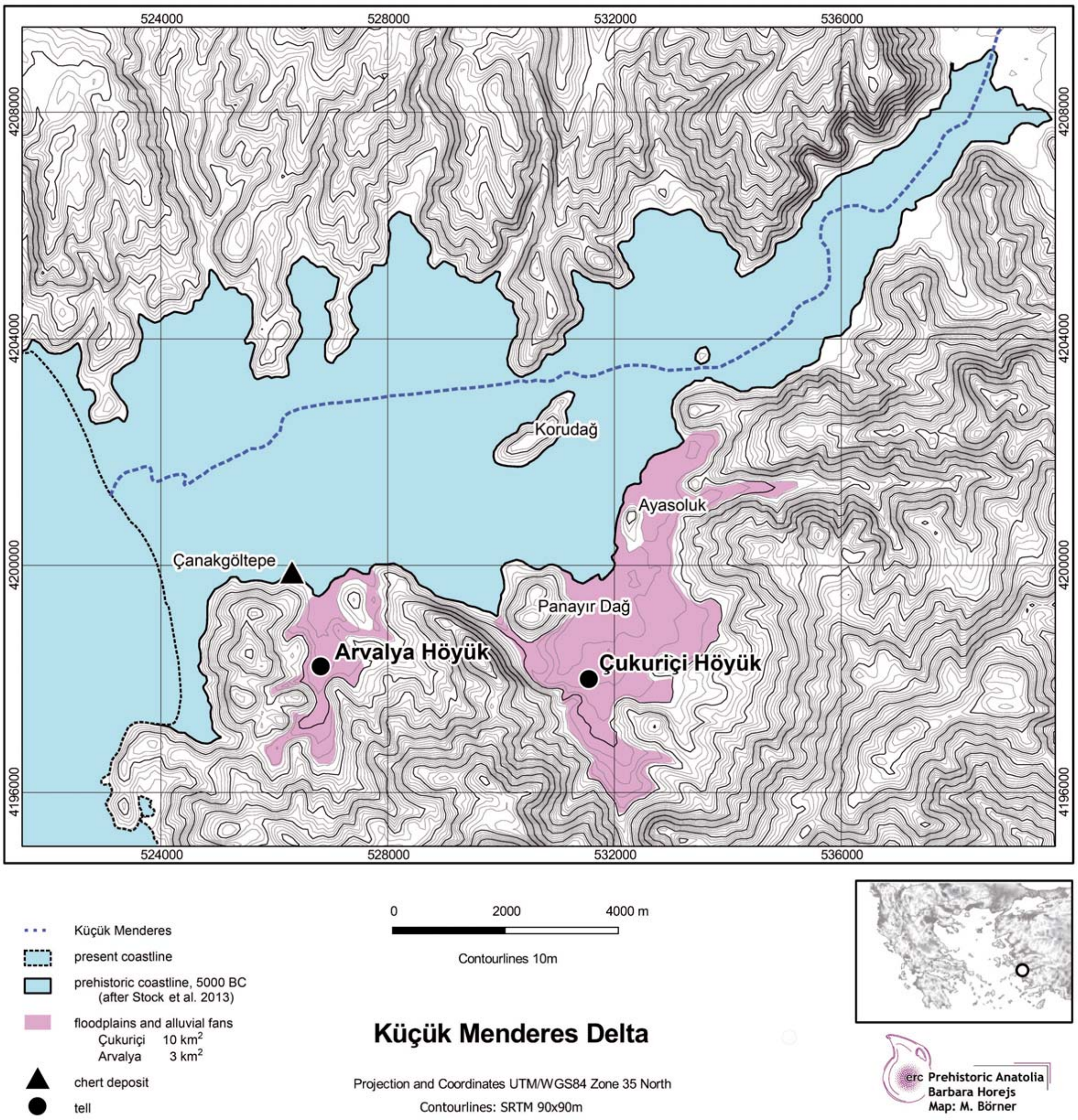

Fig. 2 Reconstructed prehistoric landscape with the archaeological sites Arvalya Höyük and Çukuriçi Höyük south of the Küçük Menderes Delta (M. Börner/ERC Prehistoric Anatolia).

Çukuriçi Höyük in the Late Chalcolithic Period

Çukuriçi Höyük is situated in a basin close to the delta of the Küçük Menderes River (Fig. 1), flanked by low mountains just outside the antique city of Ephesos. Thanks to decades of geographical work by the teams of H. Brückner, I. Kayan and C. Kraft, it became clear that the tell was originally situated approximately 1.5km from the Aegean coastline.[19] The basin comprises about 10km² and offers very good conditions for agriculture and animal husbandry, including easy access to freshwater sources like springs and rivers (Fig. 2). The results of coring by F. Stock suggest that the tell was originally larger in size (c. 200 × 160m), although a shift of settlements

[19] Stock et al. 2013.

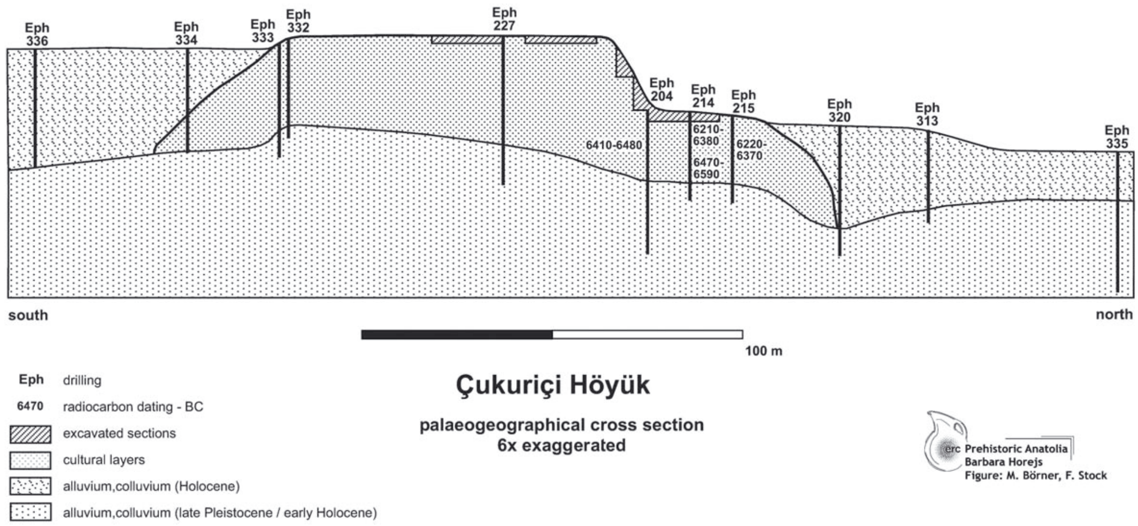

Fig. 3 Palaeographical cross-section of Çukuriçi Höyük, 6× exaggerated (M. Börner/ERC Prehistoric Anatolia after F. Stock 2013).

on the tell itself within an area of about 3.2ha in different periods cannot be excluded at the present state of research (Fig. 3).

Seven settlement phases dating to the Neolithic, Chalcolithic and Early Bronze Age have been excavated so far, of which only the earliest and latest periods have been recovered over larger areas. Remains of the 4th millennium BC have been mainly excavated in deep stepped profile trenches at the northern edge of the tell that offered a vertical sequence of the site. The stratigraphy illustrates that the 4th millennium levels (phase ÇuHö VII) directly cover the layers of phase ÇuHö VIII, dating to the Early Chalcolithic at c. 6000 BC. The 4th millennium BC levels include traces of architecture,[20] remains of buildings and corresponding horizons of use, including the skeleton of a child in a cist grave underneath a stamped clay floor dating to the second half of the 4th millennium BC (Fig. 4). The crouched infant body had been placed carefully on the right side in more or less east-west direction with the face to the north without any grave goods.

Other remains dating to the Late Chalcolithic period have been detected at the tell itself as well as in the northern plain, as intrusive interference in the Neolithic settlement. A ditch corresponding to the 4th millennium BC layers of the tell continues here, originally built when the northern area was still part of the hill, but later dug away by bulldozers. The ditch seems to encircle a settlement dating to the second half of the 4th millennium BC. The ditch was filled with only very fine-grained sediments during its use, typical settlement waste or other remnants of activity. These are only rarely presented in the oldest deposits, which could mean that the ditch had been cleared out regularly. The excavated part of the ditch is between 4 to 5m wide and around 2 to 2.5m deep (Fig. 5). Geophysical surveys from the top of the tell (ZAMG/Vienna) assume the continuation of a curvilinear structure underneath the partially excavated EBA 1 settlement (phase ÇuHö IV), which led us to reconstruct a roughly circular or egg-shaped enclosure. Further results of geomagnetic and georadar surveys by ZAMG allow reconstruction of the presumably contemporary architecture inside this continuing enclosure, including various buildings.

The enclosure apparently went out of use, as it was filled with an impressive number of stones, which seem to represent remains of original building materials of Late Chalcolithic architecture (Fig. 6). Thanks to the geological studies of D. Wolf and G. Borg, the stones can be attributed to local sources, as the size and shape of the stones are comparable to the material typically used for

20 Horejs – Schwall, in print (figs. 4–5).

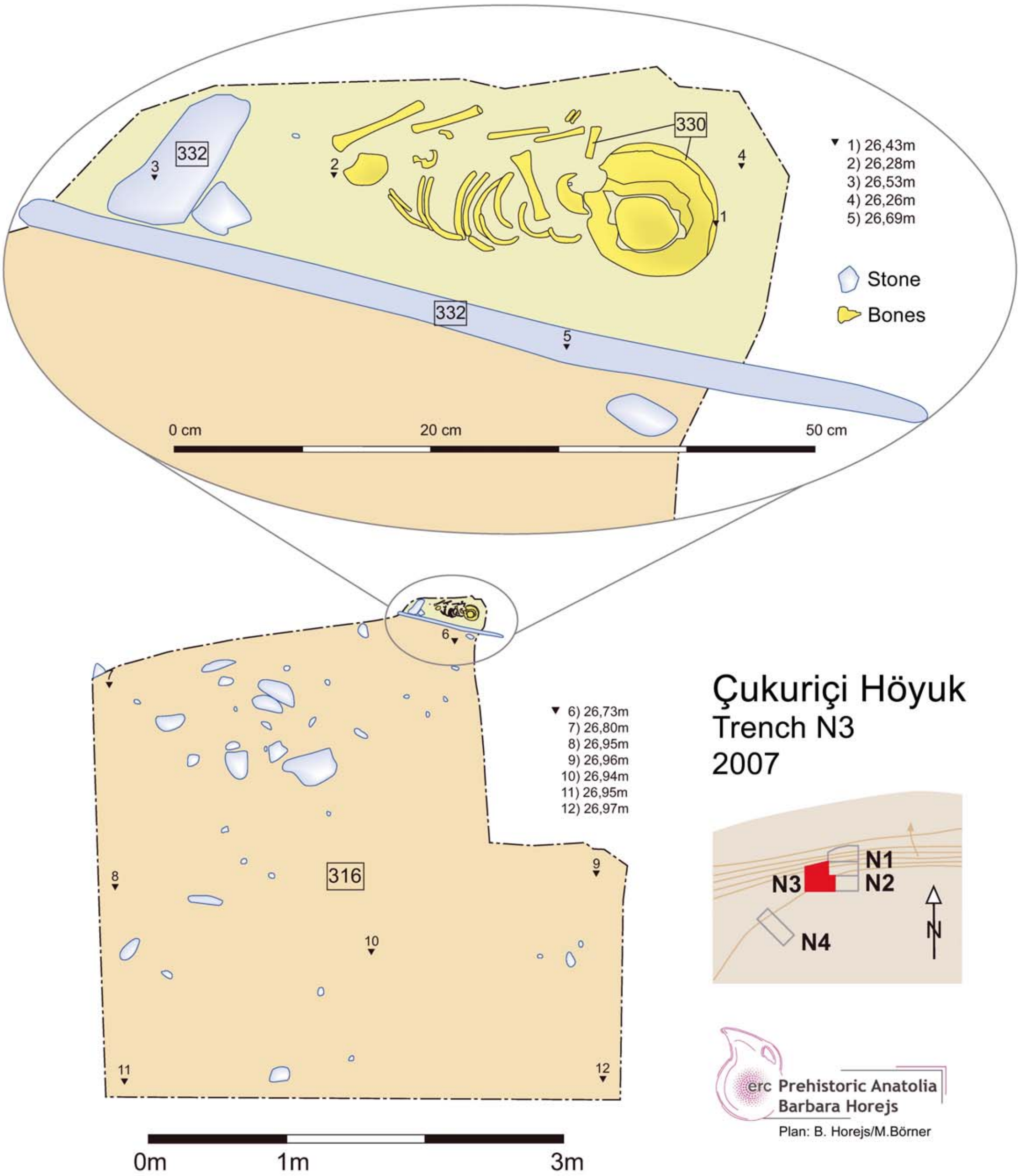

Fig. 4 Detail of trench N3 at Çukuriçi Höyük: cist grave with child burial (M. Börner and B. Horejs/ERC Prehistoric Anatolia).

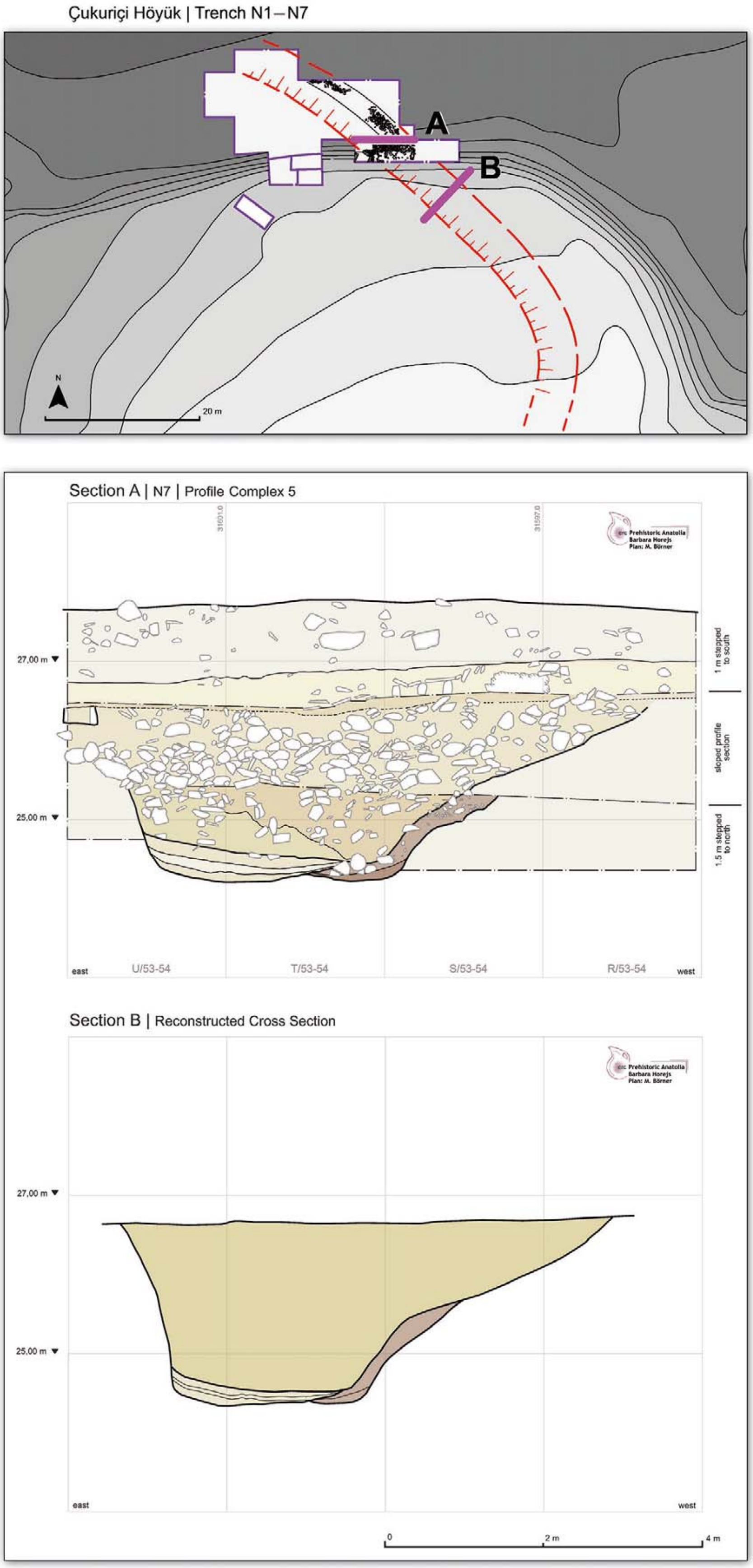

Fig. 5 Northern area of Çukuriçi Höyük with location of the ditch, profile of ditch-filling and its cross-section (M. Börner/ERC Prehistoric Anatolia).

Fig. 6 Ditch (complex 5) and its filling during excavation, view from northwest (photo: F. Ostmann/Prehistoric Anatolia).

architecture at the tell (in the Late Chalcolithic and Early Bronze Age period).[21] The ditch filling process was concluded with the installation of a stone cist, comparable to a cist grave excavated further west, which included a child burial. In contrast to this, the cist concluding the ditch filling was empty. The whole filling was finally covered by levelling layers that enlarged the settlement area and covered with architecture of the following EBA 1 period.

The radiocarbon dates of short-lived samples from the excavated settlement date the remains of phase ÇuHö VII to the second half of the 4th millennium BC, between 3300 and 3100 calBC in particular.[22] So far, only one sample of the ditch filling has been analysed and dates to 3085–2908 calBC (2σ range),[23] representing the *terminus post quem* of its abandonment and corresponding to the results of the Early Bronze Age layers. The later settlement, also covering the filled ditch, date to the early 3rd millennium BC (period EBA 1: 2900–2750 calBC for both phases ÇuHö IV and III).[24]

To sum it up, the excavated and geophysical survey areas, the material analyses of archaeological deposits and the radiocarbon dates indicate a settlement with an enclosure in the second half of the 4th millennium BC at Çukuriçi Höyük. Although neither its exact size nor its intra-site structure is known in detail as yet, the Late Chalcolithic settlement is obviously not just an ephemeral site but appears to be in use for a community living there permanently, as was the case in the preceding and later excavated settlement periods.

21 Wolf et al. 2012b.

22 Horejs – Weninger, in print.

23 Ceralia ÇuHö no. 11/1206/11/1 with ^{14}C age 4366 (Lab. no. MAMS 15267).

24 Horejs – Weninger, in print.

Economy at Late Chalcolithic Çukuriçi Höyük

Although excavations of the deposits of the 4th millennium BC are limited, they offer important insights into the communities' economy and craft specialisation, as well as use and access to raw materials. Botanical studies by U. Thanheiser revealed barley, pulses and fruits, but hardly any wild plants[25] were present in the excavated Late Chalcolithic domestic area. Studies of zoological remains by A. Galik show a balanced and developed livestock management and intensive use of marine sources for nutrition.[26] Galik furthermore points out a distinct change of subsistence management from the Early Chalcolithic to the Late Chalcolithic period at Çukuriçi, demonstrated in a change in the age at which animals were slaughtered, and potentially indicating the secondary use of animal products. Livestock composition, use of marine sources and botany suggest a farming village with a community living at the tell on a permanent basis without indications for systematic seasonal transhumance as an economic basis.[27]

The analyses of the lithic industry from the 4th millennium BC layers show a distinct dominance of obsidian in the raw materials, in addition to cherts, the latter presumably mainly of local sources. A potential local source of chert is located very close at Çanakgöltepe,[28] easily accessible from the village by crossing the Bülbüldağ Mountain or along the Aegean bay by boat (Fig. 2). M. Bergner noticed a relatively large amount of production waste, cores and core fragments of obsidian as well as of chert, which indicates that a knapping site must have been situated close to the settlement, but not in the excavated area (Fig. 7).[29] Bergner's studies based on Neutron Activation Analyses[30] further revealed that obsidian of phase ÇuHö VII was imported from Melos only, using both different sources there (Demenegaki and Adamas). The high proportion of imported obsidian in the lithic assemblage (72%) could be explained as statistical error due to the small size of the analysed assemblage, if it did not correspond to the large quantity of obsidian in the following EBA 1 period at the site, which was excavated over a much larger area and also revealed an emphasis on lithic industry.[31] Detailed material exchange analyses by D. Knitter et alii demonstrated that the large quantity of Melian obsidian at Çukuriçi during the EBA is outstanding in comparison to contemporaneous sites in the region (and beyond),[32] one reason amongst many that led us to conclude that the site was a potential gateway community for obsidian exchange in early 3rd millennium BC. Although the specific function of raw material exchange of the settlement can currently not be conclusively demonstrated for the Late Chalcolithic period, the 4th millennium BC assemblages with a dominance of obsidian as main resource indicate a comparable significance in these times.

Other crafts practiced in 4th millennium BC give further information about the community living at Çukuriçi. Textile production – presumably as normal household activity – is represented by heavy cylindrical loom weights (Fig. 8). Late Chalcolithic metal production was observed in a small excavated trench with remains of finished copper products and a possible metal working area.[33] A malachite ore fragment further demonstrates that raw metals were already being brought to the site in phase ÇuHö VII, presumably for further metal processing.

All these archaeological results together indicate a farming community with livestock management as main economic basis and access to local as well as non-local raw materials

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[25] Thanheiser, in preparation.
[26] See also Galik, this volume 385–394.
[27] See Galik, this volume 385–394.
[28] Archaeometrical studies have not been conducted so far with this ore; therefore its use in lithic assemblages is just based on macroscopic expertise.
[29] Bergner, in preparation.
[30] Bergner et al. 2009; Bergner, in preparation.
[31] Horejs et al. 2011.
[32] Knitter et al. 2012; cp. for example with recent discussion in Carter 2008; Perlés et al. 2011; Milić 2014.
[33] Mehofer, this volume 463–490.

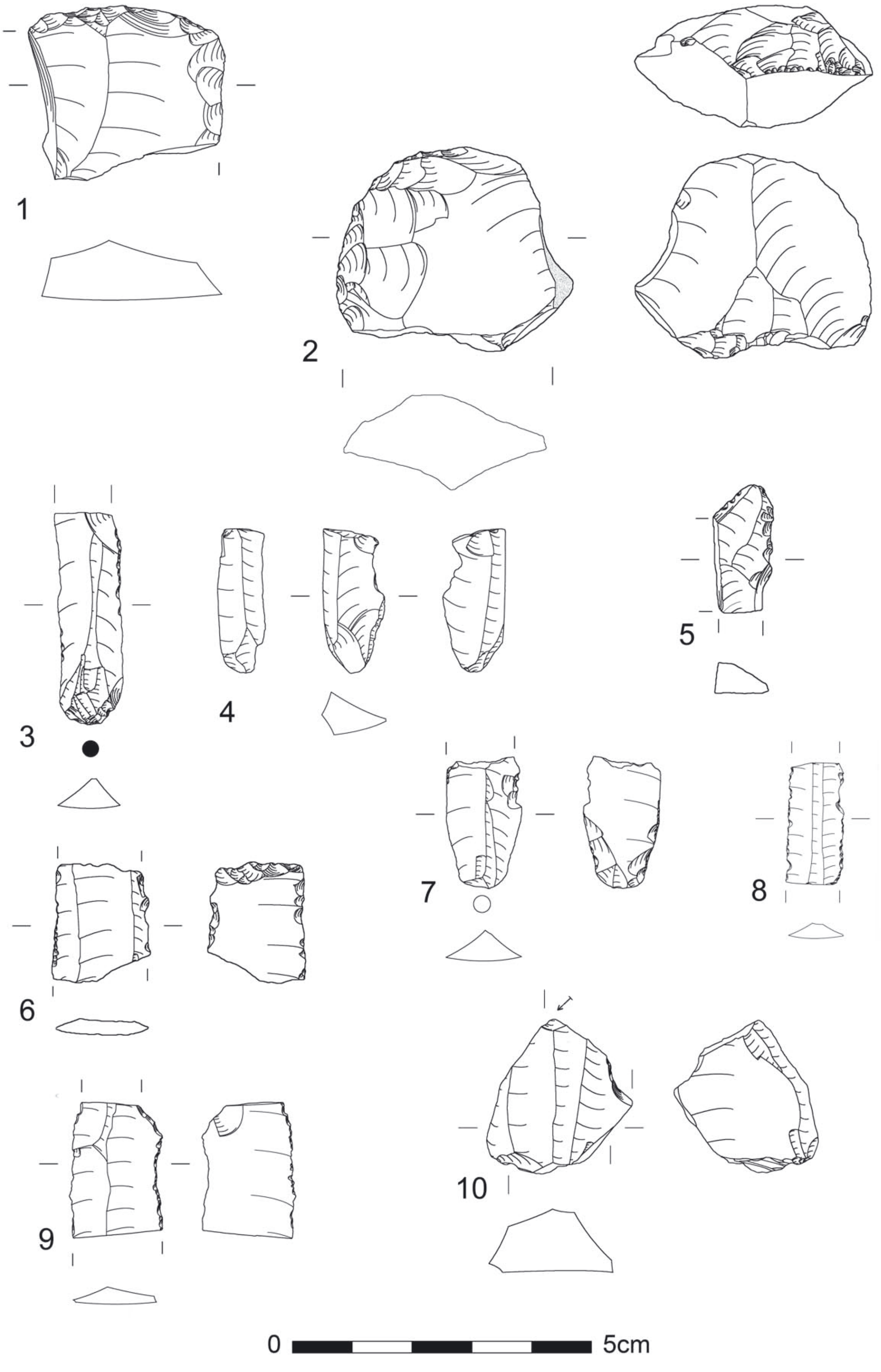

Fig. 7 Various knapped tools and fragments (modified and non-modified) from Late Chalcolithic settlement phase ÇuHö VII (Bergner/ERC Prehistoric Anatolia).

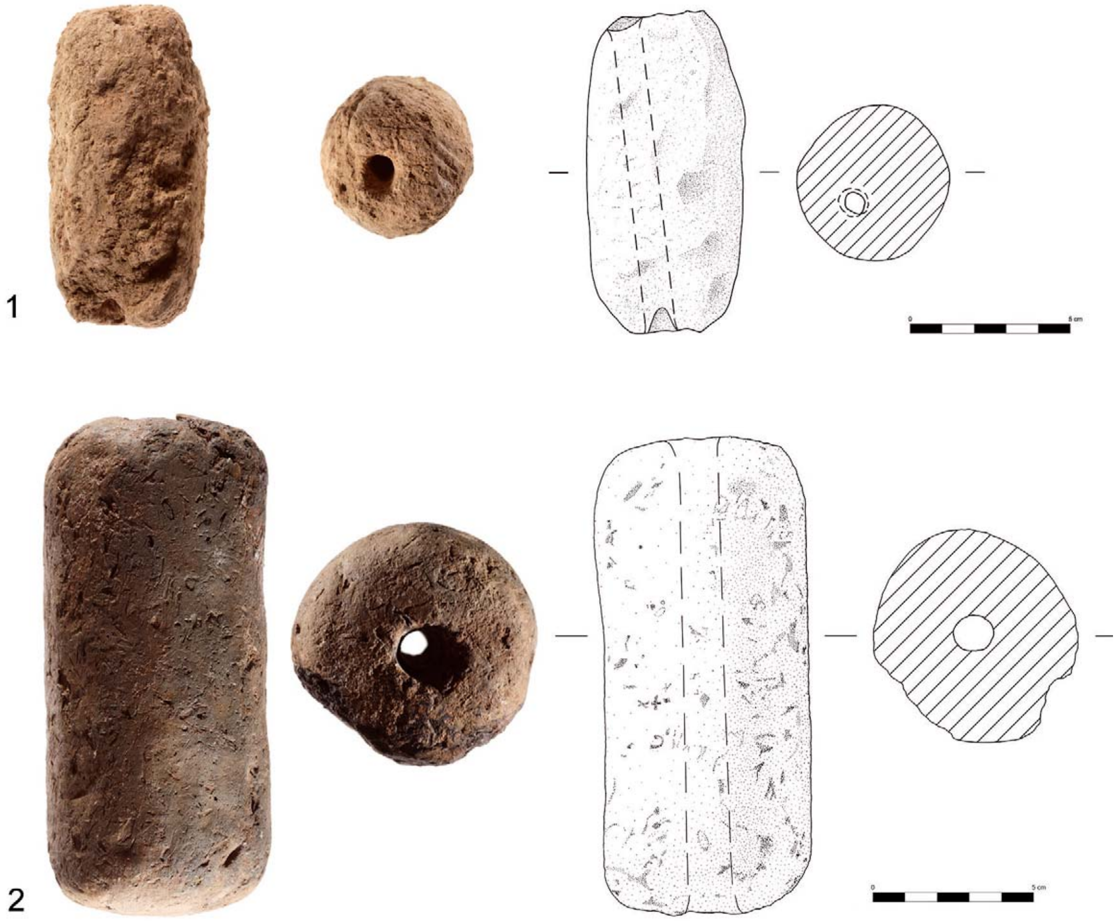

Fig. 8 Late Chalcolithic cylindrical loom weights (layout and design: M. Röcklinger/ERC Prehistoric Anatolia); 1. CuHö07/335/3/101; 2. CuHö09/883/3/001

(obsidian and metals[34]). Additional specialised crafts can be assumed at least for metallurgical production, although they have so far rarely been found in excavations. The importance of textile production in the Late Chalcolithic period is not fully understood, but recent studies by U. Schoop suggest a potentially significant impact of textile production (and exchange?) for western Anatolia before the Early Bronze Age.[35]

Regional and Interregional Material Patterns in the 4th Millennium BC

Studies of architecture and finds of the 4th millennium BC at Çukuriçi Höyük show some distinct local specifics, various regional characteristics as well as a few interregional features that demonstrate the scale of regional and interregional patterns in material cultural as indicators for the scale of connectivity. Domestic architecture indicates some principle common features in shape and function, as demonstrated by comparable built storage structures, rectangular houses and apsidal

[34] Although the metal sources are not yet fully analysed, currently it seems that metal ores are not located in direct vicinity of the site but within the wider region (Wolf et al. 2012a).

[35] S. Schoop, this volume 421–446.

buildings in both the east Aegean and west Anatolian regions.[36] Although the basis for assuming interregional connections between Late Chalcolithic communities is still very limited, some relations seem obvious from similarities in material culture and pottery production in particular.

The range of pottery found at Çukuriçi Höyük VII is composed mainly of open and some closed vessels (Fig. 9), including some characteristic regional and interregional types of the period. These are different types of bowls, of which the shallow bowls with different lips (Fig. 10, S1) and flat bowls with rolled rim or further variations of thickened lips at the inside (Fig. 10, F.H.K) are also characteristic for the Troad (Kumtepe IB, Hanaytepe B),[37] for the Izmir region,[38] for Demircihüyük[39] and Küllüoba 6[40] as well as for southwest Anatolia (Bademağaçı[41]). Rolled rim bowls in particular can be integrated in a wider interregional Late Chalcolithic stylistic picture from the Greek mainland, the Aegean islands and western Anatolia, as demonstrated by E. Alram-Stern in this volume.[42] Cheese bowls or cheese pots found in Çukuriçi VII (Fig. 10, Chb) have a comparable wide distribution that represents another typical interregional pottery feature of the 4th millennium BC,[43] while cooking pots and different types of open vessels appear to represent more local styles or regional traditions.[44]

The pottery technology and fabrics produced in Çukuriçi VII can be summarised in a similar way. In contrast to the previous periods at Çukuriçi (Neolithic and Early Chalcolithic in the 7th and 6th mill. BC), coarse wares occur frequently from phase ÇuHö VII onwards. Used as cooking pots and large closed jars, their surface is usually roughly burnished or smoothed and often covered with a self-slip.[45] Cheese bowls appear to be produced of a specific type of coarse ware with the addition of organic temper. The phase ÇuHö VII bowls, deep bowls and jugs are primarily medium or fine tempered with rough or finely burnished surfaces. Only a few pieces have a highly polished and shiny surface (black or beige), which may be decorated with white painted patterns. Apart from painted decoration, simple grooved (not fluted) and incised fragments exist, but altogether just in very small quantities.

The frequency and nature of the decorated ceramics most likely represents a regional characteristic. As the analysis of the occurrence of decorated pottery wares of the 4th millennium BC shows (Tab. 1), some differences between the regions in western Anatolia and the eastern Aegean can be observed. The number of known settlements of the Late Chalcolithic or the 4th millennium with published ceramic assemblages is nearly balanced[46] in the different regions and thus forms a good basis for comparison.

A unifying element is the presence of incised decoration in all six regions, which could be understood as an interregional characteristic. Grooved wares are likewise widespread, but do not seem to be a universal phenomenon. We observe pottery with grooved decoration in the regions of the Troad/Thrace, the Maeander Valley, the central Anatolian Aegean coast and as single

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36 For a detailed discussion of architectural features and their illustration, see Horejs – Schwall, in print.

37 Kumtepe IB: Sperling 1976, 327–341; Korfmann et al. 1995, 253; Hanaytepe: Schachner 1999a, 13–15.

38 Dedecik Heybelitepe: Herling et al. 2008, 25; Baklatepe: Erkanal – Özkan 1999, 135 and Şahoğlu – Tuncel, this volume 65–82; Cine-Tepecik: Günel, this volume 83–104.

39 Seeher 1987; Seeher 2012.

40 Efe – Ay 2000, 40–41, pls. 1, 9–10.

41 Umurtak 2005, esp. fig. 1.

42 See Alram-Stern, this volume 305–328, fig. 6.

43 E.g. Sperling 1976; Seeher 1987; Alram-Stern 1996; Sampson 2006; see also the contribution of Alram-Stern (esp. fig. 7), Blum, this volume 125–155, Şahoğlu – Tuncel, this volume 65–82, and Günel, this volume 83–104.

44 Few similarities can be seen in the Izmir region, see Şahoğlu – Tuncel, this volume 65–82.

45 Comparable pottery technologies are e.g. observable in the Lake District and Elmalı Plain (Eslick 1992, 83), in the Troad (e.g. Sperling 1976) and the neighboring sites of the Izmir region (s. Tuncel – Şahoğlu, this volume 65–82 and Kouka, this volume 43–64).

46 Tab. 1 lists only sites of the 4th millennium BC, which are dated securely by relative chronology or radiocarbon dating.

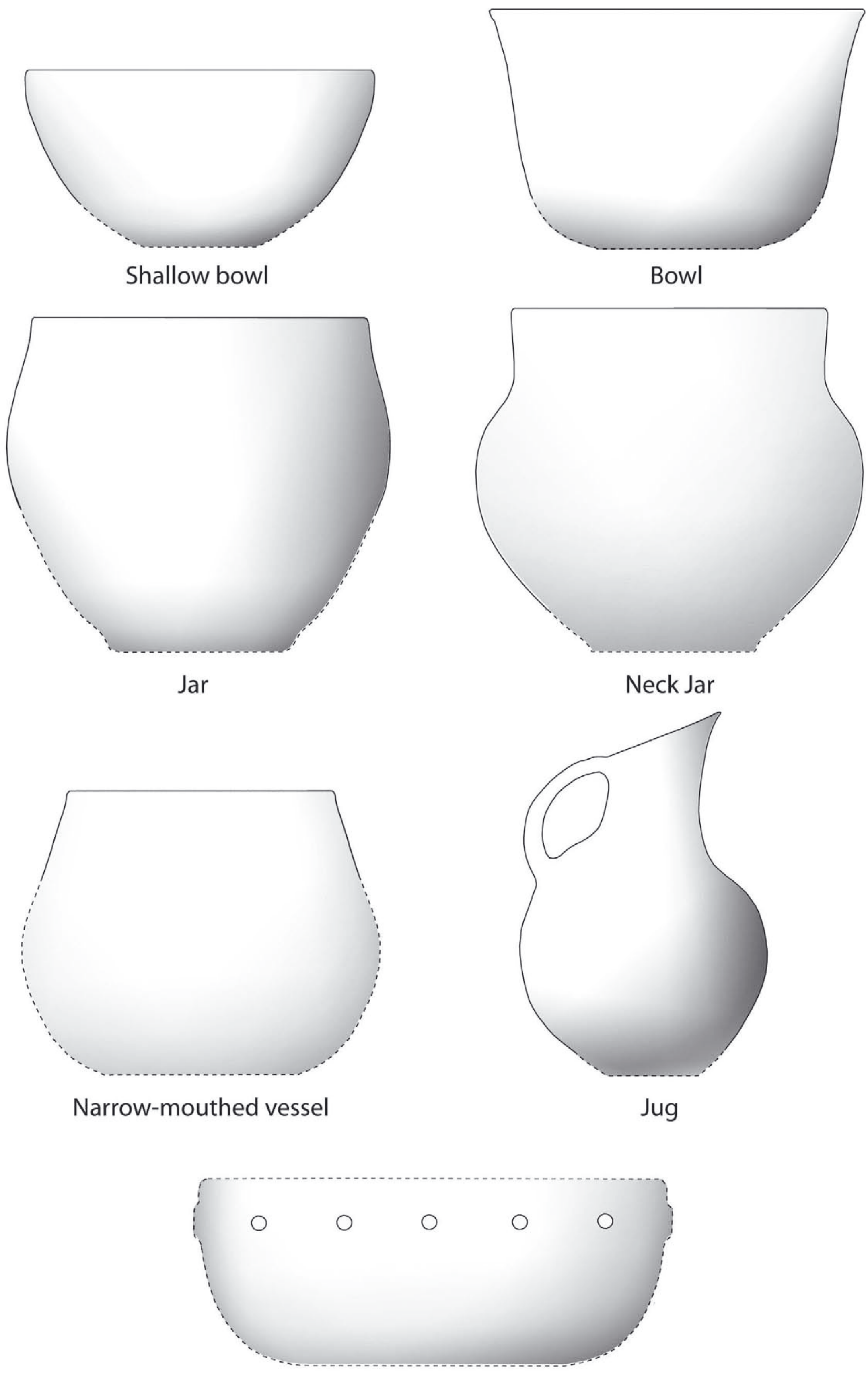

Fig. 9 Main pottery shapes at Late Chalcolithic Çukuriçi Höyük (layout and design: M. Röcklinger/ERC Prehistoric Anatolia).

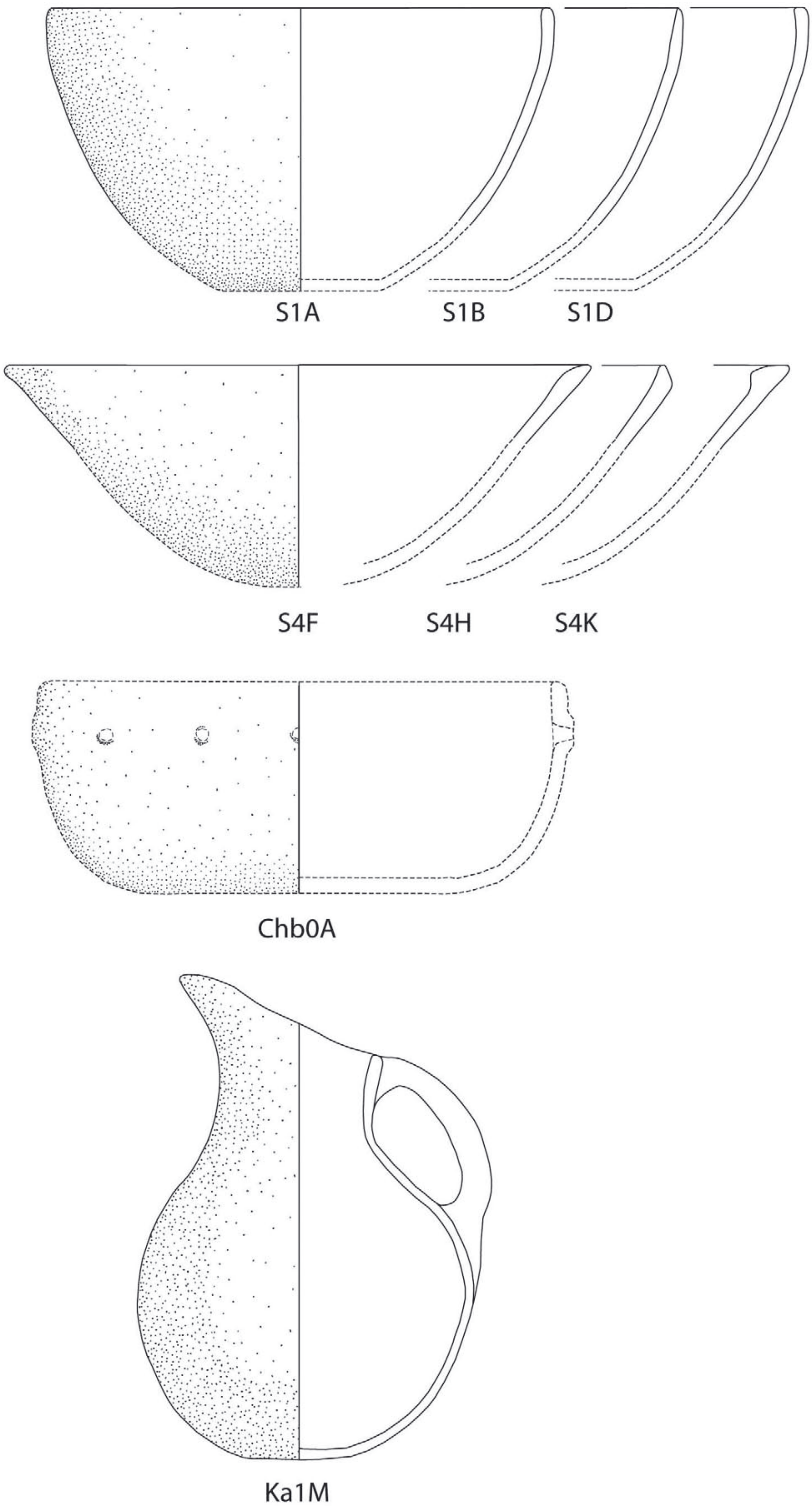

Fig. 10 Characteristic pottery types at Late Chalcolithic Çukuriçi Höyük mentioned in the text (layout and design: M. Röcklinger/ERC Prehistoric Anatolia).

4th millennium BC sites: Decorated Pottery Wares				
SITES in regional order	**Pattern burnished**	**Grooved**	**White painted**	**Incised**
Troad/Thrace				
Kumtepe IB	–	–	x	x
Hanaytepe B	–	x	–	x
Karaağaçtepe (Protesilas)	–	x	–	x
Tilkiburnu	–	x	–	x
Southeast Marmara/ Eskişehir				
Ilıpınar IV	–	–	–	x
Barcın Höyük	–	–	–	–
Demircihüyük	–	–	x	x
Küllüoba 6–3	(x)	–	x	–
Elmalı Plain/Lake District				
Kuruçay 6A–3	–	x	x	x
Yarımhöyük	–	–	–	x
Bağbaşı	x (1)	–	–	–
Bademağaçı	–	–	–	–
Maeander Valley				
Beycesultan XL–XX	x	x	x	x
Aphrodisias LC2–4	x	x	x	x
Çine MC (–LC?)	x	x	x	-
Milet I	x (?)	–	x	x
Centre of Anatolian Aegean Coast with backland				
Çukuriçi Höyük	–	x	x	x
Liman Tepe “LC later phase”	–	–	x	x
Bakla Tepe “LC later phase”	–	–	x	x
Gavurtepe Höyük	n.c.	n.c.	n.c.	n.c.
Dedecik Heybelitepe	–	x	–	–
Yeşilova	?	–	–	–
East Aegean islands				
Koukonisi	n.c.	n.c.	n.c.	n.c.
Poliochni	–	–	x	–
Dermatas	n.c.	n.c.	n.c.	n.c.
Myrina 1–2	–	–	x	x
Archontiki	n.c.	n.c.	n.c.	n.c.
Heraion/Samos	–	–	–	x
Archangelos/Kalythies	x	–	x	x
x: ware is present; –: ware is not present; n.c.: unpublished or not clear				

Tab. 1 Absence/presence table of different decorated pottery wares in 4th millennium BC in regional order (s. Appendix and Fig. 11).

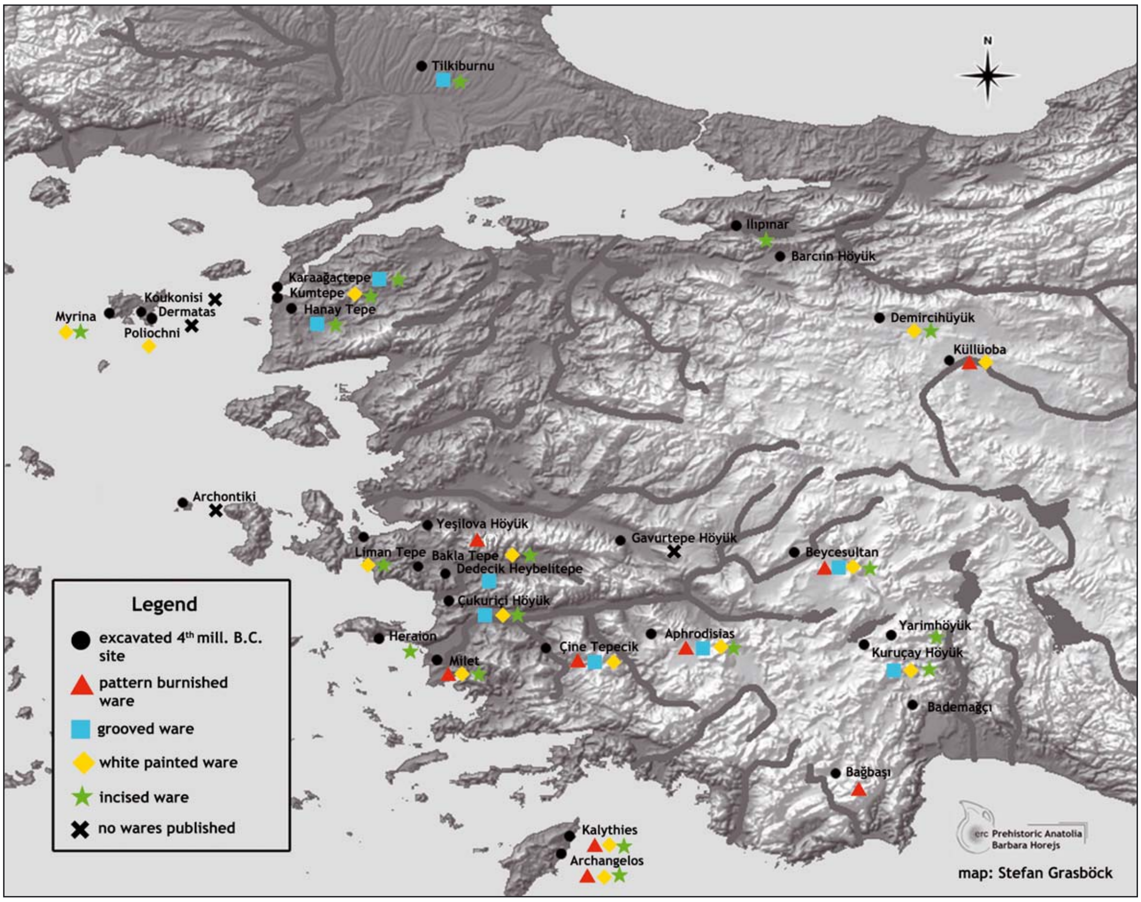

Fig. 11 Distribution of different decorated pottery wares in 4th millennium BC, s. Tab. 1 with appendix (map: St. Grasböck/ERC Prehistoric Anatolia).

finds in the Emalı Plain/Lake District (Tab. 1). On the eastern Aegean islands and south of the Marmara Sea grooved wares have so far not been found. Several studies have already concluded that ceramics with pattern burnished decoration are typical for the preceding 5th millennium BC in our study area.[47] Nevertheless, pattern burnished vessels are found in the region of the Maeander Valley in the 4th millennium BC as well,[48] which is not the case in the other five regions of the wider area. Perhaps we can observe the survival of an older tradition here, whilst it was already abandoned elsewhere.

A regional differentiation can be recognised, at least as a trend, for the White Painted Ware of the 4th millennium BC. On a small scale, it belongs to the typical range of ceramics in the regions of Eskişehir, the Maeander Valley, the centre of the Anatolian Aegean coast and the east Aegean islands. In the Troad and the Emalı Plain/Lake District white painted jars appear only at individual sites (Kumtepe IB and Kuruçay 6A–3). The absence of these characteristic finds in the Emalı Plain seems to reflect a regional production style, since at the same time there are numerous similarities in the range of vessels and ceramic technologies to western Anatolia in general and

47 E.g. Seeher 1987, 58–64; Eslick 1992, 86; Tuncel, in print; see also Alram, this volume 305–328, and Kouka, this volume 43–64.

48 While Beycesultan XL–XX and Aphrodisias LC2-4 can be securely dated to the 4th millennium BC (cf. Schoop 2005), the dating of Çine-Tepecik will have to be clarified by further studies (see Günel, this volume 83–104). The single instance at Miletus I is based on the description by Parzinger (1989, 419, no. 8), where he describes an 'ein-poliertes Muster'.

the Maeander Valley in particular.[49] The rare White Painted Ware in the Troad can probably be associated with contacts to the northeastern Aegean Islands.

No ceramic provinces can be clearly distinguished in the 4th millennium BC, as C. Eslick has aptly shown.[50] Rather, we see a far reaching western Anatolian ceramic tradition that is continuously developing and has many common features. As Eslick further worked out convincingly, the similarities hardly ever completely overlap and detailed analyses show clear local characteristics.[51] A spatial analysis of the decorated pottery wares complements and concretises this picture (Tab. 1; Fig. 11). From the perspective of the ceramic analysis we see a common ceramic tradition in the greater region of the eastern Aegean and western Anatolia, which ranges to the limits of the Anatolian plateau. The common elements of this ceramic horizon include manufacturing techniques and the repertoire of types such as the characteristic cheese pots or rolled rim bowls. They also include incised decoration of vessels, which occurs throughout the greater region in all six areas. Further, local and regional differences emerge that reflect stylistic preferences and independent productions at the various sites of the 4th millennium BC. White Painted Ware, for example, does not play a big role in northern Anatolia apart from the Eskişehir region with two sites. The individual pieces from Kumtepe IB could perhaps be explained by contacts to the northeastern Aegean islands (Poliochni Nero, Myrina 1–2) and may therefore be amongst the first of many to be expected from the Troad. On the eastern Aegean islands, in the region at the centre of the Anatolian Aegean coast and in the remote Maeander Valley there seems to be at least one common horizon of White Painted Ware in the ceramics production.

Against this background, the results of Çukuriçi Höyük are very well embedded in a regional ceramic horizon, which in turn can be anchored in a larger cultural tradition in the eastern Aegean and western Anatolia. The comparable or at least similar material culture underpinning the area at the macro scale speaks for a continuous exchange of concepts and ideas between the various regions, which are implemented in local (or regional ?) production. The distribution of White Painted Ware reveals a corridor of intensive contacts for the regions of the islands and along the western Anatolian coast of the Aegean, which O. Kouka has named the *Aegean Koiné*.[52] Although at present there are no comparable regional archaeometric ceramic analyses for the 4th millennium BC, a local and regional ceramic production can largely be assumed. The traditional local and regional characteristics at least hint at this tentative conclusion. The interregional parallels and similarities described above therefore probably reflect the mobility and communication of communities that may have been more intense in the eastern Aegean and western Anatolian coastal zone around Izmir up to the hinterland of the Maeander Valley.

Functional Diversity of Archaeological Sites at the Central Anatolian Aegean Coast

The question of possible functional differences of sites within a larger settlement area are essential to commenting on social transformation processes in the context of proto-urbanisation, as explained in the introduction. Even if no urban centres existed in the 4th millennium BC in western Anatolia,[53] functional differentiation still most likely occurred between the individual settlements and activity areas. The region at the central Anatolian Aegean coast gives us at least some evidence of this diversity. In this period at the latest we observe a denser settlement pattern and use of the landscape, which now also encompasses the side valleys of the great river basins running from east to west as well as increasingly remote areas and areas of higher altitude for

[49] Eslick 1992, 78–79.
[50] Eslick 1992, esp. 81–89; see also Lloyd – Mellaart 1962, 103–110 with less data.
[51] Eslick 1992, 86–87.
[52] Kouka 2002; Kouka, this volume 43–64.
[53] Compare e.g. Yakar 2011, 289–298.

settlements. Settlement structures also play a large role in the most recent research, as publications by Yakar and Düring on prehistoric Anatolia demonstrate.[54]

Düring's differentiation of Late Chalcolithic settlement types in Anatolia shows that there are mainly ephemeral sites in the west, defined by a different kind of huts, which are possibly only used seasonally.[55] Only few permanent villages in Beycesultan, Kuruçay and Kumtepe are characterised as farming settlements with well-built structures. Complex villages with public buildings, communal infrastructure and defensive installations are only found in central and east Anatolia in the Chalcolithic period.[56] The recently excavated sites at the central Anatolian Aegean coast are not integrated in Düring's recent publication, probably due to a lack of published material. The present volume with numerous contributions about this region should now fill this research gap.

It is undisputable that permanently used settlements existed in western Anatolia, of which Kuruçay in the Lake District represents an important basis for comparative studies with other sites.[57] This village with well-built houses in compact order has been excavated at a large scale and the preservation conditions for architectural features are exceptional.[58]

Current studies of Chalcolithic settlements in western Anatolia by C. Schwall reveal that the ordinary rectangular house can generally be understood as the main type of domestic architecture.[59] Although the excavated areas on other sites are limited, architectural structures comparable to those at Kuruçay were, for instance, observed at Beycesultan, Aphrodisias, Kumtepe IB and Poliochni Nero, even if only a few remains were preserved or excavated.[60] Circular buildings, sometimes in larger dimension, appear to have mainly been characteristic for storage, a possible hint of communal organisation in permanent settlements. They are known from Myrina, Bakla Tepe and Poliochni and can be seen as communal storage areas, at least at these three sites.[61] Much less common are the 'grill-plan houses', known from Bakla Tepe and Çamlibel Tarlası, probably also from Çukuriçi Höyük as badly preserved remains.[62] Their principle function (e.g. storage? food production? workshop?) is not yet clear; at least at Bakla Tepe, the dimensions of the "grill-plan houses" indicate they were built for the benefit of a larger group than just the nuclear family. With all due caution, these types of buildings suggest the construction of communal buildings in the 4th millennium BC, at least at Bakla Tepe.[63]

Finally, the ditch enclosure at late Chalcolithic Çukuriçi Höyük is indisputably a public structure. The 4th millennium BC ditch does not stand alone and can be compared to the contemporary enclosure of Barcın Höyük, which is interpreted as a symbolic settlement boundary by the excavators.[64] Regardless of whether the enclosures of both sites are of symbolic or of more practical and defensive function, they nevertheless represent a monumental structure built by a society with some sort of communal organisation. Çukuriçi's ditch moreover shows not only an organised construction, but also collective decision making leading to the process of filling the ditch after its use to enlarge the settlement area at the beginning of the Early Bronze Age. Comparing the villages' sizes to recognise potential differentiation is only possible to limited extent due to the current state of research, but seems to indicate that we are dealing with small to medium-sized villages in Late Chalcolithic western Anatolia after Düring's definition.[65]

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54 Düring 2011a; Düring 2011b; Yakar 2011.
55 Düring 2011b, 799–781.
56 Düring 2011b, 803–806.
57 Duru 1996; Duru 2008.
58 For a critical discussion of the excavation results see Schachner 1999b, and Schoop 2005.
59 For a typology of Late Chalcolithic houses see Schachner 1999b, and Horejs – Schwall, in print fig. 7.
60 Summarised with illustrations by Yakar 2011, 289–294.
61 Bernabò Brea 1964; Achilara 1997; Kouka 2002; Erkanal 2008.
62 Şahoğlu 2008; Schoop 2010; Horejs – Schwall, in print.
63 Tuncel, in print.
64 Gerritsen et al. 2010.
65 Düring 2011a, 254–255.

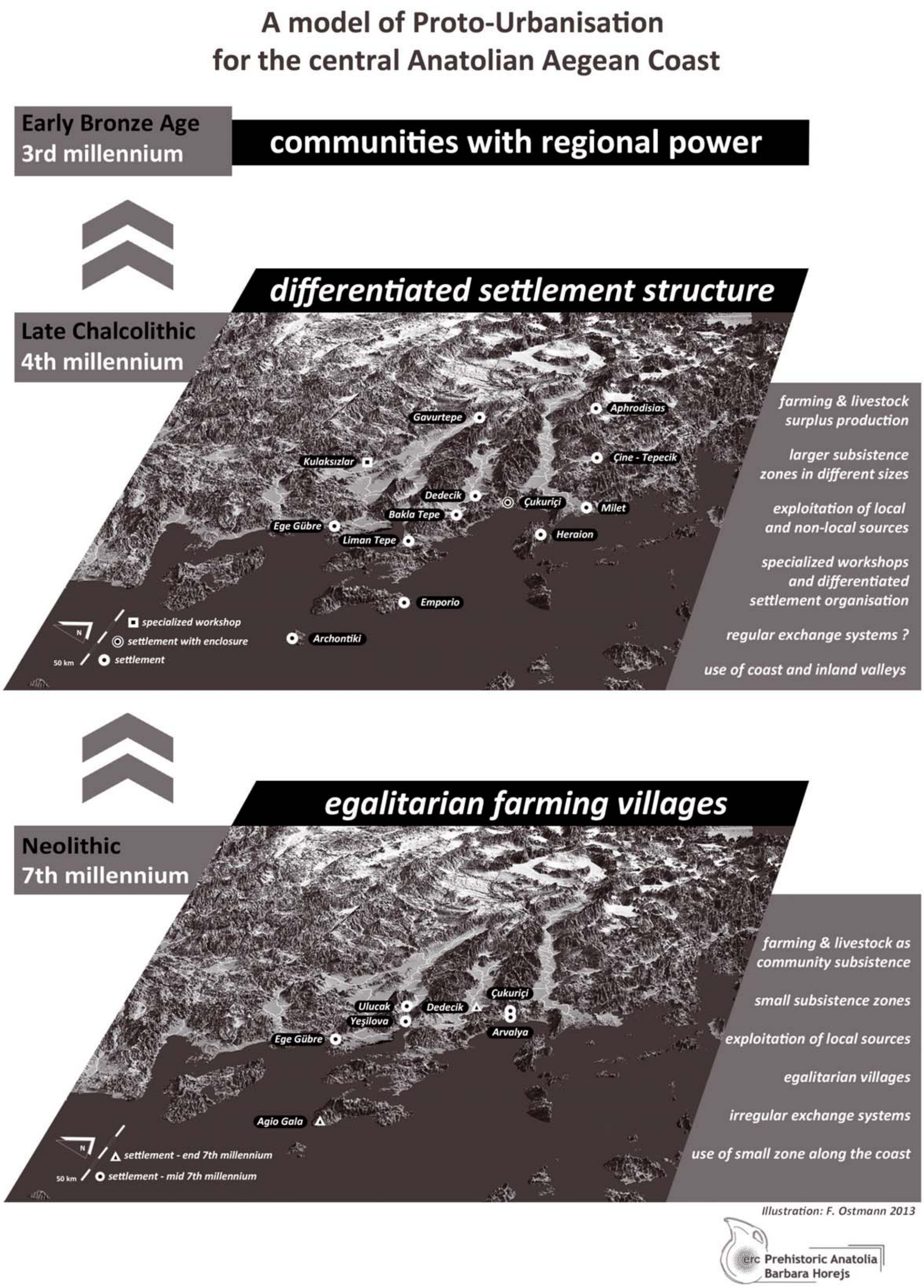

Fig. 12 A model of proto-urbanisation for the central Anatolian Aegean coast (illustration: F. Ostmann/ERC Prehistoric Anatolia).

Coming back to Düring's differentiation of settlement types, the research gap at the central Anatolian Aegean coast can now be filled with permanent villages of small and medium size. At least some of them show social and public organisation indicated by enclosures and granaries, potentially also by "grill-plan houses" of so far unknown function. Finally, in addition to normal settlements with or without enclosures, attention has to be paid to the presence of specialised workshops. T. Takaoğlu investigated a marble workshop at Kulaksızlar,[66] in which both marble vessels and figurines were produced. Following J. Seeher's studies, the produced figurines belong to the Kiliya group, which is characteristic for the Chalcolithic period in western Anatolia, in particular in the 5th and 4th millennium BC.[67] The frequent occurrence of Kiliya figurines in various settlements of our region (Çukuriçi Höyük, Aphrodisias, Malkayası, Gavurtepe and Çine-Tepecik)[68] suggests a connection to this specialised marble workshop. Even if archaeometric analyses of provenience are still missing, it may be assumed that the figurines do indeed come from the workshop at Kulaksızlar. This represents a further indication of the process of diversification – both in the use of space in the landscape and in society.

A Model of Transformation for the 4th Millennium Central Anatolian Aegean Coast

Complex urban systems represent the end point of a process of long-term transformations and multi layered developments over the *longue durée*, as discussed in the introduction. Kemp's model for pre-dynastic and dynastic Egypt is based on one of the best studied archaeological regions worldwide (see above). His second stage in the transformation to early dynastic city states consists of structured territory with functional differentiation between farming villages and settlements for the exploitation of Nile sources. These sites are dependent on each other and are connected through regular contacts. This kind of functional differentiation of land use can also be suggested for the central Anatolian Aegean coast in the 4th millennium BC (Fig. 12). For the first time, an expansion of permanent settlement into the hinterland can be seen in this period, for which side valleys and basins along the wide rivers are now also utilised. Design, construction and continuity of these settlements speak for a permanent rather than seasonal use, which, although only indirectly, infers the cultivation of the surrounding areas.

The evidence of stockpiling in *pithoi* and storage buildings points to a surplus production that suggests collaborative and strategic action. The extent to which the differentially exploited food resources of the coastal zone and the hinterland were regularly exchanged, or whether these areas were independent, as in Early Dynastic Egypt,[69] is still to be clarified. The exchange system for imported raw materials such as obsidian, which probably passes through the coastal zone into the hinterland, is unambiguously in place. Copper of Çukuriçi Höyük would also have circulated in the regional networks of the 4th millennium BC,[70] either as raw ore or finished products. At the current state of research it remains unclear to what extent metal-producing and metal-consuming settlements in this region were differentiated. At this point I would argue, however, that the pronounced specialisation in metallurgy at Çukuriçi Höyük in the 3rd millennium BC is already rooted in the Late Chalcolithic. Functional diversification through specialised workshops in other crafts areas is, after all, apparent from the 4th millennium BC at the latest. The marble workshop in Kulaksızlar, for example, produced objects (e.g. Kiliya figurines) whose recipients are found in a larger regional or possibly supra-regional circuit. The specialists who operated in this workshop remain unknown, as matching cemeteries or settlements still have not been

66 Takaoğlu 2005.
67 Seeher 1992.
68 See Günel, this volume 83–104.
69 Cf. Galik, this volume 385–394, about marine sources and domestic life stock at different sites in western Anatolia.
70 Mehofer, this volume 463–490.

found. Further conclusions as to their social status within their community can therefore not (yet) be drawn. Textile production is another area that intensifies in the late 5th millennium BC, as U. Schoop has conclusively argued in his analysis.[71] Apart from the underlying technological and practical implications, textiles represent indirect economic indicators, which allow a community to accumulate economic wealth.

All these technological and economic developments of the 4th millennium BC must have had consequences for the socio-cultural development of societies.[72] The larger, supra-regional context provides further details on these formative processes. In the Late Chalcolithic cemetery of Ilıpınar, for instance, metal objects seem to have been deposited both as personal and individual tools and jewellery objects (knives, needles) and as symbols of social status within the community (dagger, possibly axe).[73] The analysis of grave goods by J. Roodenberg reveals different concepts of how the nearly 40 burials were equipped; with all due caution, the analysis demonstrates social differences within society.[74] Three graves are clearly set apart from the rest in terms of the range of grave goods: they are characterised by an oversupply of vessels in combination with tools (awls, knives) and weapons.[75] A single adult male, an adult male/female couple and an adult and a child together were most likely buried in these three special graves.[76] In addition to their putative specific social role, the objects reflect the importance of copper weapons in the early 4th millennium BC: The only dagger of the necropolis has been added to the grave of a male individual buried separately within the group of exceptional graves. The beginnings of social differentiation seem imminent. The dynamics of the late Chalcolithic period can be captured by the technological and economic developments, a structural differentiation of the landscape, including cultivation of new areas, as well as the emergence of specialised workshops and crafts. The settlement expansion into the hinterland at the centre of the Anatolian Aegean Coast likely reflects this development at a spatial level. This process is particularly evident when it is contrasted with the spatial and functional structure of older periods. Our knowledge of the 6th and 5th millennia is still very poor, but the 7th millennium BC Neolithic period is now much better explored; for this reason, it was selected for comparison (Fig. 12). In my opinion, the factors discussed here represent a phase in the long-term socio-cultural process of development, which I would like to describe as proto-urbanisation. The Late Chalcolithic in western Anatolia can be compared to the second stage level of Kemp's model; this necessary pre-phase on the way to urban centres represents a crucial link between egalitarian agricultural communities with simple subsistence economies and organised societies with urban regional power. In the settlements of the 4th millennium BC we can detect a phase of this process, which from around 2700 BC results in the concrete proto-urban forms of settlements of later central places such as Troy II and Limantepe.

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71 Schoop, this volume 421–446.
72 Hansen, this volume 243–260.
73 Roodenberg 2008.
74 Roodenberg 2008, esp. 321, tab. 1.
75 Roodenberg 2008, 321, tab. 1: Single grave W12/UH with more than seven vessels, dagger, knife and awl; double burial W12/UO+UP with eight vessels, an axe and a knife; double burial V13/UP+UQ with nine vessels, two axes, two knives and one awl.
76 The osteological analysis is still not complete, see Roodenberg 2008, 317.

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Appendix to Table 1

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Bakla Tepe LC: Erkanal – Özkan 1999, 135; Tuncel, in print.
Gavurtepe Höyük: Meriç 2009, 124.
Dedecik Heybelitepe: Herling et al. 2008, 21–26.
Poliochni: Bernabò Brea 1964, 112–114, tab. 1.
Dermatas: Bernabò Brea 1964; Kouka 2002, 25.
Myrina 1–2: Achilara 1997; Doba 1997; Doba 2003, 101–108.
Heraion/Samos: Kouka, this volume.
Archangelos/Kalythies: Sampson 1987, 31–32, 36–37, figs. 51–63, pls. 7, 12–18.
Yeşilova: Derin 2011, 103–104, fig. 13.2.

Past Stories – Modern Narratives: Cultural Dialogues between East Aegean Islands and the West Anatolian Mainland in the 4th Millennium BC

Ourania Kouka[1]

Abstract: In relation to political and economic structures and social dynamics, the 3rd millennium BC on the north and east Aegean islands and in the western Anatolian littoral has been characterised as homogenous. This assessment has been established through extensive site-excavations on the islands of Lemnos (Poliochni and Myrina), Lesbos (Thermi), Samos (Heraion), excavations at Troy, Liman Tepe and Bakla Tepe, as well as through less extensively excavated sites, such as Mikro Vouni on Samothrace, Koukonissi on Lemnos, Emporio on Chios, Asomatos on Rhodes, Beşik-Yassı Tepe, Çeşme-Bağlararası, Çukuriçi Höyük, and Miletus. Therefore, this paper aims to selectively present older (Poliochni and Myrina on Lemnos, Tigani on Samos) and more recent (Heraion on Samos, Miletus) archaeological evidence of the 4th millennium BC, and discuss aspects of spatial organisation, economy (technological advances and trade networks) and society (social differentiation) within the wider cultural framework of the Aegean and western Anatolia in order to trace structures that may predate the emergence of 3rd millennium early urban structures in the aforementioned landscapes.

Keywords: Greece, Turkey, Aegean, western Anatolia, 4th millennium BC, architecture, technology, trade, emergence of urbanism, social stratification

The 3rd millennium BC on the north and east Aegean islands and the west Anatolian littoral is synonymous with the Early Bronze Age (henceforth EB)[2] and demonstrates a cultural uniformity in political and economic structures and social dynamics. Such a characterisation stems from extensively excavated sites, such as Poliochni and Myrina on Lemnos, Thermi on Lesbos, Heraion on Samos, Palamari on Skyros, Troy, Liman Tepe and Bakla Tepe, as well as less extensively excavated sites, such as Skala Sotiros and Limenaria on Thasos, Mikro Vouni on Samothrace, Koukonissi on Lemnos, Emporio on Chios, Asomatos on Rhodes, Beşik-Yassı Tepe, Yeşilova, Çeşme-Bağlararası, Çukuriçi Höyük, Miletus, Tavşan-Adası and Iasos (Fig. 1).[3] Archaeological evidence from all aforementioned sites led to the recognition of a distinct cultural unit in this part of the Aegean that contributed to the formation of a cultural *koine* since the EB I.[4] Despite the cultural uniformity, only certain sites reached the peak of prosperity in the long EB II period (2700–2200 BC). Such sites possess evidence for participation in land and sea trade networks

1 Department of History and Archaeology, Archaeological Research Unit, University of Cyprus; email: ouraniak@ucy.ac.cy.

2 See chronological maps: Kouka 2002, tab. 1; Manning 2010, tab. 2.2; Kouka 2013, 570, fig. 1.

3 Kouka 2002, 2–7, maps 1–2; Myrina: Dova 2003; Archontidou – Kokkinoforou 2004; Philaniotou 2010, 309–312, figs. 1–10; Heraion: Kouka 2013, 575–576; Palamari: Parlama 2007; Troy: Ünlüsoy 2006; Jablonka 2011; Liman Tepe: Erkanal 2008a; Erkanal 2011; Erkanal – Şahoğlu 2012a; Kouka 2013, 570–574; Kouka – Şahoğlu, in print; Bakla Tepe: Erkanal – Özkan 1999; Erkanal 2008b; Erkanal – Şahoğlu 2012b; Skala Sotiros: Koukouli-Chryssanthaki 2012; Limenaria: Papadopoulos – Malamidou 2012; Koukonissi: Boulotis 1997; Asomatos on Rhodes in the wider area of Ialyssos: Marketou 1997; Marketou 2010, 775–776; Beşik-Yassı Tepe: Korfmann – Kromer 1993; Yeşilova: Derin 2007; Çeşme-Bağlararası: Sahoğlu 2012; Çukuriçi Höyük: Horejs et al. 2011; Miletus: Niemeier – Niemeier 1997; Niemeier 2005; Niemeier 2007; Tavşan-Adası: Bertemes – Hornung-Bertemes 2009; Iasos: Pecorella 1984.

4 Kouka 2002, 299.

Fig. 1 Map with the Late Chalcolithic and Early Bronze Age sites mentioned in the text.

(Anatolian Trade Network,[5] Great Caravan Route[6]) related to tin-bronze technology and the exchange of prestige goods, new ceramic technologies, symbolism and ideas. Due to population increase, settlements like Troy IIa–g, Liman Tepe V, Bakla Tepe-EBII–III/early, Poliochni Green–Yellow, Myrina, Thermi IV–V, Heraion II–V and Palamari II–III were expanded following a new architectural plan. Such expansions may also be a result of the abandonment of smaller neighbouring settlements within their respective regions.[7] These new settlements were reinforced with strong fortifications, creating landmarks within these micro-regions. Additionally they had communal buildings of economic or political character and indications for craft specialisation, social stratification, and personal and communal symbolism.[8] These features were observed within the framework of a multi-criteria analysis,[9] which led to the designation of the above mentioned sites as settlements with – *mutatis mutandis* – early urban features, or local centres in these respective micro-regions. Needless to say, they can by no means be compared to the early urban centres of Early Dynastic Mesopotamia (Uruk, Ur) whose landscape and the economic dynamics differed

5 Şahoğlu 2005.
6 Efe 2007.
7 Kouka 2002, 299–300.
8 Kouka 2011.
9 Kouka 2002, 11–13, 299.

entirely from the Aegean Sea. The cultural interaction and competition among the stronger island settlements of the east Aegean and those of the western Anatolian littoral led to the abandonment of some of the settlements (e.g. Thermi).[10] However, others, due to their geographical location on crucial trade sea routes and also through their more or less active participation in the Minoan sea trade network prospered even more during the Middle Bronze Age through the Late Bronze Age I (henceforth MB, LB) (Troy V, Mikro Vouni, Koukonissi, Palamari IV, Liman Tepe IV, Heraion VI, Miletus III).[11]

This paper aims to present evidence from the Late Chalcolithic (henceforth LCh), in particular from the 4th millennium BC, from selected previously excavated (Poliochni and Myrina on Lemnos and Tigani on Samos) and more recently excavated sites and studied material (Heraion on Samos and Miletus)[12] of the north and east Aegean and western Anatolia in order to investigate the LCh past of these glorious settlements of the 3rd millennium BC. Therefore, settlement patterns, architecture, arts and crafts, trade, and social symbolism in the selected sites will be briefly presented. Furthermore, this data will be juxtaposed within the wider cultural frame of the east Aegean and western Anatolian littoral and the rest of the Aegean.

Lemnos

On the island of Lemnos, LCh habitation is identified through surface finds from Myrina-Kastro, Vriokastro, Progomylos, Ayios Ermolaos, Koukonissi and Dermatas, as well as through stratified finds at Poliochni, on the east coast, and Myrina-Richa Nera, on the west coast of Lemnos.[13] The location of these sites indicates an intensive use of the natural harbours of the island. Extensive and extremely fertile plains which occupy two thirds of the island surface form the economic basis. At least three large 3rd millennium BC (c. 6,000–15,500m²) densely populated, fortified harbour settlements organised in *insulae* emerged in the excavations of the LCh sites. These sites, Myrina in the west, Koukonissi in the middle and Poliochni in the eastern part of the island, were involved in bronze metallurgy and trade. In addition to the already well documented settlements, one can suspect the presence of many more small villages and farmsteads distributed over the fertile plains of the island. These small sites, all founded in the first half of the 4th millennium BC, could have acted as economic satellites of the three big harbour settlements.[14]

Poliochni, Black Period

Excavations conducted by the Scuola Archeologica Italiana di Atene in the 1930s and the 1950s[15] in two deep trenches at the peninsula of Poliochni (15,300m²), as well as during the 1980s[16] west of the EB settlement indicate that the LCh[17] settlement, Poliochni Black Phase, was extensive consisting of free-standing, circular (2.80–4.5m in diameter), apsidal, and also rectangular stone

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10 Kouka 2002, 300.

11 Kouka 2013, 576.

12 The results of the preliminary study of the material from Miletus and Heraion by the author will be presented for the first time in this short paper. The 4th and 3rd millennia materials derive from excavations directed by B. and W.-D. Niemeier. The 4th millennium BC materials from Heraion, Samos were excavated by the author in 2009–2013 (Kouka 2013, 575–576).

13 For habitation and settlement patterns on prehistoric Lemnos see Kouka 2002, 21–29, map 6; Dova 2003, fig. 10.

14 Kouka 2002, 28–29, maps 6–9.

15 Bernabò-Brea 1964, 45–114, figs. 25–30, 45–46. The evidence of Poliochni Black has been presented in detail by Kouka 2002, 34–45, plan 2.

16 Tinè 1997.

17 Contrary to the traditional use of the term Late Neolithic (LN) by colleagues working in the Aegean, I prefer to use the term Late Chalcolithic (LCh) for the east Aegean islands due to their cultural similarity with LCh settlements in western Anatolia (Yakar 2011, 60–61, 69–72, tabs. 4.2–4.5); Tuncel 2011, 125–126.

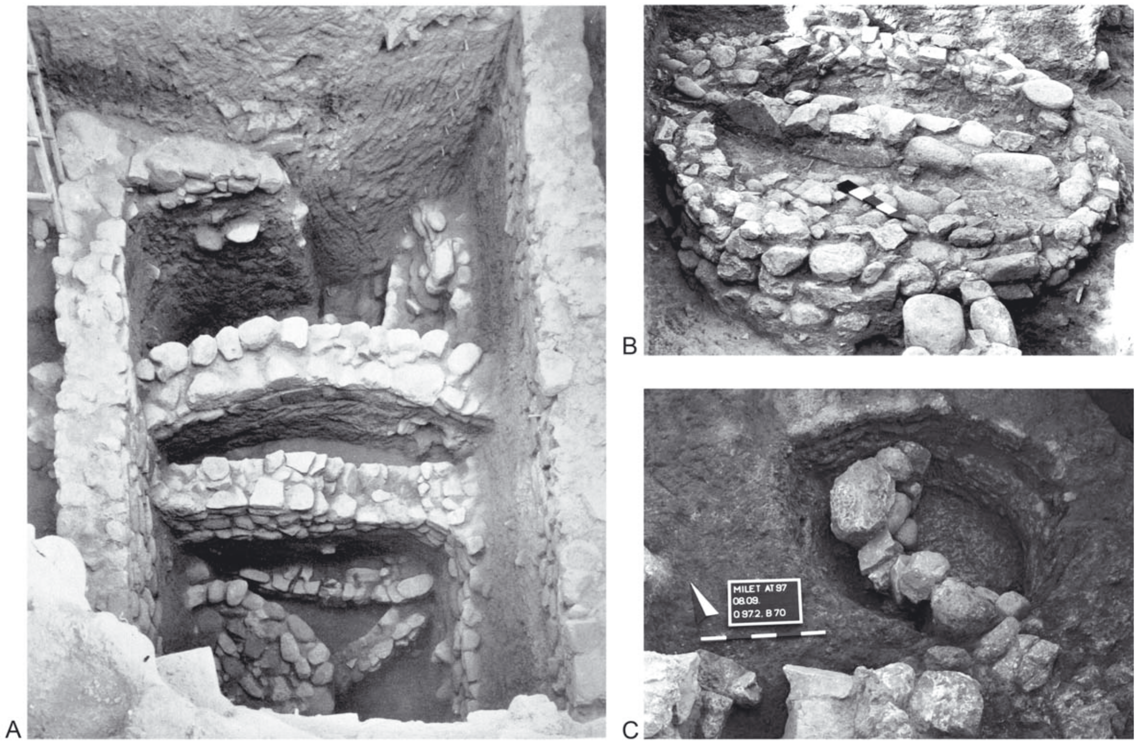

Fig. 2 A. Curvilinear houses and storage buildings from Poliochni Black (after Bernabò – Brea 1964, fig. 48); B. Myrina III (after Dova 1997, fig. 3); C. Miletus I (photo: W.-D. Niemeier).

buildings (c. 5 × 3m) towards the end of the LCh. They consisted of stone foundations and a superstructure of mudbrick.[18] The discovery of three and seven successive architectural phases in the deep trenches beneath the EB I–II/late Megara 605 and 832 respectively, and the trenches east of the peninsula[19] point to an active settlement with continuous use of a space with a diameter of c. 200m. The smaller one of the circular constructions most likely served for storage, like in Myrina and Miletus (Fig. 2A).

The pottery from these phases was homogeneous and comprises of coarse open storage jars with brown to red brown, light burnished surfaces, and medium coarse, dark, highly burnished, hemispherical cups with loop handles, shallow bowls, footed bowls, bowls with rolled rims and horizontal tubular handles, as well as jugs with white, linear painted decoration.[20] This ceramic assemblage, with the exception of the footed bowls which depict a local favourite, is similar to those of Myrina-Richa Nera,[21] and also to further east Aegean island settlements (e.g. Emporio VII–VI, Tigani IV, Heraion–LCh), as well as to assemblages from sites on the western Anatolian coast (Kum Tepe IB/3–4, Liman Tepe VII, Bakla Tepe).[22]

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18 For a detailed presentation of the architecture of Poliochni Black see Kouka 2002, 34–41, plan 2.

19 Tinè 1997, 52, pl. IX.

20 Bernabò-Brea 1964, pls. I–III.

21 Myrina-Richa Nera at Meteorologikos Stathmos, Phases I–III: Dova 1997, 289–292; in Dova 2003, 101–108, phases 1–2 are designated as FN and contemporary with Poliochni Black.

22 For comparative LCh pottery see: Emporio: Hood 1981, 300–350, figs. 144, 145, 148, 150, 153, 154, pls. 43–49; Kum Tepe IB: Sperling 1976; Liman Tepe VII: Şahoğlu – Sotirakopoulou 2011, 257, cat. nos. 77–78; Bakla Tepe: Erkanal – Özkan 1999, 135, fig. 198.

Myrina-Richa Nera

Habitation of the LCh period in the region of Leschi Axiomatikon, located on the rocky peninsula of Meteorologikos Stathmos in the bay of Richa Nera, was corroborated during the 1995 rescue excavations conducted by the 20th Ephorate of Prehistoric and Classical Antiquities.[23] The peninsula was inhabited in the Late/Final Neolithic (henceforth LN, FN) (Phase I or Phase 1),[24] in the FN (Phases II–III or Phase 2) and in the EB (Phase IV or Phase 3). During the EB, the settlement was extended from the peninsula (Phase IV or Phase 3)[25] up to the inland of Richa Nera (Phases 3–6[26] cf. Poliochni Phases Blue, Green, Red and Yellow) (3200–2200 BC) to form an area of c. 15,000m².[27]

The FN/LCh Phase I habitation has been built on the bedrock and included long-wall stone foundations.[28] The LCh Phase II included free-standing, round and apsidal buildings (diameter 3.8–5.5m).[29] Phase III revealed parts of rectangular houses with stone foundations and two storage buildings. A stone-constructed, round storage building (internal diameter 1.50m, external 2.10m) was divided in two parts by a stone wall, and its floor was covered with stone slabs and pebbles Fig. 2B).[30] The second storage building was rectangular (2.10 × 1.60m) and similar in construction to the round storage building.

The pottery production of Phase I includes dark burnished, rolled rim bowls, small pyxides with pressed bodies and tunnel lugs and baking pans (i.e. cheese pots), that are not known from Poliochni Black but known from Kum Tepe IB-3. The assemblage also contains bowls with vertical rims and carination, carinated bowls with out-turned rims and tunnel lugs that are well known from the earliest stage of Poliochni Black.[31] The pottery of Phases II and III comprises coarse storage jars and jugs with red-burnished surfaces, dark-burnished shallow bowls with out-turned rims, carinated bodies and horizontally pierced lugs below the rim, footed bowls, rolled rim bowls with or without horizontal tubular handles, hemispherical cups with one or two loop handles, and jugs with white, linear painted decoration.[32] Based on the architecture and pottery the habitation at Myrina is contemporary with Poliochni Black and points to homogeneity in material culture and economy that extends from the east to the west part of Lemnos.

Samos

Archaeological research on Samos so far has only revealed five prehistoric settlements located in the only extensive, fertile plain of Samos. This plain is located in the south part of this extremely

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23 Dova 1997, 289–292, drawing 2α–2γ. For a summary of old rescue excavations at Richa Nera with a bibliography see Kouka 2002, 21–22. In a more recent study the excavator undertook a new periodisation for the settlement at Richa Nera (Dova 2003, 101–108, figs. 1–2). According to this, Phase I comprises features earlier but also similar with the earliest Poliochni Black, and was renamed as Phase 1 (Dova 2003, 105–106). Phases II–III contain material similar with Poliochni Black and were renamed as Phase 2 (Dova 2003, 106–108).

24 Dova 1997, 284–285, drawings 2α–2β, 3–6; Dova 2003, 101–108, figs. 3–4.

25 Dova 1997, drawings 2α–2γ, 10, fig. 5–7. Dova 2003, 108–109, fig. 5 renamed this phase Phase 3. It is contemporary with Poliochni Blue (EB I).

26 Dova 2003, 108–116.

27 Dova 2003, 108–116, fig. 2; Archontidou – Kokkinoforou 2004, 12–13, 18–19, 20, 101; Philaniotou 2010, figs.1, 4–10.

28 Dova 1997, 284–289 figs. 2a–b, 3, drawings 3–6; Dova 2003, 101–103, fig. 3.

29 Dova 1997, 289–290, drawings 2α, 2γ, 7–8.

30 Dova 1997, 290–291, drawings 2α–2γ, 9, fig. 3. At least eleven EB 1 round storage buildings were found during rescue excavations at Androni, east of the peninsula of Meteorologikos Stathmos, and were dated to the Poliochni Blue Phase. However, coarse pottery and clay figurines of Poliochni Black were also noted within the same area (Acheilara 1999, 764, figs. 41–42).

31 Dova 2003, 101–102, fig.3.

32 Dova 1997, 289–290, drawing 7 (Phase II), 291–292, drawing 9, fig. 4 (Phase III); Dova 2003, 106–108, fig. 4.

mountainous island.[33] According to this evidence prehistoric habitation on Samos dates back to the LN and FN or Ch as displayed by stratified levels on the Kastro-Tigani Peninsula at Pythagoreion (Ancient Samos).[34] New evidence north of the Sacred Road of the Sanctuary of Heraion, 7km west of Pythagoreion, shows that Tigani, at least during the LCh, was not the only settlement in the expansive plain of Pythagoreion, opposite of the Maeander Delta.[35]

Kastro-Tigani

The LN I–Ch settlement at Kastro-Tigani (Phases I–IV) was excavated by W. Wrede (1928–1930), and U. Jantzen (1967–1968).[36] The material was studied systematically and published by R. Felsch.[37] Tigani I–III dates to the LN, while Tigani IV with subphases a–b to the LCh.[38]

Tigani IV lacks architecture, but some stone paved areas and stone concentrations occur.[39] The pottery includes forms in coarse wares such as baking pans (cheese pots),[40] open storage jars,[41] amphorae and tripod cooking pots with flat feet that are roughly rectangular at the ends.[42] The latter ones typically comprise of a thick brown or red burnished slip. Besides burnishing, pots were decorated with white paint on a dark burnished surface, and less frequently with fine, densely arranged holes.[43] A specific type of amphora imitates the Early Cycladic I (henceforth EC) *kratiriskoi* that were also found at the cemetery of Iasos.[44] Tigani IVa included medium coarse, red polished bowls with an S–profile and out turned thickened rims with vertically, pierced lugs and bowls with black pattern burnished decoration.[45] In Tigani IVb brown polished conical bowls, wide mouthed jugs and amphorae with white, linear decoration dominated.[46] In this phase, beakers with flat bases and horizontally pierced vertical lugs make their appearance in clay[47] and marble,[48] apparently imitating EC I marble beakers found in EC I graves, as well as beakers found at the EB I cemetery at Iasos.[49] Furthermore, pointed marble beakers[50] that are mainly known from LCh Kephala on Keos and the marble workshop at Kulakzıslar near Izmir[51] were also found. Similar conical beakers were also observed at the 4th millennium sites of coastal and inland western Anatolia (Liman Tepe VII, Kumtepe, Gülpınar, and Demircihöyük).[52]

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[33] For a catalogue of the so far known prehistoric sites and comments on settlement patterns of Samos see Kouka 2002, 280–284, maps 28–31.

[34] Felsch 1988.

[35] Kouka 2013, 575–576.

[36] Wrede 1935–1936; Jantzen 1968; Kouka 2002, 280.

[37] Felsch 1988.

[38] Felsch 1988, 38–40, 124–129, tab. 2. For Tigani and its cultural correlations with western Anatolia see also Schoop 2005, 238–241.

[39] Felsch 1988, pls. 8.5; 9.1.

[40] Felsch 1988, pl. 40.2–3.

[41] Felsch 1988, pl. 33.1–2.

[42] Felsch 1988, pls. 40.4 nos. 417, 419–420; 42.1–3, 5; 43.3–4; 60.

[43] Felsch 1988, pl. 40.4 no. 421.

[44] Felsch 1988, pls. 40.7; 43.5–6. Cf. Pecorella 1984, fig. 6.35–36; Şahoğlu – Sotirakopoulou 2011, 244 cat. no. 29.

[45] Felsch 1988, pls. 38.1–8; 68.359–368; 59.206, 209, 228.

[46] Felsch 1988, pls. 39, 41, 69.

[47] Felsch 1988, pls. 59, 70.427.

[48] Felsch 1988, pl. 75.V20, V22, V27, V28.

[49] Pecorella 1984, 55, fig. 10, pl. XXXVII.138; Şahoğlu – Sotirakopoulou 2011, 244, cat. no. 27 (Panayia, Paros), 286, cat. no. 187 (Iasos).

[50] Felsch 1988, pl. 75.V23, V24, V26.

[51] Kephala and Kulaksızlar: Takaoğlu 2005, pl. 30/211, 213 (Kephala); Takaoğlu 2011, 158–160, figs. 3–4; Şahoğlu – Sotirakopoulou 2011, 283–285, cat. nos. 176–186.

[52] Kouka 2009, fig. 5; Şahoğlu – Sotirakopoulou 2011, 282, cat. nos. 174–175 (Liman Tepe VII); Takaoğlu 2005, pl. 30/217 (Kumtepe), 30/218 (Gülpınar), 30/219 (Demircihüyük).

A Kiliya type marble figurine[53] is also of importance, a type that was produced among others at the marble workshop at Kulaksızlar.[54] A clay ring pendant,[55] a well-known type of the LN and FN on mainland Greece, the Cyclades and Crete[56] is also a significant find. Finally, blades and leaf-shaped arrowheads made of obsidian from Melos abundantly occur.[57]

The aforementioned material chronologically corresponds with Emporio VII–VI, Liman Tepe VII–later phases,[58] Beysesultan LCh 2–4,[59] Attica–Kephala Culture and the early Rachmani Period.[60] While the pottery production is typical for the east Aegean, the marble vessels, the obsidian and the ring pendant indicate contacts with the neighbouring Cyclades. Moreover, the Kiliya figurine substantiates the cultural interaction with the western Anatolian coast, and was probably imported to Tigani due to its symbolic and prestigious value.[61]

In contrast to the majority of the LCh sites in the east Aegean and western Anatolia that were continuously inhabited though the 3rd millennium BC (EB) Tigani was abandoned before the end of the 4th millennium BC.

Heraion

Heraion was one of the most glorious sanctuaries of Ionia, dedicated to the goddess Hera, and located on the southern coast of Samos, which is the biggest, most fruitful and best watered plain of the island. Since 1911, excavations of the Deutsches Archäologisches Institut (DAI) have brought to light impressive buildings and votive offerings from the Sanctuary of Hera which date from the Early Iron Age through the Late Roman periods (1050 BC–400 AD).[62]

Prehistoric Heraion extended on a flat area between the two main branches of the Imvrassos River encompassing 35,000m² and was the biggest EB island settlement in the east Aegean,[63] as published excavations in the 1950s by V. Milojčić[64] and unpublished ones by H. Walter[65] and the 1960's by H. Isler,[66] in the area of the Temple of Hera indicate. The EB phases Heraion I–V, as defined by Milojčić, were synchronous with Troy II–Troy IV (c. 2500–2000 BC).[67] Architecture dating to Heraion I and possibly even earlier was found beneath the Late Roman settlement north of the Sacred Road of Heraion in 1981 by H.-J. Weisshaar and is only known from a short preliminary report.[68] The latter finds led to systematic investigations of the prehistoric habitation north of the Sacred Road. Excavations were conducted by the University of Cyprus under the direction of the author, within the framework of a joint project with the DAI between 2009 and 2013.

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53 Felsch 1988, pls. 46.7–8; 85.V12.
54 Takaoğlu 2005, pl. 37; Şahoğlu – Sotirakopoulou 2011, 286, cat. nos. 191–196; Takaoğlu 2011, 162, fig. 6.
55 Felsch 1988, pl. 47.8.
56 Zachos 2010, 88–89, figs. 4; 8γ–δ; 9.
57 Felsch 1988, pls. 47.6; 87.1–2 (obsidian arrowheads); 88.68–73 (obsidian blades).
58 Kouka 2009, 143–144, fig. 5.
59 Lloyd – Mellaart 1962, 111, fig. P.2–P.13.
60 For the Aegean LN–FN chronology see Papadimitriou – Tsirtsoni 2010, 14–15.
61 For prestige objects in the LN–FN in the Aegean and the existence of a symbolic code see Kouka 2008, 313–315, fig. 27.1.
62 Walter 1976; Tsakos 2003.
63 Kouka 2002, 285, diagramme 2, plan 45; Kouka 2013, online open access image gallery fig. 1 on <http://www.ajaonline.org/forum-article/1660> (last access 20.11.2014).
64 Milojčić 1961. A special study of the settlement of Heraion within the wider north and east Aegean see by Kouka 2002, 285–294, plans 45–55.
65 Walter 1963, 286–289.
66 Isler 1973.
67 Milojčić 1961, 58, 64–67, fig. 3.
68 Kyrieleis et al. 1985. The final publication will be undertaken by O. Kouka and S. Menelaou.

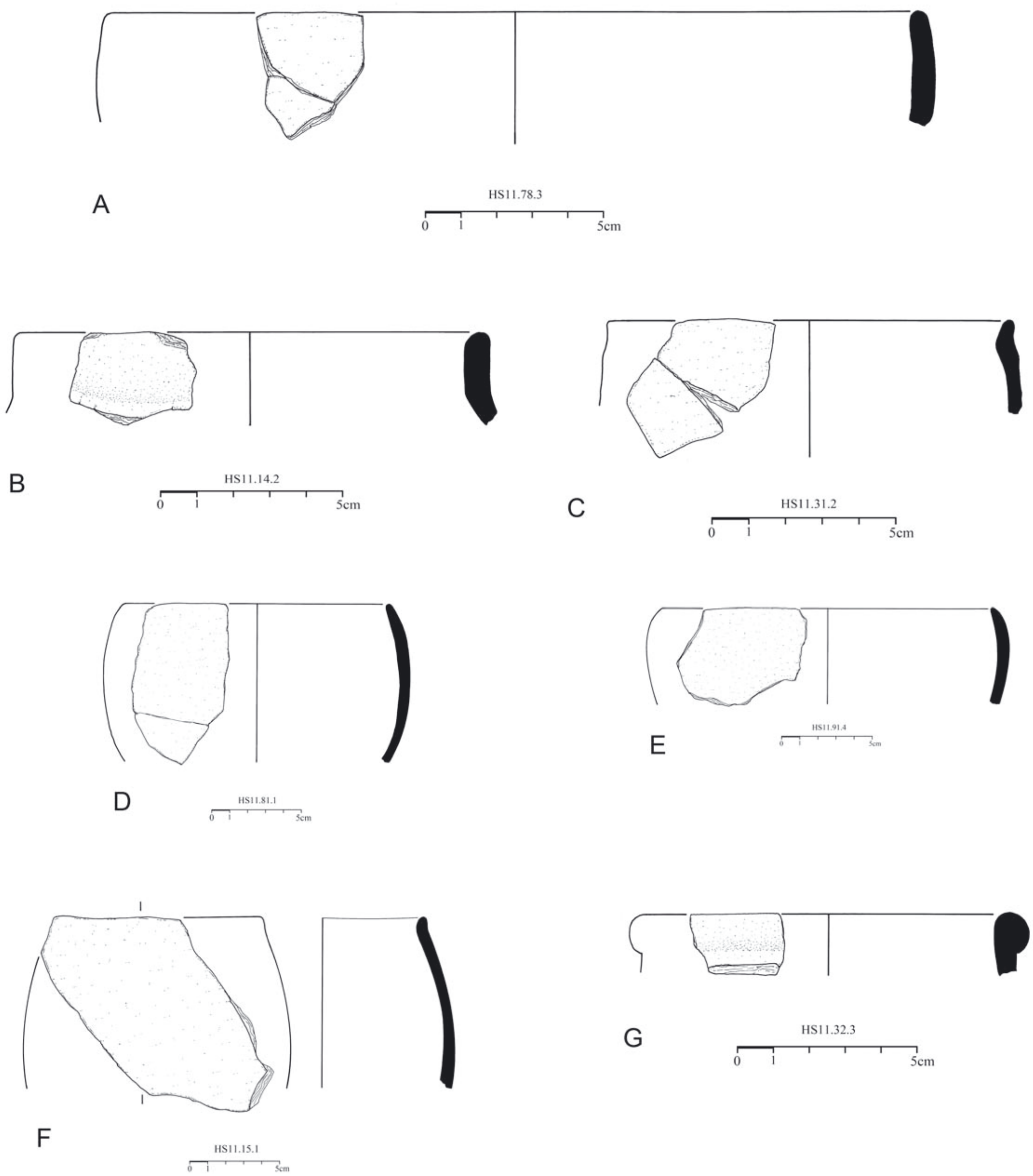

Fig. 3 Heraion. Open pots of the Late Chalcolithic period (drawings: A. Kontonis).

Heraion-Late Chalcolithic

In trenches excavated between 2009–2013, north of the Sacred Road, directly north of the 1981 excavation, stone foundations belonging to long-room rectangular houses with one to two rooms constituting five successive phases of the earliest, so far unknown settlement core of Heraion were exposed. Most of the architecture was located within the ground water level.[69] The foundations date to the Phase Heraion I and earlier, namely to the early EB II and EB I (EB 1–5) (c. 3200–2500 BC).[70] A sixth cultural level, dating to the LCh, located directly on sterile soil among

[69] Niemeier – Kouka 2011, 105; Niemeier – Kouka 2012, 100–101.

[70] Niemeier – Kouka 2010, 113, figs. 15–16; Niemeier – Kouka 2011, 104–105, figs. 17–18; Niemeier – Kouka 2012, 100–101, fig. 21; Kouka 2013, 575–576 and online open access image gallery fig. 1 on <http://www.ajaonline.org/

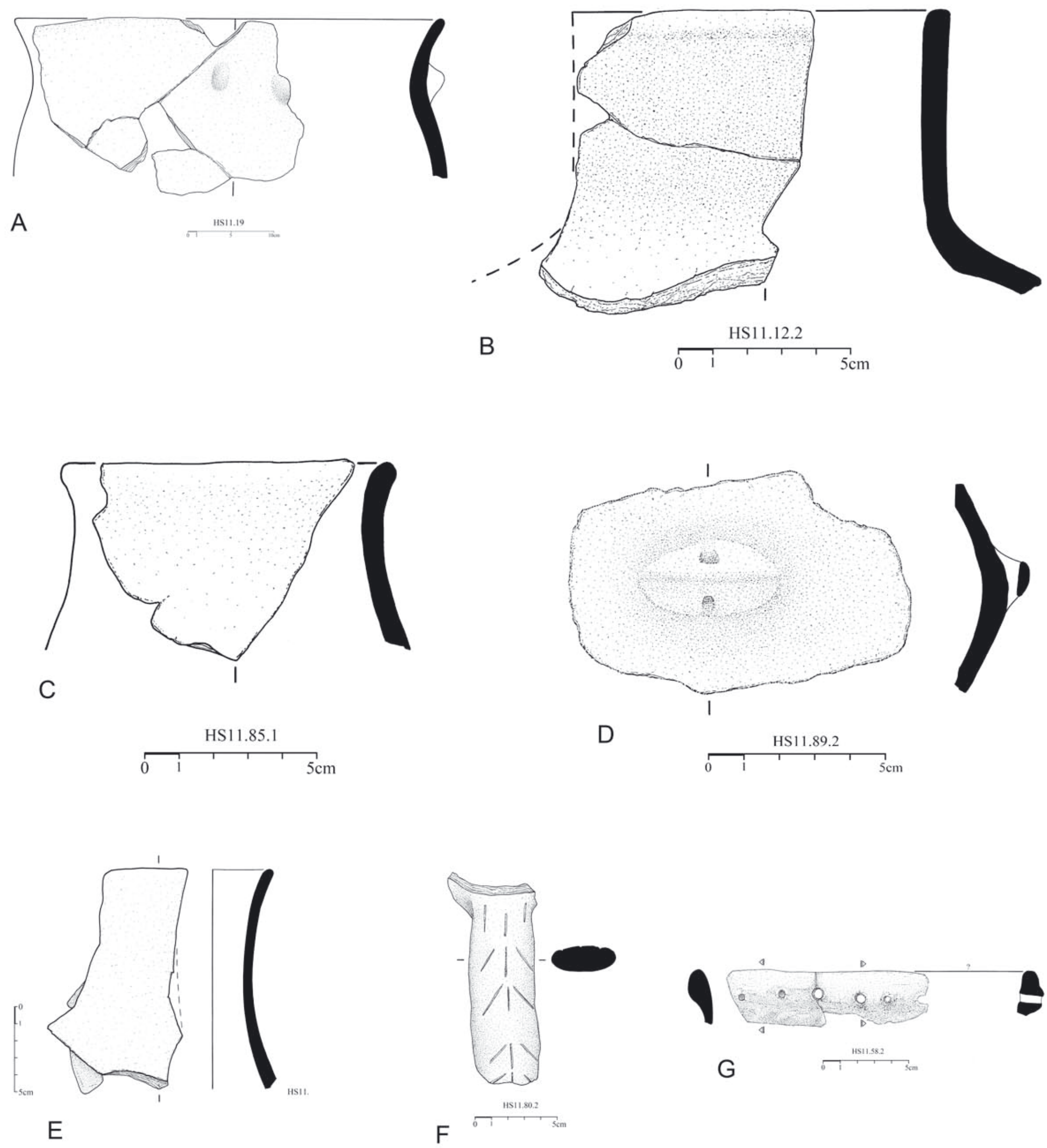

Fig. 4 Heraion. Closed pots and a baking pan of the Late Chalcolithic period (drawings: A. Kontonis).

and below the EB I–II walls (0.20m below sea level) was investigated in 2011.[71] Further LCh finds were discovered in 2013 on the sterile soil (0.11 and 0.37m below sea level) on which the east part the EB III (Heraion V) and the MB (Heraion VI) stone enclosures/fortification walls were established, some meters north of the EB levels mentioned above. Based on the erection of stone enclosures/fortifications and the documentation of the periodically flooded east branch of the Imvrassos River we may assume that the LCh settlement was extending west of the river and directly to the coast.

forum-article/1660> (last access 20.11.2014). The description EB 1, 2 etc. displays the numbering of the successive architectural phases in these trenches and not their classification in the cultural phases EB I, II and III.

71 Niemeier –Kouka 2012, 100, fig. 21.

The LCh architecture was severely destroyed by the river floods and by the deep foundations of the EB I–II walls. As a result, no walls of the LCh were found, however house remains including roof clay and roof beams, as well as parts of floors made of fine sea pebbles or limestone slabs. Due to the rapid rise of ground water, excavation conditions were desperate – despite the continuous use of water pumps.

Pottery was in its vast majority produced by clay with organic and limestone and quartz inclusions.[72] The assemblage includes orange, reddish brown to black coated and/or burnished hemispherical bowls with thickened rim, bowls with rolled rims, deep bowls with inverted or everted rims,[73] bowls or pyxides with vertically pierced lugs,[74] deep bowls (Fig. 3),[75] cut away spouted jugs – some also with incised decorated handles –,[76] collar-necked jars with narrow vertical or everted rims and unpierced lugs,[77] as well as tripod cooking pots[78] and cooking pans (cheese pots) (Fig. 4).[79] Observations on the surface treatment can be hardly made, because the pottery was waterlogged. Therefore, no pattern burnished or white painted decoration could be distinguished. However, the pottery is comparable with those found at the neighbouring settlement at Tigani IVb,[80] at Emporio VII–VI, Liman Tepe VII, Bakla Tepe and Miletus I.[81]

Among the few small finds some pierced rounded pottery sherds indicate weaving. The stone finds included two stone weights and chipped stone and obsidian blades and flakes. The obsidian could be macroscopically identified as Melian. Finally, the most important LCh small find, is a marble artefact, a stray find from the 1981 excavation. This marble artefact represents a schematic head for the body of a clay figurine (*Steckidol*),[82] a well-known figurine type in the FN of Thessaly.[83]

Habitation at Heraion, north of the Sacred Road, continued until the mid-3rd millennium BC. The 1981 and 2009–2013 excavations exposed parts of the EB settlement consisting of long rectangular houses and a communal storage facility.[84] The settlement was fortified with a stone-built fortification supported by a stone ramp; rectangular bastions flanked its gate.[85] This new settlement planning signifies new political, economic and social structures at the end of the LCh, as it was also the case at Poliochni and Myrina on Lemnos, Emporio on Chios, Liman Tepe and Bakla Tepe. In the mid-3rd millennium BC, the settlement became much larger and extended to the west up to the area of the Temple of Hera. It was also protected with a new fortification wall, included communal buildings and developed into a local centre in the south part of Samos opposite to the Maeander Delta.[86]

[72] Systematic study of the pottery is currently in progress. Therefore, these observations have a preliminary character. The material presented in this article was drawn by A. Kontonis and photographed by C. Papanikolopoulos.
[73] Felsch 1988, pls. 38.361; 45.5; 65.299; 67.352.
[74] Cf. Felsch 1988, pls. 69.398; 71.438.
[75] Cf. Felsch 1988, pl. 72.456–458.
[76] Cf. Hood 1981, pls. 50.811; 51.640–641.
[77] For the form of the neck cf. Felsch 1988, pl. 70.408–411.
[78] Cf. Felsch 1988, pl. 70.417.
[79] Cf. Felsch 1988, pls. 40.2–3; 70.424–425.
[80] Felsch 1988, pls. 59–60.
[81] Şahoglu – Tuncel, this volume 65–82. For the pottery of Miletus I, see below 53–56.
[82] Kyrieleis et al. 1985, fig. 42.1.
[83] Papadimitriou – Tsirtsoni 2010, 116, cat. no. 18; Treuil 2010, 60, fig. 8.
[84] A part of this building was excavated in 1981: Kyrieleis et al. 1985, 412, figs. 35–36 (Bauphase 2); Kouka 2002, 286. In 2009 and 2010 a further part of its destruction level was investigated: Niemeier – Kouka 2011, 104–105, figs. 17–18.
[85] Kyrieleis et al. 1985, 412–413, figs. 35–37a (Bauphasen 1, 3).
[86] Kouka 2002, 294, plans 50, 52, 54; Kouka 2013, 575–576 and online open access image gallery fig. 1 on <http://www.ajaonline.org/forum-article/1660> (last access 20.11.2014).

Miletus

Miletus is located on the mid coast of the western Anatolian littoral, at the delta of the Maeander River and opposite Samos Island. Palaeogeographic investigations undertaken by H. Brückner, from the Department of Geography of the University of Marburg, in the area of the Temple of Athena showed that during the LCh (3500–3200 calBC) the site was not covered by the sea, therefore, well suited for settlement activities.[87] Around 2500–2000 calBC, during the late EB II and the EB III, the local sea level in the Latmian Gulf reached its highest position (about 1.30m below sea level) and created an archipelago-like coastal landscape. A similar pattern is evident on the southern fringe of the Lion Harbour embayment, around the later Sanctuary of Apollo Delphinius, where shallow marine sediments cover cultural debris from the LCh.[88] Therefore, the habitation of the LCh was extended to two small islands located 300 to 400m from the coast.[89]

Excavations in the area of the Temple of Athena, directed by B. and W.-D. Niemeier from 1994–2004, brought to light six successive architectural levels dating from the LCh through the LB.[90] Due to the high water table level excavation was only possible by using the Well-Point-System to pump the ground water out of the trenches. Miletus I dates to the LCh and Miletus II to the late EB II–III. Stray finds indicate that the LCh habitation was extending in the areas of Delphinion, under Heroon III and west of the Bouleuterion.[91] Between 3000 and 2500 BC the LCh settlement in the area of the Athena Temple was flooded by the sea and people had to move to higher grounds during the EB I and the early EB II. The area of the Temple of Athena was resettled at 2500 BC, when this area turned into an island once more.

Athena Temple-Miletus I

The oldest excavated in situ finds from Miletus included only a stone-built circular storage structure divided in two parts (diam. 1.40m, 40cm deep) (Fig. 2C), with postholes cut into the bedrock and two terrace walls.[92] Circular storage buildings are typical in the east Aegean, as noted above, in the case of Myrina and Liman Tepe VII,[93] as well as wattle-and-daub technique.[94] However, the distribution of pottery over the entire area of excavation indicates an intensive use of this area during the LCh.

Coarse wares include light brown to red coated, medium to hard fired pots, such as baking pans (cheese pots),[95] tripod cooking pots with legs with rectangular ends,[96] and *pithoi* (Fig. 5).[97] Medium coarse wares consist of light brown, red and black burnished, hard baked pots, such as shallow conical bowls with vertical lugs,[98] deep bowls with interiorly thickened rims (Fig. 6), spouted jugs and amphorae with band handles either plain or with plastic knobs.[99] Fine wares include red and grey, light polished bowls and little pyxides with vertical pierced lugs (Fig. 6G).[100]

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87 Brückner et al. 2006, 70–71, figs. 1–3, tabs. 1–2.
88 Brückner et al. 2006, 75–77.
89 Niemeier 2000, 125.
90 Niemeier – Niemeier 1997; Niemeier 2000; Niemeier 2007; Kouka 2013, 574–575.
91 Voigtländer 1981; Voigtländer 1982; Parzinger 1989; Niemeier 2000, 125.
92 Niemeier – Niemeier 1997, 241, fig. 81a; Niemeier 2000, 125–126, figs. 2–3; Niemeier 2007, 6–7, pl. 1.1–2.
93 Myrina: Dova 1997, 290–291, drawing 2α–2γ, 9, fig. 3. Liman Tepe: Kouka 2009, 143; Şahoğlu – Tuncel, this volume 65–82.
94 Şahoğlu – Tuncel, this volume 65–82.
95 Cf. Felsch 198, pls. 31.280; 70.424.
96 Cf. Felsch 1988, pl. 40.417–420.
97 A petrographic and chemical analysis of the LCh–EB pottery is currently being conducted by C. Knappett and J. Hilditch.
98 Cf. Felsch 1988, pl. 69.389–391.
99 Cf. Liman Tepe: Şahoğlu – Tuncel, this volume 65–82, and Çine-Tepecik: Günel, this volume 83–104.
100 Niemeier – Niemeier 1997, 241, fig. 81a.

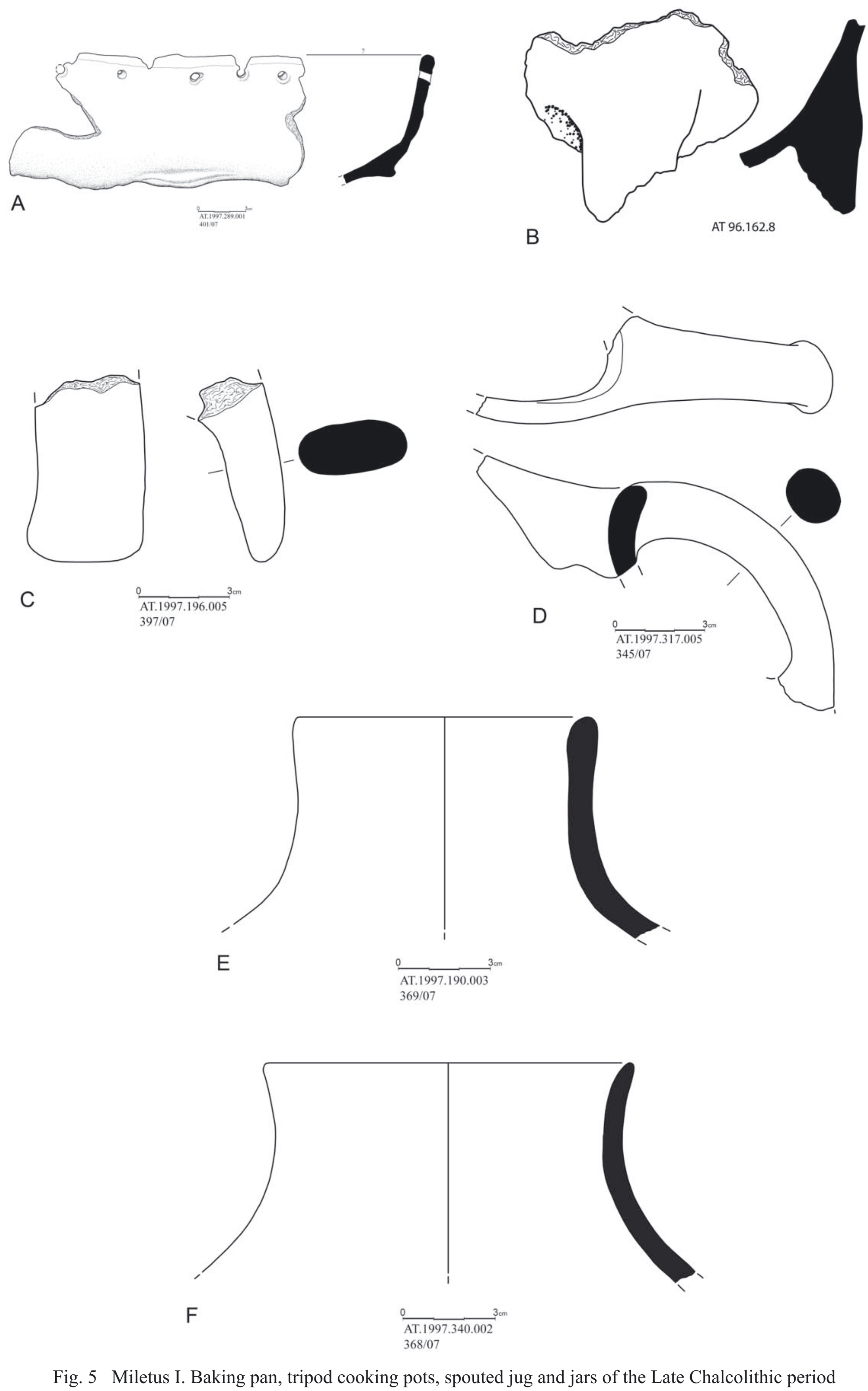

Fig. 5 Miletus I. Baking pan, tripod cooking pots, spouted jug and jars of the Late Chalcolithic period (drawings: D. Faulmann – B. Konnemann – E. Damaliti).

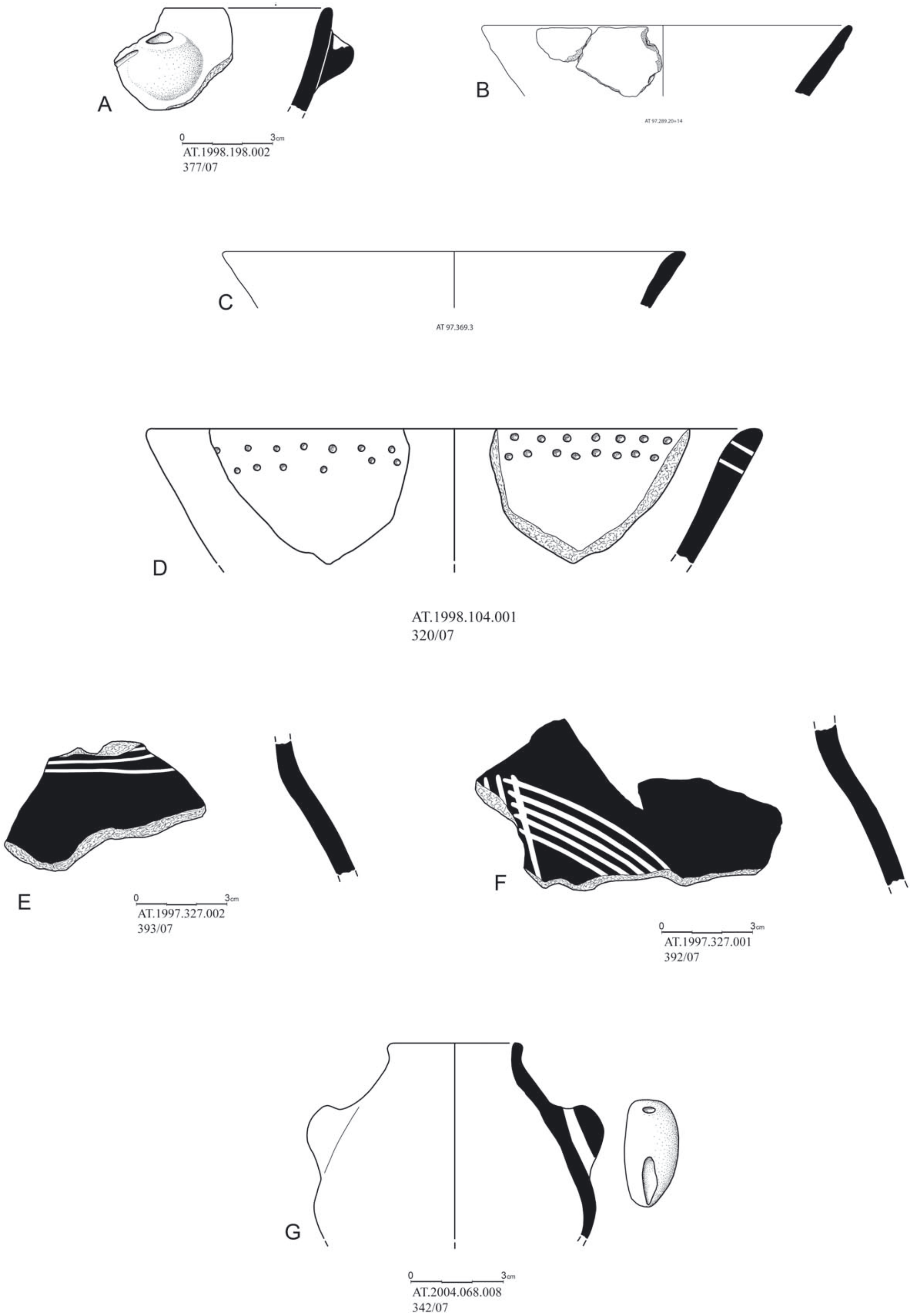

Fig. 6 Miletus I. Bowls, amphorae with white painted decoration and a pyxis of the Chalcolithic period (drawings: D. Faulmann – B. Konnemann – E. Damaliti).

Finally, decorated wares include coarse and fine wares with incised, pointed (also with multiple small holes) (Fig. 6D),[101] as well as highly dark burnished jugs and amphorae with white painted linear patterns (Fig. 6E–F).[102] The above presented ceramics, most of which are highly calcareous with organic inclusions, date Miletus I to the Anatolian LCh (Kum Tepe, Liman Tepe VII, Bakla Tepe) or to the final stage of the Aegean FN (Poliochni Black Phase, Tigani IV, Heraion-LCh).[103]

Numerous Melian obsidian blades[104] indicate close contacts of Miletus I with the Cyclades.[105] Obsidian artefacts were also found in the area of Heroon III,[106] as well as in the wider vicinity of Miletus at Kiliktepe, Mengerevtepe (Assessos), Mersim Dere by Panormos and Altınkum Plaji.[107] Melian obsidian was found not only in the western Anatolian littoral, for example in Liman Tepe VII, Bakla Tepe[108] and Malkayası Cave,[109] but also inland, as LCh finds from Beycesultan, Aphrodisias,[110] and more recently from Çine-Tepecik indicate.[111] The extremely high percentages of Melian obsidian in Aphrodisias and Beycesultan suggest that Miletus had a key role in the contacts between the Aegean and inland Anatolia during the LCh (but also in the EB),[112] and may well have been the main distributor of Melian obsidian at least in the valley of the Maeander. If so, Tigani and Heraion were apparently the last insular links in the obsidian trade from Melos to the inland of western Anatolia via Miletus.

The settlement of Miletus was located beyond the island of the Temple of Athena during the EB I–II/early. The area was resettled during the EB II/late–III.[113] Despite the extremely limited evidence of Miletus II, ceramics of high quality, e.g. depas cups used by the local elites, Early Minoan II–III and Early Cycladic III imports, and a possible symbolic context with five Anatolian schematic marble figurines, and one of the early EC II Dhokathismata types,[114] indicate the existence of a flourishing settlement with evolved social and economic structures between the Aegean and the Anatolian world in late EB II–III Miletus.[115]

Discussion and Conclusions

The archaeological evidence from the settlements at Poliochni, Myrina, Tigani, Heraion and Miletus and further data from older and previously published excavations in the east Aegean islands and western Anatolia,[116] as well as data from more recent excavations presented in this volume display a good background for outlining the main cultural aspects of the 4th millennium BC.

On the islands there are coastal sites, located on either low peninsulae (Poliochni, Myrina, Tigani, Emporio) or coastal plains (Heraion). They are more (Poliochni Black, Myrina II–III,

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101 Cf. Felsch 1988, pls. 40.421; 70.421.
102 Niemeier 2000, fig. 3. Cf. Felsch 1988, pls. 41.459–460; 69.390.
103 For comparisons with Tigani IV and Heraion-LCh see above.
104 The provenance of obsidian was identified by M. Bichler, Institute of Atomic and Subatomic Physics, University of Vienna. The obsidian artefacts were studied by Katja Focke, University of Mainz, whereas the obsidian is being furthermore analysed by Vassilis Kilikoglou, Demokritos Archaeometry Laboratory at Athens.
105 Niemeier 2000, 126, 134, note 13.
106 Parzinger 1989, 421–423, fig. 4.1–9.
107 Niemeier 2000, 125, 134, notes 8–10.
108 Horejs et al. 2011, 48–50, fig. 11; Kolankaya-Bostancı 2011, fig. 1B.
109 Peschlow-Bindokat – Gerber 2012, 74–75, fig. 40.
110 M. J. Blackmann in Joukowsky 1986, 279–285, tabs 76, 78, 79, fig. 272 reports that in the LCh 1–2 the percentage of Melian obsidian in Aphrodisias was 57%, while in LCh 3 reached 100%.
111 Çine-Tepecik: Günel, this volume 83–104.
112 Parzinger 1989, 431; Niemeier 2000, 125–127.
113 Niemeier – Niemeier 1997, 241, fig. 82; Niemeier 2000, 127–130; Niemeier 2007, 7; Kouka 2013, 574–575, fig. 4.
114 Niemeier 2007, 8, pl. 1.3.
115 Kouka 2013, 574–575, fig. 4.
116 A reconstruction of the chronology of western Anatolia with Emporio and Tigani in the LCh see by Schoop 2005, 248–272, fig. 6.10–11.

Heraion-LCh) or less extensively (Emporio VII–VI, Tigani IVb) and intensively used settlements, based on agriculture and animal husbandry. They consist of successive phases of free-standing, stone or clay, circular, apsidal or rectangular houses and storage buildings (Fig. 2). Similar patterns are present in western Anatolia where small (Kum Tepe, Liman Tepe, Miletus) and big settlements (Bakla Tepe) usually show more than two successive architectural phases.[117]

Thus far, archaeological evidence does not indicate any communal buildings in the east Aegean island settlements, for example restricted and protected enclosures, as was the case on mainland Greece and the Cyclades.[118] The erection of massive terrace walls in Emporio VII–VI that enclosed a street leading to the community well is the only indication of communal effort.[119] On the contrary, Strofilas on the Cycladic island of Andros,[120] which was located on important sea routes for trading metals from Lavrion, Siphnos and Serifos, was fortified and exercised control over the area from Attica and south Euboea up to Siphnos and Paros.[121]

The pottery technology is similar in both the east Aegean islands and west Anatolia, as coarse, medium coarse and fine wares are present in both regions. Decorated pottery includes black burnished pottery that was initially decorated with pattern burnish and later with white painted linear patterns.[122] Cooking pans (cheese pots), simple or tripod cooking pots, conical bowls with pierced lugs below rolled or everted rims, wide-mouthed jugs and amphorae occur in all settlements, despite some expected, local peculiarities.[123]

Craft specialisation includes in situ specialised production of chipped stone and obsidian (e.g. Liman Tepe VII)[124] in the majority of the settlements. Melian obsidian was predominantly used, while obsidian from Yiali was used only in the Dodecanese. Unique to western Anatolia is the marble workshop of Kulaksızlar where marble conical beakers and Kiliya type figurines were produced.[125] Furthermore, in situ copper working thus far is only observed in a few settlements, namely at Yiali located near Nisyros,[126] at Bakla Tepe and Liman Tepe VII, in the form of crucibles, copper slags and some copper artefacts. Copper artefacts include flat axes, chisels, knives, daggers without rivet holes, miniature tools, and a casted flat axe (Bakla Tepe). Additionally, silver jewellery, i.e. two rings with hatched decoration, from Bakla Tepe and Beycesultan, makes its first appearance in western Anatolia.[127] The copper used at Bakla Tepe came from its metalliferous vicinity, which was rich in copper, silver, lead and gold. The copper used at Yiali derived from Lavrion in Attica.[128]

There are active trade networks between the east Aegean islands and western Anatolia. Central and southeast Aegean islands, in particular Chios and Samos appear – primarily due to their location – to have been important links of an extensive obsidian sea trade network from the Cyclades to the western Anatolian littoral and it's inland. Furthermore, obsidian finds from Emporio, Tigani, Heraion, Kulaksızlar, Liman Tepe, Bakla Tepe, Malkayasi Cave, Miletus, Çine-Tepecik, Beycesultan and Aphrodisias,[129] point to a well-established obsidian trade network.

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117 Şahoğlu – Tuncel, this volume 65–82.
118 E.g. Strofilas on Andros, Palioskala in east Thessaly: see Kouka 2008, 312, fig. 27.1 with bibliography.
119 Hood 1981, 104–111, figs. 57–59, pl. 19.
120 Televantou 2008.
121 Kouka 2008, 313–314.
122 For citations see above, under Poliochni, Tigani and Heraion.
123 The same pottery tradition was traced from the north Aegean islands up to the Dodecanese: Sampson 1987, figs. 32–33; Sampson 2006, figs. 209–210 (Caves of Kalythies and Agios Georgios on Rhodes), 219–221 (Partheni on Leros), 226 (Alimnia), 236–237 (Yiali by Nisyros).
124 Kouka 2009, 143 fig. 5; Şahoğlu – Tuncel, this volume 65–82. Cf. Kolankaya – Bostancı 2011.
125 Takaoğlu 2005; Takaoğlu 2011.
126 Sampson 2006, 235, fig. 239.
127 Keskin 2011, 145; Şahoğlu – Sotirakopoulou 2011, cat. no. 157; D. Stronach in Lloyd – Mellaart 1962, 291, pls. 4.1; 5.1, 3–4.
128 Sampson 2006, 235, fig. 239.
129 For citations, see above, under Tigani and Miletus.

Local trade networks were enriched by Kiliya figurines (Tigani, Malkayası Cave)[130] and marble conical beakers. Moreover, extensive trade networks brought to the east Aegean islands and western Anatolia conical beakers (Tigani, Liman Tepe), beakers with flat base made from clay and marble (Tigani) and leaf-shaped arrowheads from the Cyclades (Tigani, Heraion, Malkayasi Cave)[131] as well as a marble schematic head of a *Steckidol* (Heraion) of Thessalian tradition and a clay ring-shaped pendant from Mainland Greece and the Cyclades (Tigani). The exceptional exchange and/or imitation of these artefacts may reflect a society with emerging social inequalities in the east Aegean and western Anatolia in the 4th millennium BC. A similar phenomenon was also observed from Macedonia to the Peloponnese and from the Cyclades up to Crete, where a symbolic code emerged in the late 5th and became more pronounced in the 4th millennium BC. This symbolic code is characterised by selected items, such as jewellery made of *Spondylus gaederopus*, clay, copper, gold and silver (e.g. ring-shaped pendants), copper tools,[132] leaf-shaped arrowheads of Melian obsidian and marble figurines and conical beakers.[133]

Based on the aforementioned interpretations we can conclude that in the 4th millennium BC a cultural *koine* was established in the east Aegean and western Anatolian littoral, predating the *koine* of the EB outlined at the beginning of this paper. The east Aegean-western Anatolian *koine* of the 4th millennium BC had an agricultural subsistence economy and was, also thanks to the development of ship building technology, in a vital cultural dialogue with the societies of the central and west Aegean. This dialogue fostered obsidian and metal trade, as well as exchange of prestige objects. The 4th millennium BC settlements in our study region began to display social inequalities and seem to have acted as 'microcosms', some of which, due to their location on important trade routes, emerged as political and economic micro-regional centres a while before the mid-3rd millennium BC (e.g. Poliochni, Myrina, Emporio, Heraion, Liman Tepe, Bakla Tepe, Miletus). Sea routes, established in the 4th millennium BC were further employed in the 3rd millennium BC and established a complicated net of cultural interaction spheres within the Aegean during this millennium (e.g. mainland Greece and northern Peloponnese with Attica in the EB I, Cyclades and Crete in the EB I/early EB II, west Aegean Cyclades and east Aegean in the EB II, Cyclades with southeast Aegean in the EB III).

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[130] Peschlow-Bindokat – Gerber 2012, 74, fig. 41 (left).
[131] Peschlow-Bindokat – Gerber 2012, 74, fig. 40.
[132] For the early metallurgy in the Aegean see Zachos 2010.
[133] Kouka 2008, 312–313.

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New Insights into the Late Chalcolithic of Coastal Western Anatolia: A View from Bakla Tepe, Izmir

Vasıf Şahoğlu,[1] *Rıza Tuncel*[2]

Abstract: The focus of this paper is to define the Late Chalcolithic of coastal western Anatolia based on the new evidence from Bakla Tepe, one of the most extensively excavated Late Chalcolithic sites in that area. The site was inhabited during the Late Chalcolithic and Early Bronze Age I (EB 1) period. The extramural cemetery of the EB 1 period has also been investigated. The site exhibits an open settlement plan during the Late Chalcolithic period with wattle-and daub oval and grill-plan houses built independently with open spaces between them. Infant jar burials under the floors of the houses are a characteristic custom during this period. Pottery reflects a tradition well known throughout the western Anatolian coastline and the eastern Aegean islands. Small finds and ecofacts within the houses indicate the presence of an agricultural village. Slags and other finds related to metallurgical activities at the site are important aspects of the cultural development in this region of Anatolia. Bakla Tepe provides important evidence for changes at the beginning of the EB 1 period. A strong foundation and a ditch surrounded the site while construction materials changed to stone and mud brick. Unlike in the previous period, houses were built within the fortification in a very compact manner sharing walls and leaving very little open space within the fortified settlement. Important cultural, political and economic changes must have taken place during the transition from Late Chalcolithic to EB 1 around the Izmir region and the reasons behind these radical changes at Bakla Tepe must be sought within this framework.

Keywords: Turkey, western Anatolia, Bakla Tepe, Chalcolithic, Early Bronze Age, settlement, pottery, burials, social change

The late 4th millennium BC is an important turning point for the societies of the Aegean. This period is the eve of social and economic changes which shaped the entire Bronze Age. Important technical developments in metallurgy and metal working, as well as textile and dairy production all seem to have shaped this period. Western Anatolia and the eastern Aegean islands may reflect common cultural elements where there are no direct indications for social stratification as exemplified by uniform architectural elements and the lack of special function buildings.

The 'Chalcolithic period' of coastal western Anatolia has long been debated among scholars. Northwestern sites like Beşik-Sivritepe[3] and Kumtepe[4] were among the first ones labelled as pre-Trojan – thus pre-Bronze Age – and these sites, along with the southwestern site of Beycesultan have helped to define a certain Late Chalcolithic of western Anatolia. With the realisation that a considerable hiatus existed between the Kumtepe IA and Kumtepe IB phases in northwestern Anatolia,[5] the chronological terminology for defining these two cultures has been problematic.[6] The Chalcolithic of western Anatolia has been the focus of interest especially in the last 10 years,

1 Ankara University, Faculty of Languages and History – Geography (DTCF), Department of Archaeology; email: sahoglu@ankara.edu.tr.

2 Eastern Mediterranean University, Faculty of Arts and Sciences, Department of Arts, Humanities and Social Sciences, Famagusta, Cyprus; email: rtuncel@gmail.com.

3 Schliemann 1881, 734–744; Lamb 1932; Seeher 1985; Korfmann 1986; Korfmann 1989.

4 Koşay – Sperling 1936; Sperling 1976.

5 Korfmann – Kromer 1993; Özdoğan 1993, 183; Kromer et al. 2003.

6 Kumtepe IA phase of the Chalcolithic period, extending into the 5th millennium BC has been labelled as Middle Chalcolithic by some scholars, whereas it has been called the earlier Late Chalcolithic by others. The Late Chalcolithic proper is roughly dated to the second half of the 4th millennium BC.

Fig. 1 Map of the Aegean with sites mentioned in the text (courtesy of IRERP).

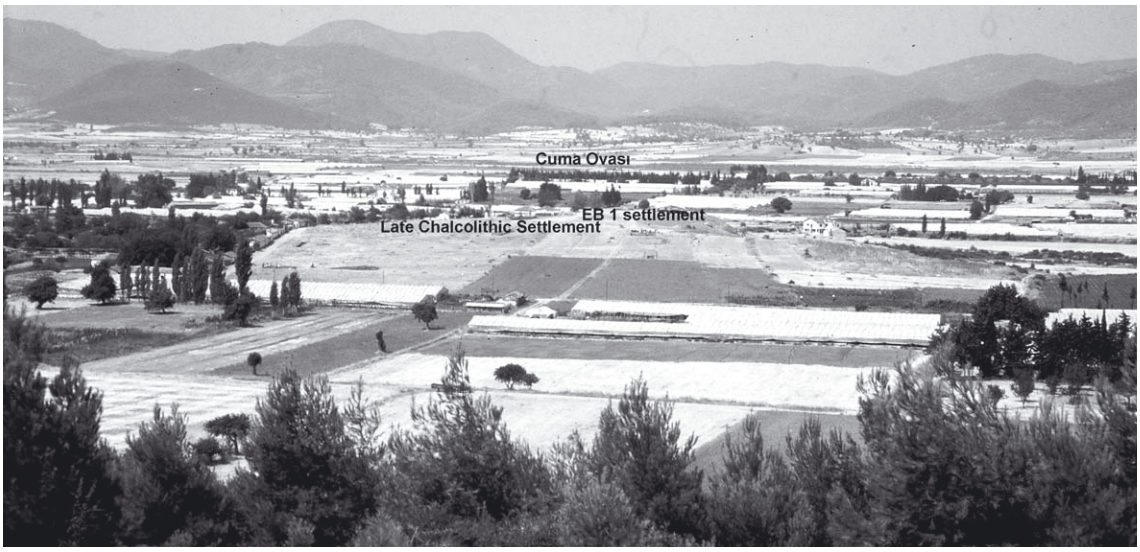

Fig. 2 A view of Bakla Tepe from the east (courtesy of IRERP).

and sites like Liman Tepe,[7] Gülpınar,[8] Çine-Tepecik,[9] Yeşilova[10] and Ulucak[11] have all initiated important new evidence for clarifying the nature of this period which exhibits extensive maritime contacts.

The focus of this paper will be to define the Late Chalcolithic (i.e. approximately the second half of the 4th millennium BC) of coastal western Anatolia based on the new evidence from Bakla Tepe. For many years, this culture was characterised and defined by the finds from Kumtepe – although the excavated area was extremely small in size.[12] During the course of the time, many new discoveries have been made through surveys[13] and finally sites like Liman Tepe, Bakla Tepe, and now Çukuriçi Höyük[14] better define this culture on the western Anatolian littoral.

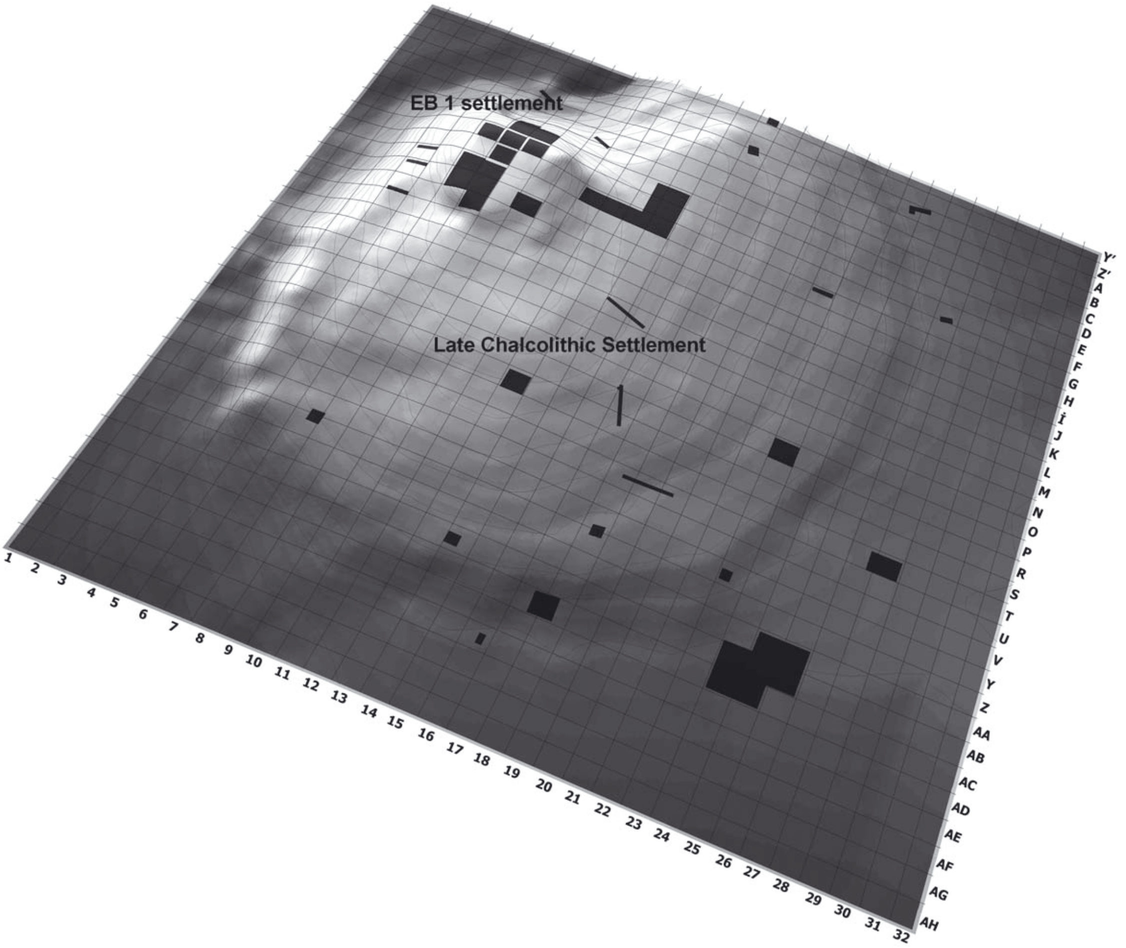

Fig. 3 Topographical map of Bakla Tepe (illustration: M. Massa, courtesy of IRERP).

7 Erkanal – Şahoğlu 2012b.
8 Takaoğlu 2006; Takaoğlu 2007; Takaoğlu – Özdemir 2013.
9 Günel 2006; Günel 2007; Günel 2008.
10 Derin et al. 2009, 8–9, 16–17, figs. 14–15.
11 Çilingiroğlu et al. 2004, 18–20.
12 Koşay – Sperling 1936; Sperling 1976; Korfmann et al. 1995.
13 Following the surveys by French in 1959–1960 in İznik, Balıkesir and Manisa regions (French 1961; 1967; 1969), more recent surveys included those by Tuna (1986) and Meriç (1987). More recently, survey of the Aydın and Muğla regions has been undertaken by Günel (2003a; 2003b; 2004a; 2004b; 2004c; 2004d; 2005a; 2005b).
14 Horejs 2012.

Bakla Tepe is situated within the boundaries of the former Bulgurca village, close to the southern end of the fertile Cuma Ovası plain in the Menderes district south of İzmir (Figs. 1–2). It is the most extensively investigated 4th millennium BC settlement of coastal western Anatolia to date (Figs. 2–3). The site is positioned at a favourable location which controls the fertile plain of Menderes and the narrow passageway, which grants easy access to the Aegean Sea within a short distance (Fig. 1). The area is extremely rich in terms of metal sources which may explain the evidence for early advanced metallurgical activities at Bakla Tepe. There are important copper, lead, silver and gold resources within easy reach of the site.[15]

Bakla Tepe was already known in archaeological literature from the previous surveys of Numan Tuna[16] and Recep Meriç.[17] Excavations at the site have been carried out within the framework of the Izmir Region Excavations and Research Project (IRERP) under the scientific direction of H. Erkanal from Ankara University as part of the Tahtalı Dam Salvage Project, which was headed by the former Director of the İzmir Archaeological Museum, T. Özkan. Salvage excavations continued for six seasons from 1995–2001.[18] However, investigations were suspended in 1999 due to the high water level caused by the newly constructed dam.

The site consists of two mounds – a larger, flatter mound of Late Chalcolithic date below and a smaller but higher Early Bronze Age I mound on top (Figs. 2–3). The Late Chalcolithic settlement extends roughly over an area 300m in diameter while the EB 1 settlement is c. 100m in diameter (Figs. 2–3). The former habitation was investigated through the excavation of contiguous trenches H/12–15 and F–G/14–15, as well as various test trenches of differing sizes throughout the site (Fig. 3).

The settlement was inhabited from the second half of the 4th millennium BC onwards until the third quarter of the 3rd millennium BC with some discontinuity. Two different settlements and burial grounds belonging to the first half and the second half of the 3rd millennium BC respectively have been excavated. There is also a built chamber tomb of Late Bronze Age on top of the EB mound along with a *pithos* grave of the same period.[19] The same area also included various Late Roman/Byzantian era burials.[20]

The Late Chalcolithic Stratigraphy and Architecture of Bakla Tepe

At least four separate architectural levels were exposed during the course of excavations at Late Chalcolithic Bakla Tepe.[21] Although not all levels have been investigated equally intensively, the settlement seems to follow a similar layout throughout its lifetime, consisting of free-standing, independent domestic units with open spaces among them (Fig. 4). The architecture consists mainly of wattle and daub structures although there are also some indications for the use of mud brick. The typical architectural unit is a grill-plan structure, sometimes with an apsidal end (Fig. 4–5). The 'grills' consist of a single row of medium-sized stones and were probably used to lift the floor of the building above the ground surface (presumably by placing wooden planks perpendicular to the orientation of the stone 'grills'), keeping it dry during the wet seasons.

Circular structures whose diameters range between 1–2m are scattered throughout the settlement (Fig. 6). These features were used in relation with the grill-plan structures in almost all

[15] Lengeranlı 2008.
[16] Tuna 1986, 215.
[17] Meriç 1987, 302.
[18] Erkanal – Özkan (1997; 1998; 1999a; 1999b; 2000); Erkanal (2004; 2008); Şahoğlu (2005; 2006; 2008a; 2008b); Erkanal – Şahoğlu 2012a.
[19] Erkanal – Özkan 1997, 401–405, figs. 1–5; Erdal 2002; Erkanal – Şahoğlu 2012a, 96–97, fig. 6.
[20] Cf. Erkanal – Özkan 1999b, 109–110, fig. 7. The anthropological studies of the skeletal material from Bakla Tepe are currently under study by Prof. Yılmaz S. Erdal (Hacettepe University).
[21] Erkanal – Şahoğlu 2012a, 92.

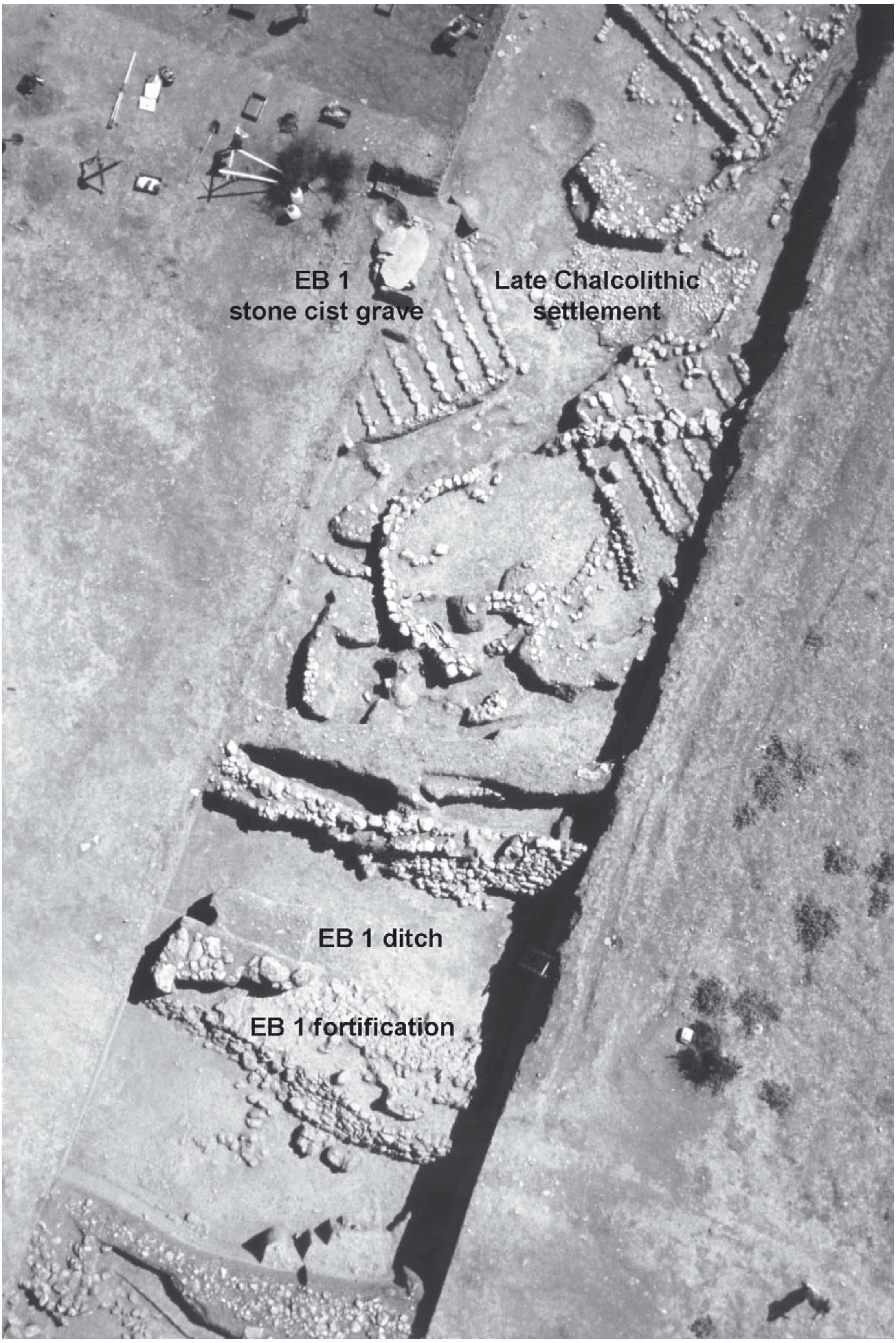

Fig. 4 Late Chalcolithic architecture from Bakla Tepe (photo: J. Driessen).

Fig. 5 Late Chalcolithic 'grill planned structure' from Bakla Tepe (courtesy of IRERP).

cases. Given the small diameter and the firmly paved floors – usually with pebbles or small stones – they must have served as storage areas, probably for foodstuffs. Storage facilities seem to play an important role in Bakla Tepe society as shown by these round structures and the special grill plans. At Bakla Tepe these features may be an important indication for surplus production which required a certain level of organisation with respect to agricultural activities and extra storage

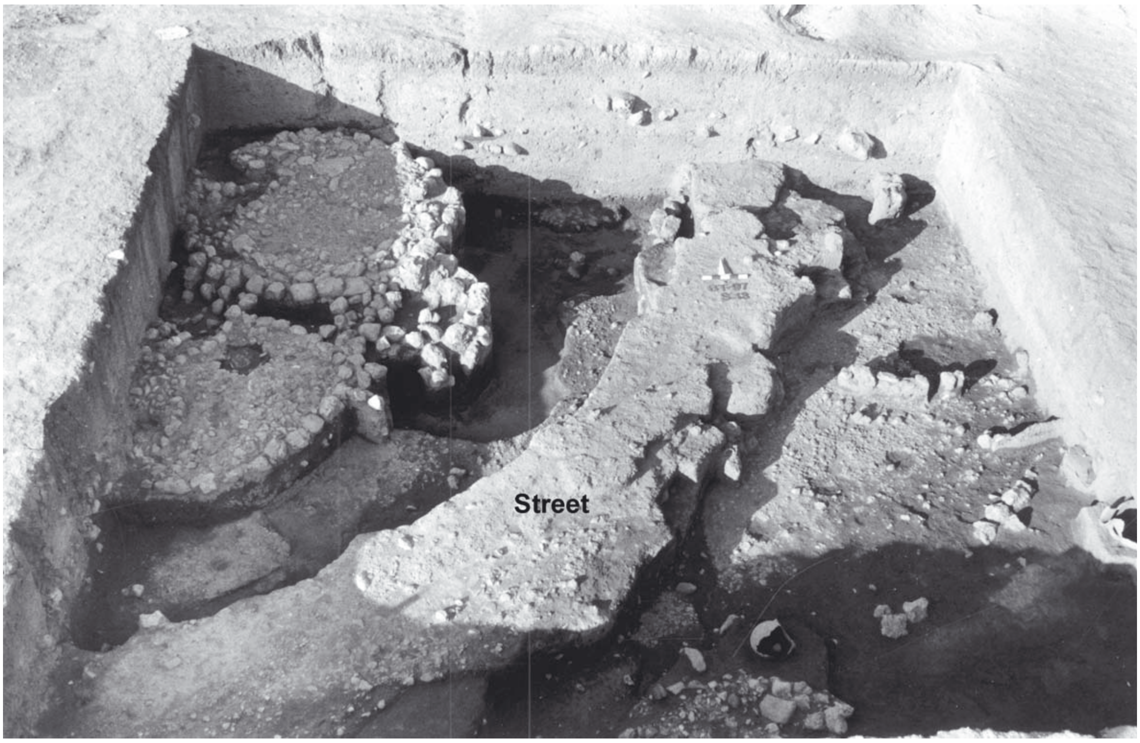

Fig. 6 Late Chalcolithic circular structures and a street from Bakla tepe (courtesy of IRERP).

facilities during the second half of the 4th millennium BC. It must nevertheless be emphasised that no communal storage facilities or central buildings were uncovered at the site. In contrast to the more densely occupied and much smaller Early Bronze Age I settlement, Late Chalcolithic Bakla Tepe possesses no fortification walls. There are hearths and fireplaces in and outside the houses indicating that open spaces were equally important, and many domestic activities were undertaken outside. The open spaces around the structures must have also been used as streets (Fig. 6) as indicated by some pebble paved pathways around the settlement.

Metals and Metallurgical Activities at Late Chalcolithic Bakla Tepe

Various finds indicate specialised activities like textile production and metallurgy at the site during the Late Chalcolithic period. Simple metal tools like borers, and small blades are among the finds related to the early use of metals. Clay *tuyères* have been found along with slag remains throughout the site during this period (Fig. 7).[22] The metals and other finds indicating metallurgical activities at the site are most important since they bear some of the earliest advances in metallurgy in this part of the Near East. Present evidence suggests that these activities were taking place within the settlement, probably in the open areas around the houses since there were no organised workshop areas for specific production activities. Almost all of the metal finds – except for a flat axe – represent small tools for cutting or boring. The environs of Bakla Tepe have rich copper sources which might have already been exploited during this period. This may also be one of the reasons for the early advanced metallurgical activities at this site. Detailed analysis of metallurgical activities at Bakla Tepe will definitely shed important light on the development of metallurgy and metal use at the dawn of the 3rd millennium – a crucial period in the history of the region.

Fig. 7 A clay *tuyère* from Late Chalcolithic Bakla Tepe (photo: Ch. Papanikolopoulos [INSTAP-SCEC], courtesy of IRERP).

Textile Production at Late Chalcolithic Bakla Tepe

There is evidence for the production of textiles through both artefacts associated with textile production as well as textile prints preserved on the bases of some vessels. An interesting category of finds believed to be linked to textile production are perforated clay cylinders. These are usually poorly fired and crumble easily. They are often found in groups and are sometimes associated with cutting implements made of obsidian or flint (Fig. 8). Their wide distribution across the settlement suggests that during the Late Chalcolithic textile production was household based just like metal production and not industrial.

22 A selection of samples from these important slags were submitted to Prof Noel Gale, Isotrace Lab (Oxford), in the past for analysis but no results have been acquired so far.

Fig. 8 Clay cylinders and associated lithics from Late Chalcolithic Bakla Tepe (courtesy of IRERP).

Fig. 9 A stone axe from Late Chalcolithic Bakla Tepe (photo: Ch. Papanikolopoulos [INSTAP-SCEC], courtesy of IRERP).

Ground and Chipped Stone Industries at Late Chalcolithic Bakla Tepe

Stone implements are another characteristic find group which further stresses the intensive agricultural activities at the site. Groundstone is widely distributed across the settlement, which points to food preparation. Stone axes of various sizes and produced from various types of stones are also abundant (Fig. 9). Many of these were probably used for woodworking which must have been a major activity especially when we consider the material necessary for wattle and daub architecture and the extensive use of wood at the site.

Flints from local sources form the main body of raw material for the lithic industry, but there is also an abundant number of obsidian tools, presumably from Melos, used at the same time. The presence of cores among the obsidian finds is important for demonstrating the import of raw obsidian into the settlement. These cores, as well as debitage from tool production point to onsite obsidian working during this period. Their distribution across the site, again points to household level stone tool production. A small obsidian workshop is known at Bakla Tepe in the following EB 1 period.[23]

[23] Kolankaya Bostancı 2006.

Late Chalcolithic Pottery from Bakla Tepe

The Late Chalcolithic pottery of Bakla Tepe reflects a mixture of the northwestern and southwestern pottery traditions as represented by the well-known contemporaneous assemblages of Beycesultan[24] and Kumtepe IB.[25] Bakla Tepe material constitutes the best pottery collection so far excavated and dates to the second half of the 4th millennium BC. The pottery of Bakla Tepe is handmade (Figs. 10–12). Mottling on most surfaces, frequent dark cores, and the relatively friable fabric suggest firing in open air. The most common fabric is a medium-coarse reddish buff ware which is mainly used for jars, cooking vessels and miniature juglets, although some examples of bowls are also known to have been produced in this fabric. The next largest group is the medium coarse black-burnished ware (although the actual colour ranges from brown to dark grey/black), commonly used for jugs and bowls. A quite distinctive fabric is the reddish buff chaff ware, characterised by a brick-red surface, and a very thick black core sharply delineated close to the surfaces, used only for jars. The fine black burnished ware constitutes another distinctive fabric characterised by tiny and infrequent specks of mica and calcareous inclusions, used for bowls and jugs and much more common in the later phases (Late Chalcolithic 1–2) of the settlement.

Fig. 10 A cylindrical necked jar from Late Chalcolithic Bakla Tepe (photo: Ch. Papanikolopoulos [INSTAP-SCEC], courtesy of IRERP).

Late Chalcolithic pottery development is best reflected on bowls. Rolled rim bowls, a type that defines the Kumtepe IB phase in the

Fig. 11 A ‘saucer’ from Late Chalcolithic Bakla Tepe (photo: Ch. Papanikolopoulos [INSTAP-SCEC], courtesy of IRERP).

[24] Lloyd – Mellaart 1962, 71–115.
[25] Sperling 1976.

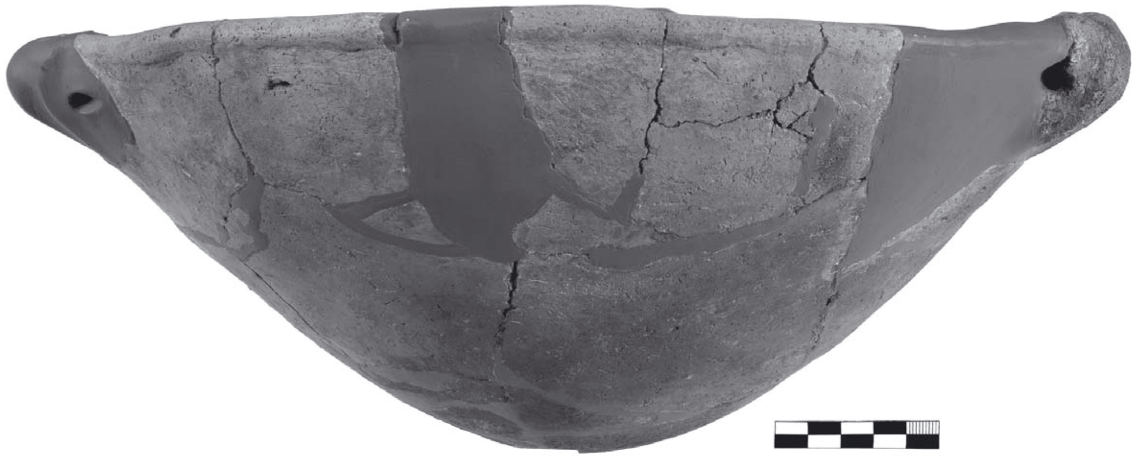

Fig. 12 A large conical bowl from Late Chalcolithic Bakla Tepe (photo: Ch. Papanikolopoulos [INSTAP-SCEC], courtesy of IRERP).

northwestern part of Anatolia[26] (Fig. 12) is common throughout all phases of the Late Chalcolithic of Bakla Tepe, however, with some variations. One distinctive characteristic of the rolled rim bowls of Bakla Tepe is that interior-thickened rims are thicker, more elongated and more frequently decorated with white paint, especially in the earlier levels, whereas in the later levels they tend to be shorter, more rounded and undecorated. Earlier bowls also possess a carination below the rim while the later examples have a more conical shape. The most common decoration, reserved only for the interior of the rim on bowls consists of inverted triangles which are filled with oblique lines.

White-painted decoration is likewise employed on jugs with globular bodies, usually consisting of antithetically placed groups of oblique lines pendent from a group of horizontal lines placed at the intersection of the neck and body. This motif is also frequently found on jugs from Late Chalcolithic Beycesultan[27] and Liman Tepe. The popularity of the white-painted decoration parallels what is already known from Beycesultan, where this technique is much more popular in the earlier levels of the site.[28] At Bakla Tepe, it is most commonly found in Late Chalcolithic levels 2–3, and less numerous in earliest Late Chalcolithic 4, but is absent in the latest Late Chalcolithic level 1. Other forms of decoration like pellets applied onto the body or the rim of bowls and incised decorations are much less common.

The material studied so far (belonging to a single 10 × 10m trench) has not produced pattern burnished decoration. Therefore, it is safe to assume that the situation again closely parallels that of Liman Tepe and that of Beycesultan, where the pattern burnished decoration occurs in very small amounts in the earliest Late Chalcolithic levels[29] and is absent in later levels. In the southwest, as exemplified by the Beycesultan assemblage, bowls are usually adorned with vertical handles in the latest Late Chalcolithic levels, and the interior of the rims, as in Liman Tepe, are decorated with white paint. Bakla Tepe displays a close parity in terms of appendages on bowls, which do not feature handles but instead employ string-hole lugs, placed on the exterior surface below the rim, sometimes with horn-like projections on either end. On the other hand, white-

[26] Sperling 1976, 327–344, figs. 13.405–407; 14.514–517; 15.535–545.

[27] Lloyd – Mellaart 1962, e.g. figs. P.1.21, 25, 26; P.4.27–30.

[28] Lloyd – Mellaart 1962, 77.

[29] Lloyd – Mellaart 1962, 91, fig. P.6.6, 10.

painted decoration is part of the southwestern Anatolian tradition that is absent in Kumtepe and other northwestern sites.

Jars are made in coarser fabric and usually have either slightly everted or straight rims with short necks. Globular bodied jugs having short necks and slightly everted beak-spouts are quite common in black burnished ware and its fine variant.

Baking pans, or cheese pots as they are more commonly called in Aegean terminology, are also quite common. Some of the Bakla Tepe examples bear matt impressions on their bases. Although this form is more characteristic of the Late Chalcolithic period, at Bakla Tepe it continues into the Early Bronze Age I period.

Figurines

Clay figurines have been found at various parts of the settlement. However, they were not necessarily associated with certain architectural features or 'special contexts'. One of the figurines is 6.7cm in height and possesses anthropomorphic features.[30] It depicts an individual with open arms (Fig. 13). The eyes are marked as two small depressions, the nose is rendered in vertical relief and a small incision forms the mouth. There seems to be a kind of conical headdress. The body is roughly rectangular and squat. The hands at the end of relatively short arms are incised and the base of the legs is flattened in order for the figure to stand.

Fig. 13 A clay human figurine from Late Chalcolithic Bakla Tepe (photo: C. Papanikolopoulos [INSTAP-SCEC], courtesy of IRERP).

Late Chalcolithic Burial Customs at Bakla Tepe

Our knowledge of the Late Chalcolithic burial customs at Bakla Tepe is quite limited. Nevertheless, there are good indications for extramural deposition of the dead since no adult grave has been found within the limits of the settlement. However, a large number of infants were buried in jars under the house floors – the largest number discovered in Anatolia to date (Fig. 14). Anthropological studies carried out by Y. S. Erdal revealed that these jar burials mostly consisted of infants who had died before reaching the age of 6 months. Most of them suffered perinatal death. Infant jar burials yielded none or very few grave goods, mainly beads.

The child burials are not only important for illustrating burial customs but equally important for giving us an insight into the kind of transport or storage jars in use during the second half of the 4th millennium BC. One of the most interesting examples is one which possesses a spout close to the bottom of the jar. Its use as burial urn is clearly a secondary function and its original use may have been for the extraction of olive oil or for processing dairy products.

30 Erkanal – Şahoğlu 2012a, fig. 2.

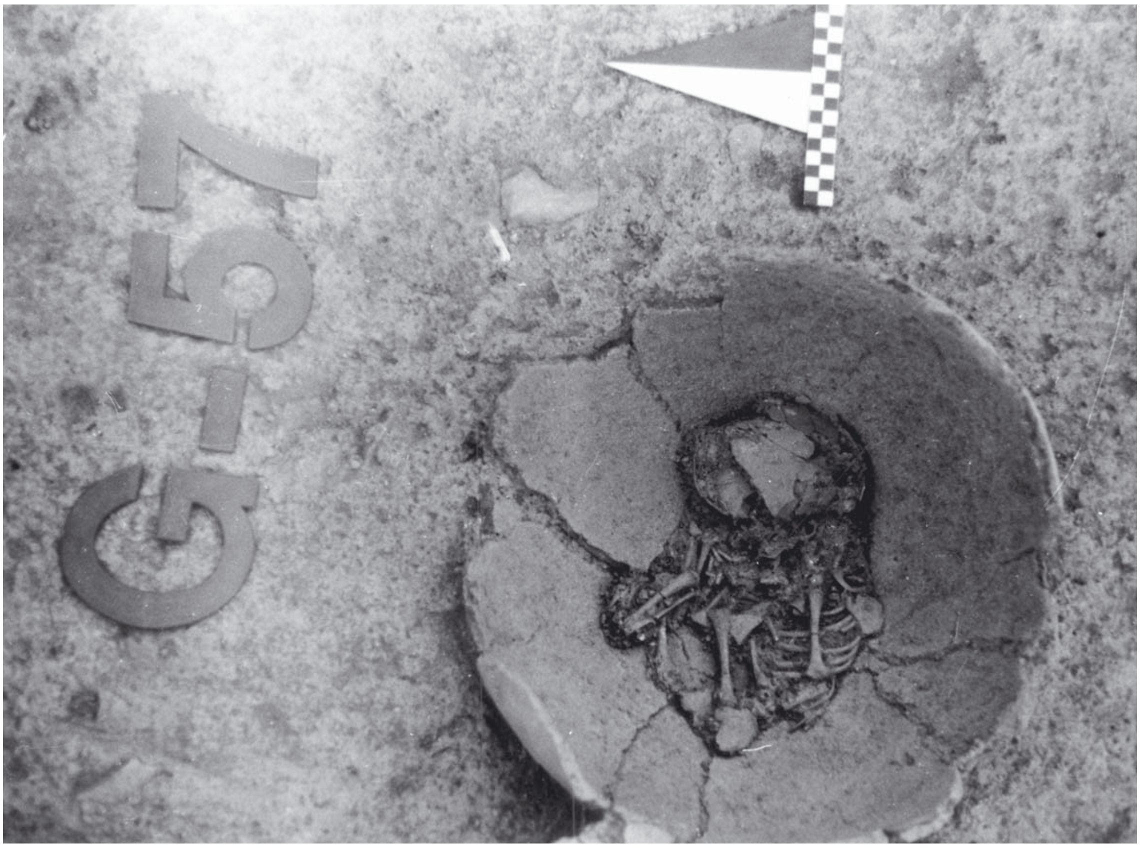

Fig. 14 An infant jar burial from Late Chalcolithic Bakla Tepe (courtesy of IRERP).

Dating

IRERP has been cooperating with Oxford Labs and B. Weninger (University of Cologne) on radiocarbon dating of samples from the project. Due to the nature of the calibration curve for the period in question, more precise calendar dates could not be obtained from the three samples so far submitted for analysis (Fig 15).[31] All samples are carbonised grain. We are aware that the number of dates is not sufficient for a more detailed analysis of the chronology of the site as a whole. Nevertheless, as we await more results from B. Weninger and the ORAU, the three available Oxford dates concord very well with similar results from Liman Tepe and all fit into the time period of the second half of the 4th millennium BC (Tab. 1).

Sample No.	Material	Bakla Tepe Level	BP	BC 2σ
Ox-A 22873	Carbonised grain	Late Chalcolithic 2	4575±28	3496–3117
Ox-A 23011	Carbonised grain	Late Chalcolithic 4	4446±29	3333–2941
Ox-A 23014	Carbonised grain	Late Chalcolithic 3	4546±28	3367–3104

Tab. 1 Radiocarbon results from Bakla Tepe.

31 All samples are calibrated with the Oxford Radiocarbon Accelerator Unit (ORAU)'s online OxCal calibration program, v.4.2 using INTCAL13 radiocarbon calibration curve (https://c14.arch.ox.ac.uk/oxcal/OxCal.html). For the INTCAL13 calibration curve see the INTCAL13 special issue in the journal Radiocarbon 55(4), 2013.

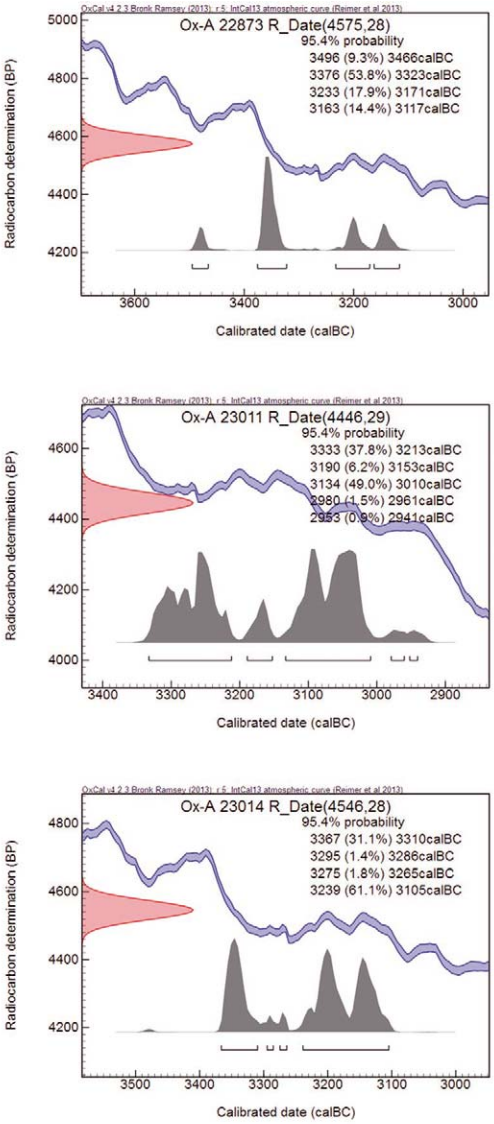

Fig. 15 ^{14}C results of three samples from Late Chalcolithic Bakla Tepe (courtesy of IRERP).

Changes and Transformations at the Beginning of the 3rd Millennium BC

Bakla Tepe represents a relatively large agricultural village society with evidence for metallurgical activities and textile production. Vast amounts of obsidian are a good indicator of the maritime contacts of the settlement, possibly through intermediaries, during the second half of the 4th millennium BC.

Radical changes occur at Bakla Tepe by the beginning of the 3rd millennium BC. The size of the settlement decreases enormously from 300m to almost 100m in diameter. The settlement is now surrounded by a robust fortification wall with an additional ditch dug into the eastern slope of the mound which is more gently inclined than the steeper west slope.

The architecture reflects drastic changes in the organisation of the settlement, as well as new, much sturdier construction methods involving thicker stone foundations with a mudbrick superstructure. The free-standing buildings of the Late Chalcolithic period give way to long-houses sharing common walls, indicating changes in the organisation of both the household as well as the community itself. There seems to be a much more compact settlement structure than before, probably due to the limitations of space within the fortified area. Organised storage areas continue to be part of the settlement's structural layout.[32]

Bakla Tepe is one of the very few Early Bronze Age I sites where both the settlement, as well as its extramural cemetery have been investigated. The cemetery itself was situated on the eastern slope of the mound, outside the ditch. Three different types of burials, consisting of pit graves, *pithos* graves and stone cist graves have been excavated.[33] Variation in burial types may reflect the presence of different cultural traditions within the settlement since grave types do not correspond either to sex, age or apparent richness of the burials. Bakla Tepe's economy continued to depend on agriculture and animal husbandry during this period, but the extramural cemetery with rich finds, such as metal burial goods reflects the advanced level of metallurgy and wealth at the site during this period.

The rich metal finds from the cemetery, in addition to moulds,[34] slags and crucibles found at the settlement all point to a society involved in metallurgical activities and probably trade. Melian obsidian continues to be in use along with local flint.[35] The pottery repertoire displays no great break in ceramic traditions, but new forms are introduced while older ones, like the well-known rolled rim bowls of the Late Chalcolithic, transform and disappear. Black burnished jugs with flaring spouts from graves seem to be specially produced as grave goods as this specific form is not found in settlement contexts. Some of these were so badly fired that it was impossible to remove them from the graves. They clearly were not meant to be used in daily life but were an important part of the burial rites.

The use of stronger building materials, fortification walls and the construction of a ditch outside the fortification wall all point out to a higher level of organised communal effort. Common use of walls within the fortification is another indication of shared responsibilities within the society. All these radical changes in settlement organisation and layout at Bakla Tepe can be interpreted as a local reflection of a more general social transformation evidenced in coastal western Anatolia at the beginning of the 3rd millennium BC. Important changes observed in architectural traditions and settlement layout may be an indication of rising inter-communal conflict at the beginning of the 3rd millennium.

The reasons behind these unsafe times at the dawn of a new millennium remains unknown, but the wider use and distribution of metals may be one of the motives which triggered further need for taking more safety precautions. The access to metals must have had an important impact on the social stratification process.

General Remarks

There is no direct evidence for a proto-urban society at Bakla Tepe towards the end of the 4th millennium BC. Nevertheless, the abundant data for trade in exotic materials, intensive metallurgical activities and the presence of external storage facilities during the Late Chalcolothic period strongly suggest that the seeds of 'centralisation' (as defined by Ö. Çevik for the Early Bronze Age of western and central Anatolia)[36] were already planted during this period.

The overseas contacts that existed throughout the eastern Aegean must have been further intensified during the second half of the 4th millennium BC (as evidenced by the high number of Melian obsidian found in the settlements of the western Anatolian coastline) which resulted in the creation of an eastern Aegean *koine*, including the western Anatolian littoral.

[32] Erkanal – Özkan 1997, 2, figs. 3–4.
[33] Erkanal – Şahoğlu 2012a, 93–94.
[34] Erkanal – Özkan 1997, 3.
[35] Kolankaya Bostancı 2008, 155.
[36] Çevik 2007.

The presence of metalliferous deposits in the region and its exchange must have played an important role in the creation of this cultural *koine,* as well as the emergence of differences in wealth. Although the evidence from Bakla Tepe concerning metallurgical activities points to a uniform spread throughout the settlement and an even intra-site distribution of metals, we cannot rule out the possibility that such activities may have been loosely controlled. Without additional data from graves – something which is sadly lacking for the Late Chalcolithic of western Anatolia, we cannot pinpoint differences in status.

Nevertheless, the creation of this eastern Aegean cultural *koine* paved the way for even more intensive interregional exchange in the first half of the 3rd millennium BC, resulting in the formation of regional centres like Liman Tepe. A monumental fortification wall was first built during the EB 1 period at this site. Although not well-preserved, a fortification wall was similarly constructed at Bakla Tepe during the same period. The impetus towards a more organised settlement and society further accelerated during the EB II. Although evidence for the settlement of this period is scant at Bakla Tepe, the construction of a central building at Liman Tepe, and the expansion of the settlement attest to increasing social complexity in this region. The creation of an 'Anatolian Trade Network' during the second half of the 3rd millennium BC running across Anatolia was most probably concomitant with trade in metals, and scarce metals, such as tin, must have necessitated tighter control of its circulation and acquisition.

Late Chalcolithic Bakla Tepe thus represents a small scale village where access to copper ores and the development of more intensive metallurgical activity coupled with surplus production of agricultural products (necessitating the construction of extra-domestic storage units) form the first step towards the more centralised polities of the EB II period.

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New Contributions Regarding Prehistoric Cultures in the Meander Region: Çine-Tepecik

Sevinç Günel[1]

Abstract: Providing a link between the Aegean and the high plateau of central Anatolia, the valleys of western Anatolia played an important role in the spreading of settlements and cultural interaction in prehistoric times. In western Anatolia, the Meander River and natural passageways extending towards its south are amongst the most important factors causing interregional communication. Tepecik, which is located in the plain of one of the southern tributaries of the Meander, the Çine Stream (Marsyas), provides evidence for continuous settlement from the Chalcolithic to the end of the Bronze Age. In the stratigraphy of the mound, Level IV belongs to a Chalcolithic settlement with domestic structures. Local burnished ware from this level forms the most important Chalcolithic find in Tepecik. Among the pottery assemblage, burnish pattern vessels constitute the richest group. Zigzag lines and crosshatched panels are the most widespread decorative tradition on bowls and jars. Apart from the pottery, a diverse and wide array of bone implements, a chipped stone industry including obsidian and flint tools and Kiliya type marble figurines define the prehistoric culture of this region.

Keywords: Turkey, western Anatolia, Marsyas, Çine-Tepecik, Chalcolithic, pottery, lithics, Kiliya figurines, marble

In recent years, archaeological research carried out in western Anatolia has shed new light on cultural influences and external contacts impacting the region. Within this body of research, the newly discovered settlement of Çine-Tepecik has contributed new data to the early period cultures in the area. In the past, the prehistoric cultures of western Anatolia have been discussed using very limited information and data. Conclusions have generally depended on archaeological information from short-term excavations and surveys. Recent systematic excavations allow the archaeological evidence, especially the architecture and the finds, to be interpreted from a stratigraphic perspective. In light of this research, the settlement models/structures and burial customs of the early period can be better assessed. The results help to define the local culture in prehistoric western Anatolia and its impact on the surrounding cultures, as well as to flesh out the interregional chronology. This paper focuses on recent results concerning the prehistoric period from Tepecik and the site's cultural relationships during this time.

Location and Stratigraphic Development of the Mound

Tepecik is located in the province of Aydın. In the area of the Çine Çayı or Çine Stream (the ancient Marsyas) – a southern tributary of the Büyük Menderes (Meander) – there is a passageway that runs in a southerly direction through the Meander plain to the Çine region. South of the Meander, the Çine Çayı bisects the foothills of the eastern and western Menteşe mountain ranges. By virtue of its geographical position, with its natural passageways between these mountain ranges, the Çine Plain connects the Aegean coast with central Anatolia. Tepecik lies in this large plain to the east of the Çine Çayı in a geographically central position. Tepecik is a very low, oval mound, extending from north to south. Excavations of the mound have provided important insights into what are still little-known prehistoric cultures in this region (Fig. 1).

[1] Hacettepe University, Ankara, Turkey; email: sgunel@hacettepe.edu.tr.

Fig. 1 Location of Çine-Tepecik in the region of the Çine River.

The excavations at Tepecik, undertaken since 2004 with the permission of the Ministry of Culture and Tourism, demonstrate uninterrupted settlement from the Aegean Late Neolithic to the Bronze Age. Before excavations began the surface of the mound was destroyed by machine-assisted earth removal. In addition to agricultural destruction, illicit excavations have caused further damage to the mound. As a result, numerous pottery finds dating to the Carian-Geometric and Classical periods were found on the surface.[2] The mound was also used as a cemetery during the Hellenistic period.[3] The preserved architectural remains and finds from the excavations show that Levels II 1 and II 2 of the settlement date to the 2nd millennium BC. The cultural remains of Levels II 2 and II 1 date to the Middle and Late Bronze Ages respectively, with evidence of a fortified settlement.[4] In this stratigraphic development of the mound, Level III revealed remains from the Early Bronze Age while Level IV contained remains from the Chalcolithic period (Fig. 2).

Settlement Remains of Earlier Periods – Prehistoric Cultural Level IV

At the mound, the cultural layers of this later period were located at the lower levels of the Bronze Age settlement, as well as outside – that is to the west – of the 2nd millennium BC fortification wall. To the west of the mound, beneath Level II, red and burnt mudbrick deposits characterise the beginnings of the Early Bronze Age and earlier periods. Level III could be clearly traced because

2 Günel 2008b, 133, fig. 7.

3 Günel 2006, 20, plan 1; Günel 2008a, 80, plan 5; Günel 2008b, 131, fig. 3; Günel 2009, 229, fig. 4.

4 Günel 2010, 25–49; Günel 2011a, 217–232, figs. 2–11; Günel 2011b, 69–80; Günel, in print.

I	1		**Classical Period**
	2		**Carian-Geometric Period**
II	1	a	**Late Bronze Age**
		b	
II	2	a	**Middle Bronze Age**
		b	
III			**Early Bronze Age**
IV			**Chalcolithic / Late Neolithic**

Fig. 2 Stratigraphic development of the mound.

the remains of a rectilinear building were well preserved (Fig. 3; building 1). The foundations of the northern and eastern walls of this building were constructed using large stones. The walls, which are 70cm thick, were built with the larger stones set on the faces of the wall, while smaller ones were placed in between. The preserved section of the northern wall is 6.50m long. So far, only a length of 12m of the eastern wall of the structure has been uncovered. The dimensions of this structure and the thickness of its walls suggest a substantial building. A dark grey slipped, burnished jug fragment recovered from this building probably belongs to a beak-spouted jug and is Early Bronze Age in date. The Early Bronze Age pottery wares from this area are characterised

Fig. 3 The excavated area with Early Bronze Age and Chalcolithic remains; Building 1 from Level IV.

Fig. 4 Pottery and grindings stone in the southeastern area of the building from Level IV.

Fig. 5 Detail of the southeastern area of the building from Level IV.

by burnished red and dark grey slips. Among the finds, decorated spindle whorls, a lid, and several blades and stone axes were also recovered from the same deposit.

Burnt mudbrick fragments from the early phases of this building clearly demonstrate a destruction caused by fire. Inside the building, the presence of fragments of various pottery types, jars and grinding stones point to the domestic character of the structure (Figs. 4–5). Ceramics from these earlier deposits belong to a different ware group and represent pottery belonging to an earlier period than the beginning of the Early Bronze Age. The bowls belong to fine and medium-fine red, reddish-brown and grey wares (Pl. 1A). Vessels also have either knobbed, horned handles or handles decorated with incisions and encrustation (Pl. 1). Decorated handles are frequently observed. Bowl handles with knobs were recovered in great quantities within these deposits (Pl. 1B). This structure (Building 1), which belongs to Levels III and IV, must date to the transitional period from the Chalcolithic to the Early Bronze Age. Remains from even earlier periods continue to the north and northwestern sections of the building. Among the ceramics, bowl and handle shapes correspond to the local pottery tradition of Tepecik. Various types of decorated handles can also be seen within the pottery repertoire. 'Cheese pots' have a wide geographic distribution during this period and some examples from Tepecik have lugs with relief decorations, some resembling snakes. In this context, amongst the medium-fine pattern burnished pottery, motifs such as oblique lines, crosshatching and zig-zags are common (Pl. 2). A burnish pattern consisting of parallel diagonal lines was applied either on the interior or exterior surface of the vessels. Grey ware bowl fragments with crosshatched lines on panels have been documented (Pl. 2A). The crosshatched motif on vessels is among the most popular decorative elements during this time (Level IV). In addition to pottery, lithics such as flint blades and points are also among the finds. To the south of this area, remains of a mud-brick floor and the pottery assemblage reflect similar cultural traits. A redware pattern burnished jar with horned handles (Pl. 3) and a terracotta loom weight were recovered from this mudbrick floor. Around the mudbrick remains were obsidian and flint blades as well as bone tools belonging to the same cultural phase suggesting the Chalcolithic settlement extended towards the south (Pl. 4A–B).

This early settlement on the mound also extends towards the west outside the 2nd millennium BC fortification wall. Within this area, associated with the deposit of severely burnt soil, wall fragments, – not sufficiently preserved to provide a plan – were uncovered (Figs. 6–7). These walls, which probably belonged to a single structure, were constructed forming two rows of stones. The walls measure 34cm and 46cm in thickness. Immediately on either side of the structure there are architectural remains in a circular plan. These buildings measure 1.12m north-south and 1.20m east-west respectively. Some of the stones used in their construction were placed vertically. Jar fragments and grinding stones were situated between the stones walls. Among the pottery recovered from the circular structure and fragmentary walls, were grey wares decorated with pattern burnish on the interior surface, with crosshatched lines in panels and a dark grey burnished bowl with horizontal arched handles on the rim, as well as grey ware jars with handles (Pl. 5A–B). In addition to the grey and red ware, bowl fragments with pattern burnishing on the interior surface display the characteristic form and decorative style of the earlier part of the Chalcolithic period. Motifs such as crosshatching are well known in both western Anatolia and the Aegean cultures during this time. The shapes, as well as the motifs, correspond to the pattern burnished pottery tradition of the western Anatolian coastal region. From the same area come pottery fragments decorated with parallel grooved diagonal lines and semicircles on the body of the vessel, and fragments with an incised decoration. Furthermore, a wide variety of textile/mat impressions are displayed on the bases of vessels from Tepecik, also observed on similar contemporary vessels from the surrounding cultural regions. Other finds from the same level include stone axes, lithic finds consisting mostly of obsidian and flint blades, as well as points, borers and flakes (Fig. 8). The number of obsidian and bone tools increases considerably at these levels. The early settlement also yielded marble figurines and vessels (Pls. 6–11). These finds suggest that the architectural remains, as well as the adjoining areas, must have served a domestic purpose.

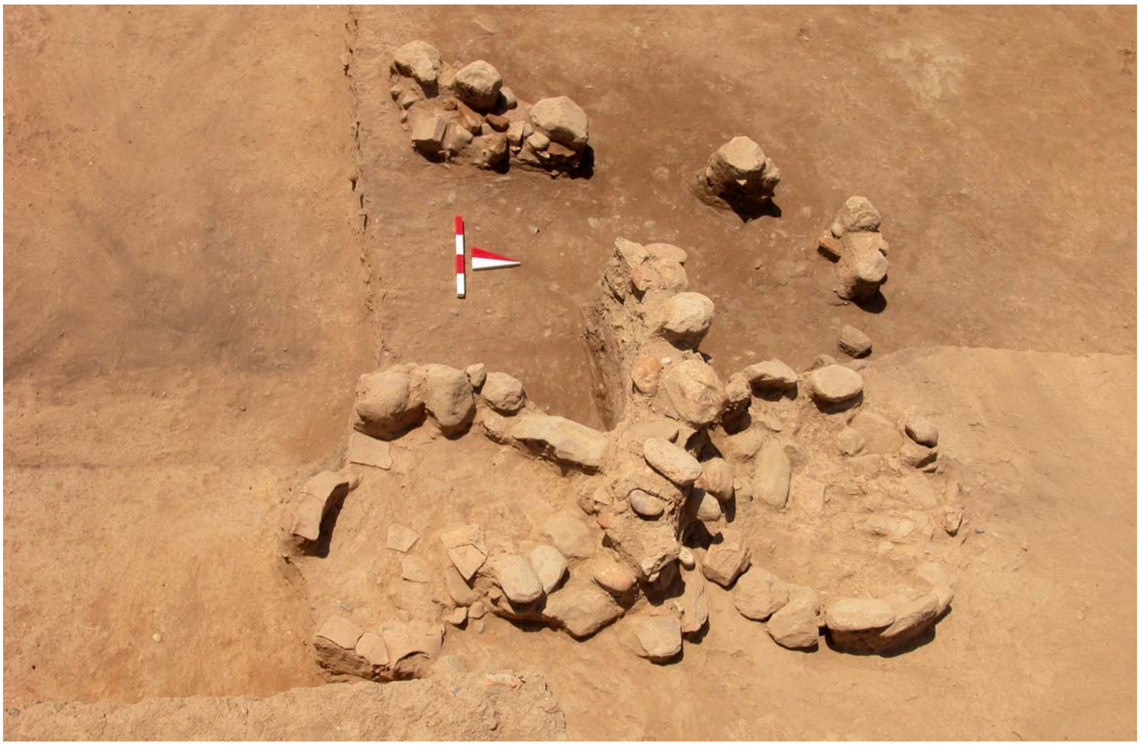

Fig. 6 Architectural remains from Level IV.

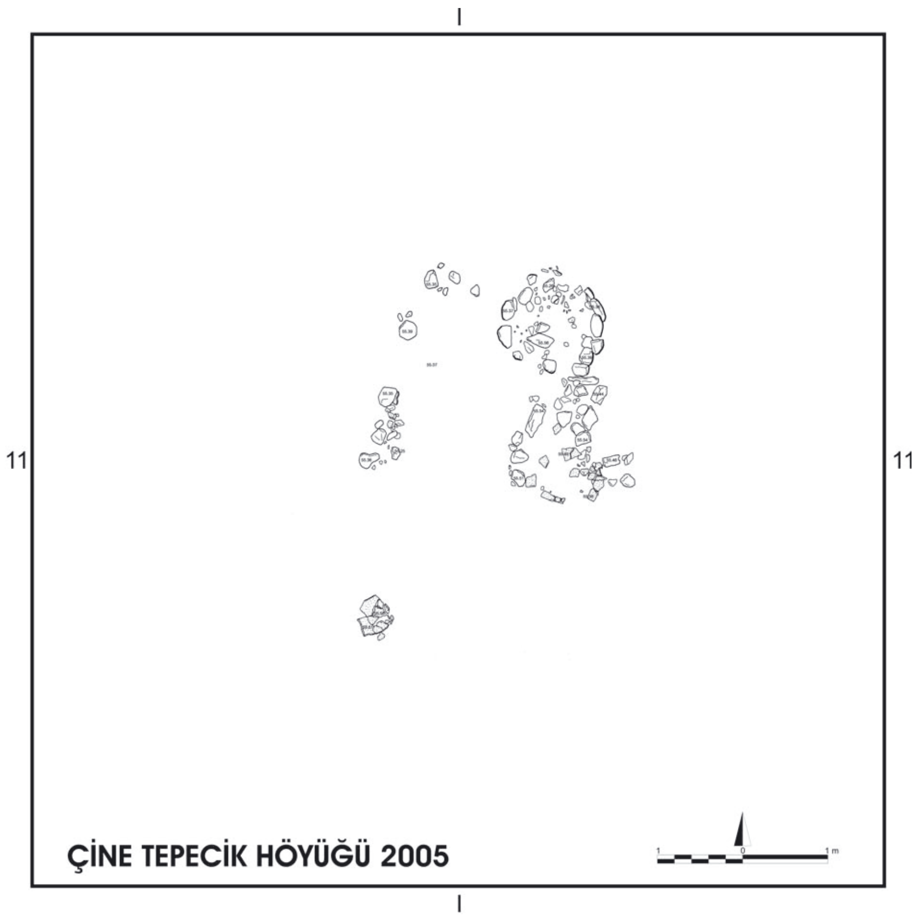

Fig. 7 Plan of architectural remains from Level IV.

Cultural Relationships and Chronological Definition according to the Findings

Local Pottery Styles

The local pottery styles revealed in the finds from Level IV, with regard to material, technique and form, are distributed widely in the Meander region and over the entirety of western Anatolia. Regarding the Chalcolithic pottery, the best parallels to the grey pattern burnished bowls, in terms of both form and decoration (crosshatched motifs placed in panels at regular intervals on the interior of the bowls) come from Gülpınar,[5] Beşik-Sivritepe,[6] Kumtepe IA,[7] Malkayası Mağarası,[8] Samos-Tigani,[9] and Kalymnos-Vathy III.[10] From Gülpınar,[11] Beşik-Sivritepe,[12] Tigani III,[13] and Kephala[14] parallel diagonal lines and zig-zags are also known. Additionally, horned handles appear among the handle forms of Tigani I/II,[15] Chios-Emporio X–VIII,[16] Gülpınar,[17] Beşik-Sivritepe,[18] Hanaytepe,[19] and Aşağı Pınar.[20] The characteristic Tepecik handle type in this cultural level are bowl handles with knobs. This type of handle is also present at Gülpınar.[21] Chronologically, Tigani II is contemporary with Emporio IX, Gülpınar, Beşik-Sivritepe and the period before Kumtepe IA, while Tigani III is contemporary with Emporio VIII, Kumtepe IB and Beycesultan LCH 1–2, and Tigani IV is parallel with Emporio VII, Kumtepe IB (late) and Beycesultan LCH 3.[22] However, another pottery based chronology exists for the Troad region.[23]

In light of these results, the examples reflect a pottery tradition in Tepecik belonging to the Middle Chalcolithic period. In terms of pottery these are contemporary with the surrounding cultures represented by Gülpınar, Beşik-Sivritepe, Kumtepe IA and Liman Tepe in western Anatolia and Tigani II/III, Emporio IX–VIII on the Aegean islands, as well as the Aşağı Pınar 2/3 Late Neolithic and 4/5 Middle Neolithic transitional periods in Thrace. On the other hand, they also represent a culture that covers periods earlier than the Late Chalcolithic of Beycesultan. The pattern burnished pottery from Tepecik is comparable to that from different areas. This assessment demonstrates the relation of Tepecik to the eastern Aegean islands as well as to Thrace in the north. In this respect, the motifs seen on the vessels reflect the decorative tradition of the Middle Chalcolithic periods in a chronological development similar to the pottery repertoire of western Anatolia and the Aegean.

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5 Takaoğlu 2006, 298, 305, fig. 10/26.
6 Lamb 1932, 127, fig. 13/5.
7 Korfmann 1996, 51, fig. 44/1.
8 Peschlow-Bindokat 2006, 85, fig. 82/a–b.
9 There are grey, pattern burnished bowls with similar forms and motifs in Tigani II and III–IV. See Tigani II: Felsch 1988, 49, pls. 19.5; 57.143; Tigani III: Felsch 1988, 56, 168–169, pls. 27.1–2; 62.255; Tigani IV: Felsch 1988, 65, 68, 185, 191, pls. 38.4–5; 41.3; 68.367–368; 71.435–437.
10 Benzi 2008, 88, 92–93, fig. 20.
11 Takaoğlu 2006, 298, fig. 10.24–29; Kiyak et al. 2010, 38, fig. 3.
12 Lamb 1932, 127, fig. 13.
13 Felsch 1988, 51, 60, 165–166, 175–176, 183, pls. 32.5; 37.1, 4; 62.233–234; 64.291, 295; 67.350–351.
14 Coleman 1977, 81, 107, pls. 40–43.
15 Felsch 1988, 207, pl. 79.4b–c.
16 Hood 1981/1982, 271, 286, fig. 128.225, 135, pl. 37.335–337.
17 Seeher 1987, 542, fig. 6.6–7; Takaoğlu 2006, 295, figs. 6.13–14; 8.
18 Lamb 1932, 127, fig. 14.3.
19 Lamb 1932, 116, fig. 2.17.
20 Parzinger – Schwarzberg 2005 fig. 15, pl. 5.
21 Takaoğlu 2006, 295, fig. 6.1–4.
22 Felsch 1988, 72–95, tab. 2.
23 Korfmann – Kromer 1993, 139–169.

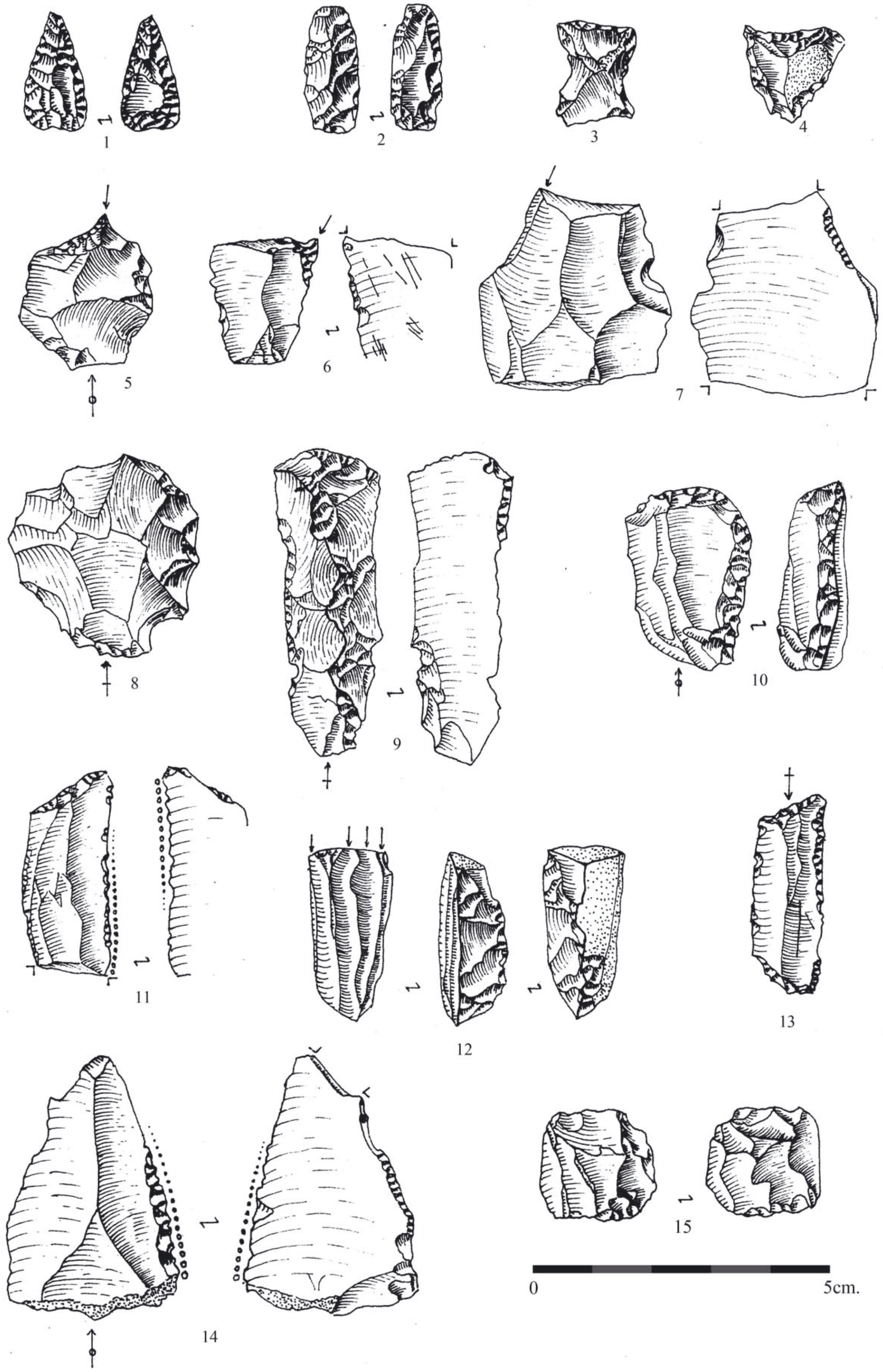

Fig. 8 Lithics tools; obsidian and flint (description and drawings of lithics tools made by Dr Beray Kösem).

Manufacture of Lithics

In addition to pottery, obsidian and flint were used in the manufacture of lithic artefacts (Fig. 8). The tools of the Tepecik chipped stone industry primarily comprise of arrow heads (Fig. 8/1–3), borers, mostly micro-borers (Fig. 8/4–6), burins (Fig. 8/7), small-notched tools and denticulates (Fig. 8/8), end scrapers (Fig. 8/9–10), sickle elements (Fig. 8/11, 14) retouched or truncated flakes and blades (Figs. 8/13). Artifacts defined as 'piéce esquillee' have also been found in considerable numbers (Fig. 8/15).[24]

Marble Figurines

Among the early period marble figurines are examples with different head and face details (Pls. 6–10). These figurines are commonly known as 'Kiliya type figurines',[25] and their chronological range, areas of production and importance have been considerably discussed. These figurines are found on the western coast as well as in the central-western part of Anatolia; their geographic distribution reaches as far as the south. Besides the Eceabat-Kiliya bay on the Gelibolu peninsula, this type of figurine is found throughout the geographical region stretching from the northwest southward including Troy, Beşik-Yassıtepe and Hanaytepe, to the Akhisar region with Papazköy, Yortan, Alaağaç and Selendi, towards the south with Alaşehir-Gavurtepe, the mound of Aphrodisias-Pekmez,[26] and to southern Anatolia with Karain Mağarası[27] and Kozağacı.[28] An example of a surface find is currently curated at the Lesbos-Mytilene museum in the Aegean.[29] The Kırşehir finds and the other Kiliya figurines belong to private collections.[30]

Time period and place of production of the Kiliya figurines has become an interesting topic of archaeological research. Data, which has cast light on the production of this type of figurine, were recovered through research realized in central-western Anatolia. One group of marble figurines in the Manisa museum played an important role in drawing attention to the village of Kulaksızlar (Manisa province, district of Akhisar).[31] Archaeological research conducted within the villages of Kulaksızlar and Harmandalı has shed light on the figurines' manufacture. At Kulaksızlar an artist's workshop was discovered.[32] In particular, the presence of marble vessel fragments suggests that not only figurines but also marble vessels were produced.[33]

Marble working has played an important role in discussions related to the production of the Kiliya figurines as well as their distribution patterns. New examples of Kiliya marble figurines from Tepecik have enlightened researchers about the distribution area south of the Meander. Head and body marble figurines belonging to the Chalcolithic of Çine-Tepecik feature Kiliya type figurines characterized by large heads, contrasting flat bodies and delicate cylindrical necks. From the Tepecik examples, two different head types are known. The first of these have surface detailing, and a head configuration that widens from a long, slim neck into a triangle and rounded on top. The surface treatment constitutes a nose in the form of a vertical relief while the eyes are depicted with small, round reliefs (Pls. 6–7). It resembles the figurine obtained from Gelibolu-Kiliya with respect to the nose and eye details, as well as the rear part of the head.[34] Furthermore,

24 Description made by Dr. Beray Kösem.
25 Schmidt 1902, 282, no. 7643; Caskey 1972, 192–193, pl. 44.
26 Kadish 1971, 129, fig. 8.1598a, 3; 1598e, 5; Joukowsky 1986, 206–208.
27 Seeher 1988, 224, fig. 13.2.
28 For distribution area see Seeher 1992, 154–161; Takaoğlu 2002, 79–78, fig. 8; Takaoğlu 2005, 38, figs. 5, 17.
29 Evangelides 1927/1928, 19, fig. 10.
30 Seeher 1992, 159–162.
31 Dinç 1996, 11–12; Dinç 1997, 256–263.
32 Dinç 1996, 13–27; Takaoğlu 2001, 160–161; Takaoğlu 2005.
33 Dinç 1996, 12, figs. 2–9; Takaoğlu 2002, 72–78.
34 Seeher 1992, 154, fig. 2a.

its head and face details can be seen in one of the examples of the Kiliya figurines from Kırşehir.[35] The protrusion of these head and facial details of the Kiliya figurines is similar to the typical head conception of early Cycladic figurines, with respect to the long neck and workmanship of the nose, and in some examples, also the eye and mouth details.[36] It is possible to extrapolate a mode of cultural interaction and connections in ways of thinking. Another type of head found among the Tepecik figurines carries a basic head design and an oval head form (Pls. 8–9). One of the examples exhibits diversity in workmanship, having a face with a distinctive bulge on the forehead (Pl. 8). In contrast, in both cases the nose is again depicted with a vertical relief. Of the two Tepecik figurine heads, the flat and oval head pattern in particular depicts the ears through bulges with concave workmanship at the rear of the head, similar to those found at Yortan-Alaağaç.[37] The second Tepecik head type is similar to the head forms observed at Alaşehir-Gavurtepe.[38]

Distinctive marble figurine body designs were also found at Tepecik (Pl. 10). On the body, just beneath the neck, there is a hole. One of the arms belonging to the figurine has been preserved. The arm has a wing feature that is bent at the elbow and placed over the breast. The workmanship of the arms, along with the flat bodies, is similar to other Kiliya type figurines. The breasts are depicted through very slight round reliefs. The body of the Tepecik figurine is similar to those from Papazköy,[39] the N. Schimmel Collection from Kırşehir,[40] Elmalı-Kozağacı[41] and Level VIII A of the late Chalcolithic I from Pekmez Mound.[42] An example in the shape of a seashell pendant from Can Hasan 2 A belongs to the Chalcolithic period as well.[43] A similar example is present among the bone finds from Tigani III.[44] The Can Hasan and Tigani pendants are made of different materials but in a similar style, and draw attention with their holes on the upper brim, from which they are hung. On the other hand, it is possible to follow up with other examples in the Balkan region, which exhibit diversity in detail but are reminiscent of the Can Hasan and Tigani examples in form.[45]

Interpretations concerning the chronology of the Kiliya figurines, especially taking into account the contexts in which some of the figurines were found, indicate that they are part of the chronologic development extending from the Late Chalcolithic Age to the beginning of the Early Bronze Age. Among this group, the Yortan example was obtained from an Early Bronze Age tomb.[46] Meanwhile, the artifact from Beşik-Yassıtepe, believed to be a Kiliya figurine, most likely belongs to the Chalcolithic.[47] Furthermore, the fragment found in Phase II of the Karain Mağarası, and of which only the nose and a part of the neck are partly preserved, is considered to be part of a Chalcolithic layer.[48] The figurines obtained from the VIII A layer of the Aphrodisias-Pekmez mound are dated to the late Chalcolithic Age.[49] The stratigraphic development of the Kiliya type figurines found at Tepecik, which lies west of Aphrodisias, allows a more sound age determination.

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35 Seeher 1992, 161, fig. 1.
36 Thimme 1975, 7–14; Fellmann 1981, 8–20; Tzonou-Herbst 2010, fig. 16.1.
37 Dinç 1995, 94–95, pl. 6b.
38 Meriç 1989, 158, fig. 6.
39 Seeher 1992,158, fig. 2c.
40 Seeher 1992, 161, fig. 2b.
41 Ormerod 1909/1910, 105, pl. 7.18–19.
42 Joukowsky 1986, 526, 532, figs. 379.31; 385.47.
43 French 1963, 34–35, pl. 2d.
44 Felsch 1988, 220, pls. 46/8; 85/5, 12.
45 Parallel figurines in terms of form can be seen in the Balkan region. In the Varna tombs belonging to the Karanovo VI Culture, bone and marble figurines belonging to this type are also known to exist (Seeher 1992, 169, fig. 10d; Ivanov – Avramova 2000, tomb no. 1/23, 3, 11), as well as in the Pietrele-Gumelniţa Culture (Dumitrescu 1924, 337, fig. 10.1; Berciu 1967, 60, fig. 18.2) and that of the Renie (Morintz – Roman 1968, 55, fig. 5.5).
46 Kamil 1982, 20, fig. 84, 292; Seeher 1992, 158, 163.
47 Mellink 1984, 446, fig. 3; Korfmann 1985, fig. 8: LL83.23; Seeher 1992, 163.
48 Seeher 1988, 224.
49 Kadish 1971, 129; Joukowsky 1986, 219–221, 526, 532.

The Tepecik examples presented here belong to the Chalcolithic period. A reevaluation of the distribution of the Kiliya type figurines that includes those from Çine is required.

Marble Vessel Fragment

A marble vessel fragment is also among the finds. It has a conical body form which expands from the bottom (Pl. 11). The conical fragment is similar to examples from Kumtepe I C,[50] Hanaytepe,[51] Beşik-Sivritepe,[52] Gülpınar[53] in the northwestern region, and from Demircihöyük[54] in the inner western region. In the coastal region marble conical vessels, dated to the Early/Middle Chalcolithic, are known from Urla-Liman Tepe.[55] The tradition of conical marble vessels in the Aegean has a chronology extending to the end of the Neolithic in one of the Cycladic islands, Keos-Kephala.[56] The marble rython, found as a grave good in Kephala, has a pointed bottom, conical body and vertical handle.[57] Regarding the marble type and colour it is thought to have been produced in Kulaksızlar due to its production technique, dimensions and different vertical handle layout.[58] Apart from the conical marble cup dated to the Tigani II–III phases, the other marble vessel fragment from Tigani IV phase, on which only the rim and the vertical handle are protected, runs parallel to the Kephala example based on the handle layout.[59] Naxos[60] and Lemnos-Koukonesi[61] are within the distribution zone of the conical stone vessels.

At Tepecik, the remains of Level IV represent the tradition of decorated pottery, bone and stone tools and the chipped stone industry of the Chalcolithic Age in western Anatolia, providing extremely rich material. These assemblages reveal a chronology parallel with the culture of the Middle Chalcolithic period (in the Aegean chronology Late Neolithic).[62]

Conclusions

According to finds from the Tepecik excavations thus far, the earliest settlement has domestic features dating to the Chalcolithic period. The artifacts within the architecture indicate that the earliest settlement is associated with domestic practices. The pottery among the finds reveals an advanced local ceramic tradition. The bowl and jug decoration tradition is understood to have been widespread. The burnished, encrusted and incised decoration has a very rich motif repertoire. Such decoration has been observed not only on the bodies of vessels but also on the handles. Decorated handles are remarkably common among the vessel repertoire. Apart from the material-technique features, decoration styles also play an important role in the chronological discernment. Tepecik pottery tradition runs parallel along a chronology with both the Early/Middle Chalcolithic cultures of western Anatolia and the Late Neolithic cultures of the Aegean world. Sickle blades make up a high percentage of the lithic assemblage at Tepecik. This density indicates that the Tepecik people's economy was based on agriculture. Ground stones, bone tools, and marble vessels and figurines make up the finds of the earliest period of Tepecik. Among these, marble vessels and figurines have

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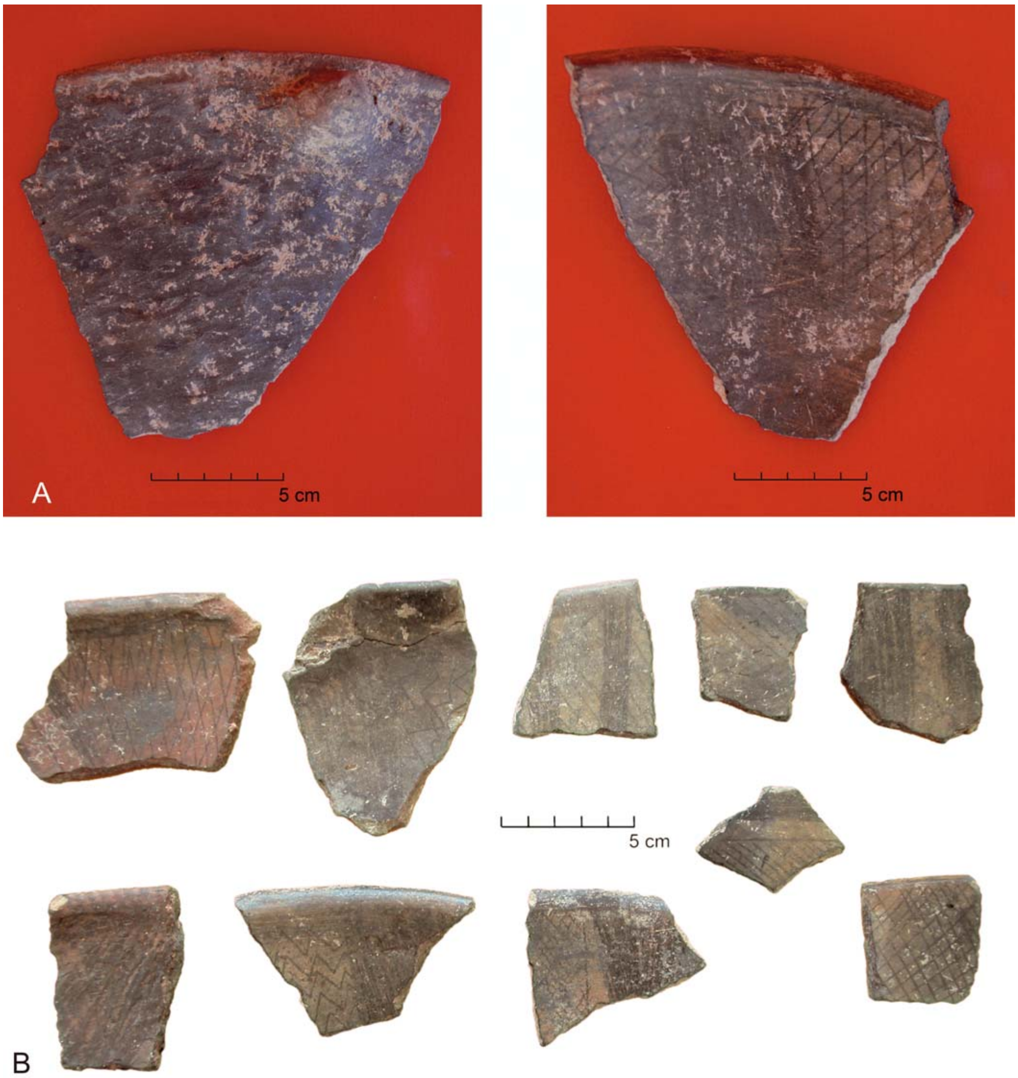
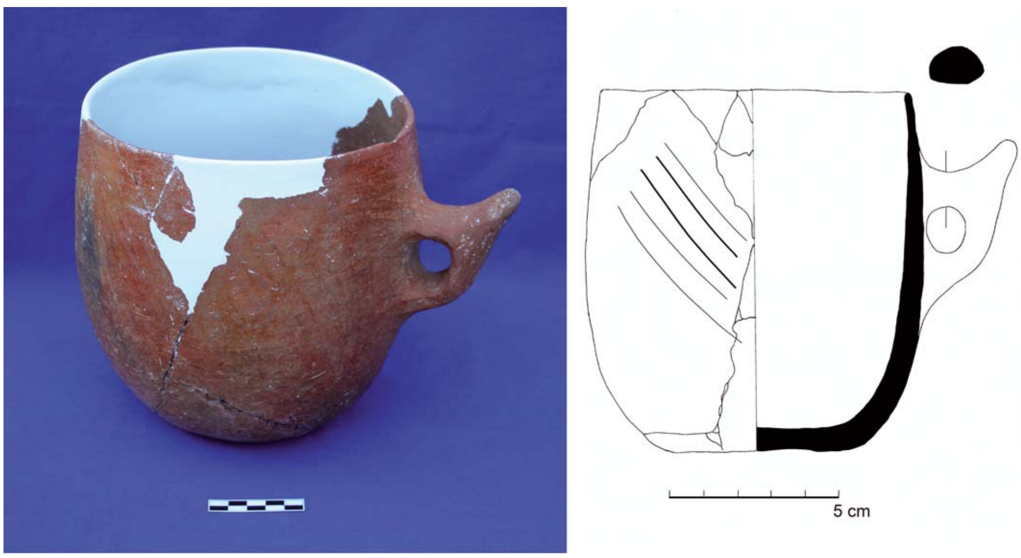
50 Sperling 1976, 354, pls. 70, 830.
51 Takaoğlu 2011, 161.
52 Takaoğlu 2006, 309.
53 Takaoğlu 2006, 309, fig. 14.
54 Efe 1988, 79, pl. 37.
55 Şahoğlu 2011, 282, 376, cat. 174–175; Takaoğlu 2011, 161.
56 Sotirakopoulou 2008, 537, fig. 2; Renfrew 2010, 86.
57 Coleman 1977, 64, 108, pls. 23.103, 109; 67.103, 109; Stampolidis – Sotirakopoulou 2011, 30, fig. 4.
58 Takaoğlu 2005, 37.
59 Felsch 1988, 221–222, pl. 75.V23, V26.
60 Getz-Gentle 1996, 52, 54, figs. 29–30, pl. 22; Takaoğlu 2005, 37.
61 Takaoğlu 2005, 37; Sotirakopoulou 2008, 537.
62 Günel 2006, 20–21; Günel 2008b, 136–138.

parallels with western Anatolian and Aegean examples. This evidence sheds light on the diffusion sphere of Chalcolithic culture, one that extends into Tepecik, and the Menderes region. Finally, the early settlement in Tepecik has made an important contribution to the regional archaeology, especially the chronological definition of the Chalcolithic culture in western Anatolia. Due to its favourable position in the southern area of western Anatolia, Çine-Tepecik is interpreted as a new centre located between the Aegean and central Anatolian regions during the Chalcolithic.

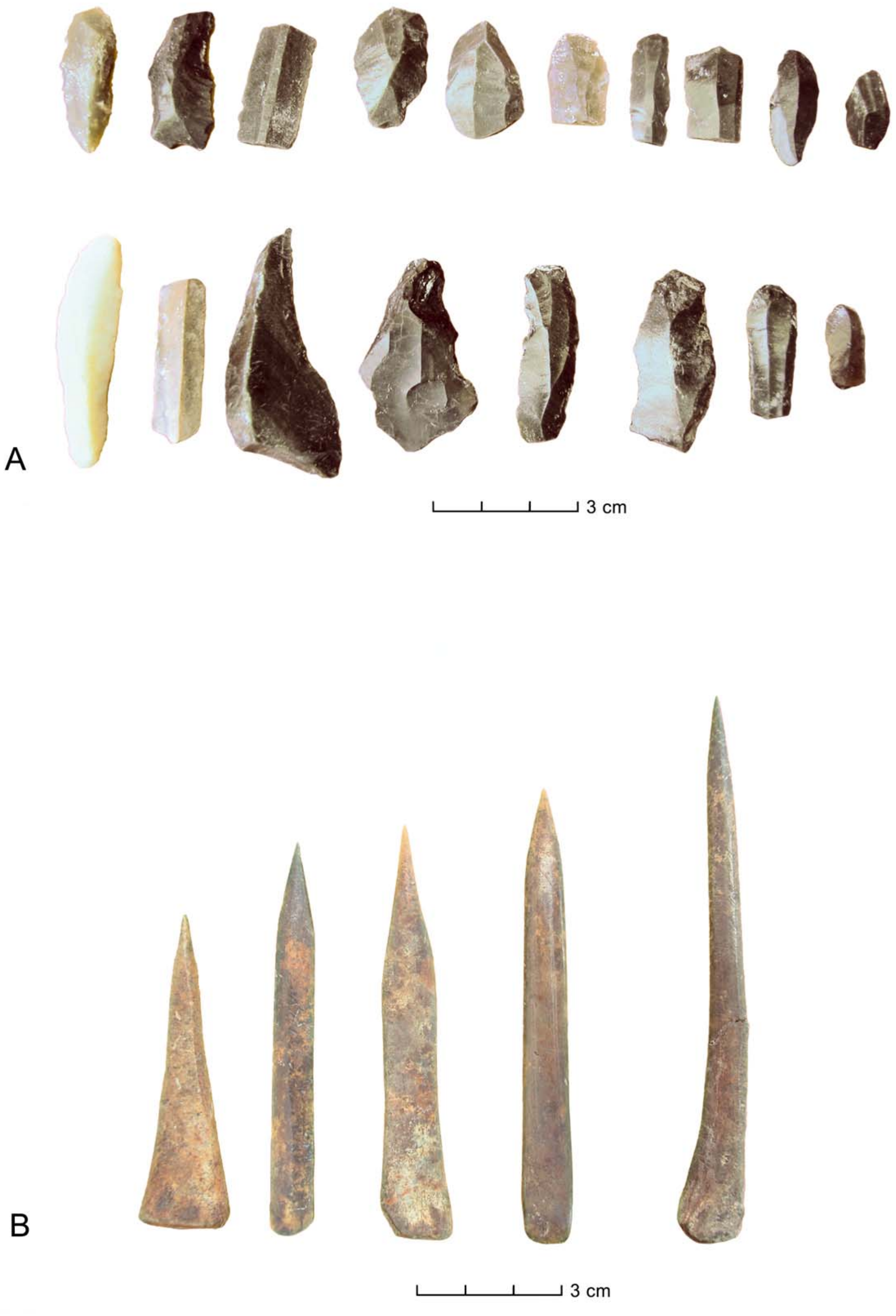
Pl. 1 A. Grey and redware bowl fragments and handles;
B. Handles with knobbed, horned, incisions and encrustation.



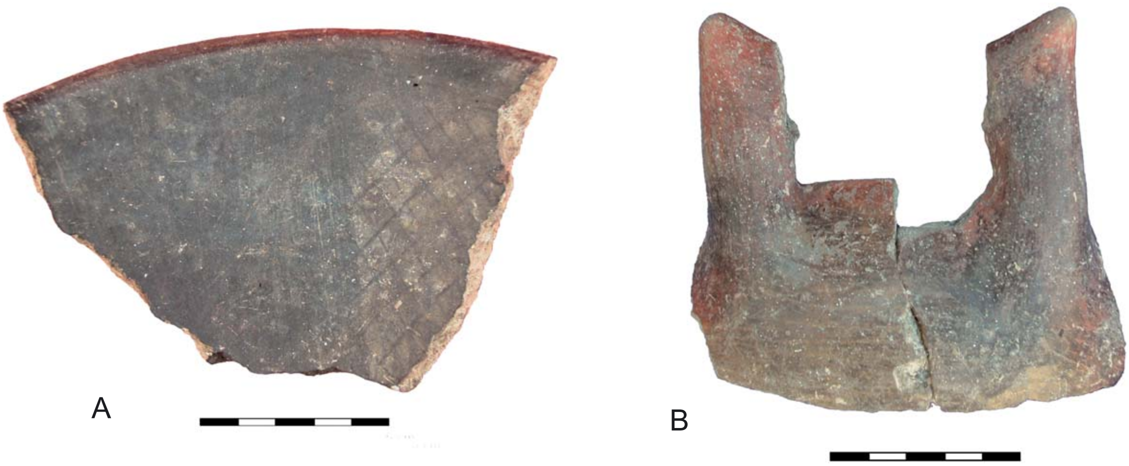
Pl. 2 A. Sherd pertaining to a grey ware pattern burnished bowl with crosshatched lines;
B. Pattern burnished pottery with zig-zag, crosshatched and diagonal lines.



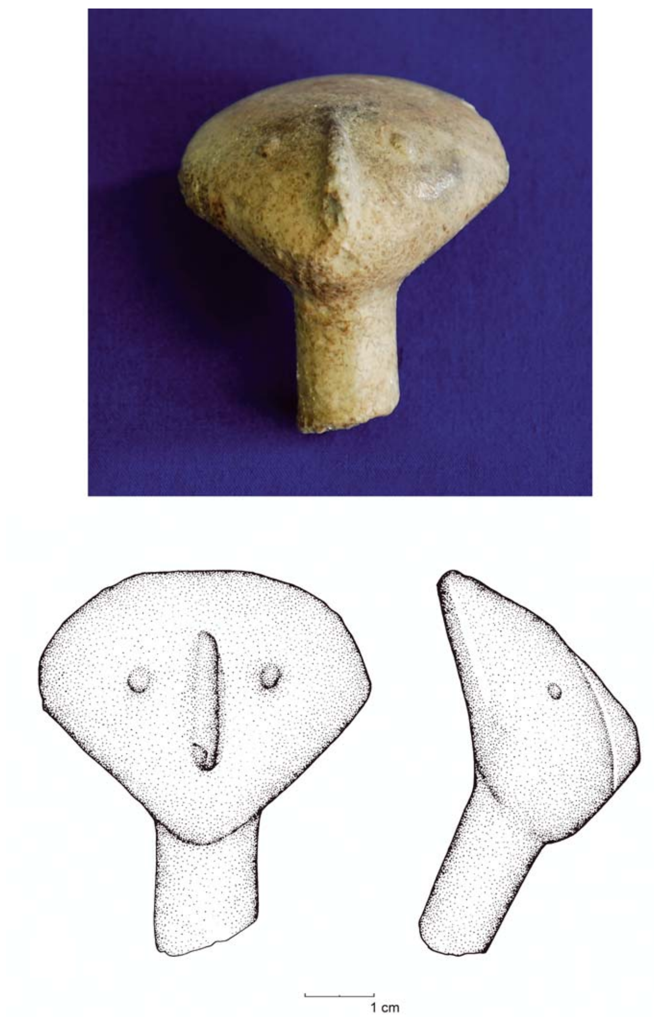
Pl. 3 Redware pattern burnished jar with diagonal lines.



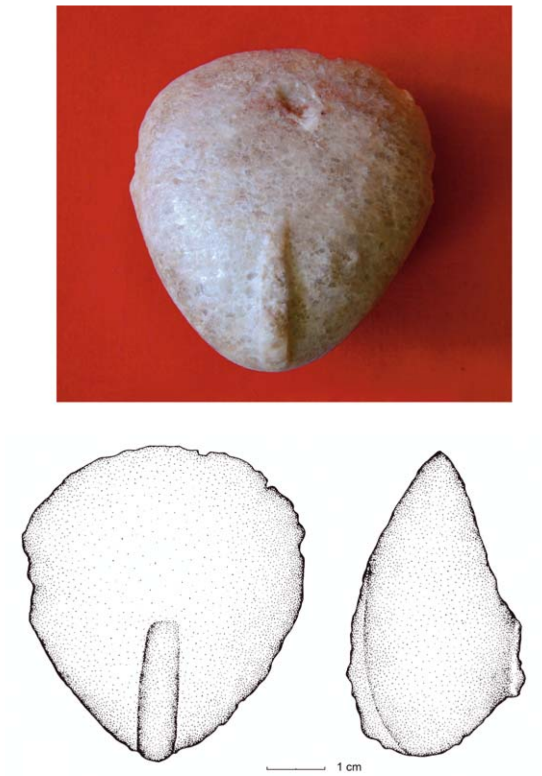
Pl. 4 A. Lithic tools; obsidian and flint; B. Bone tools.



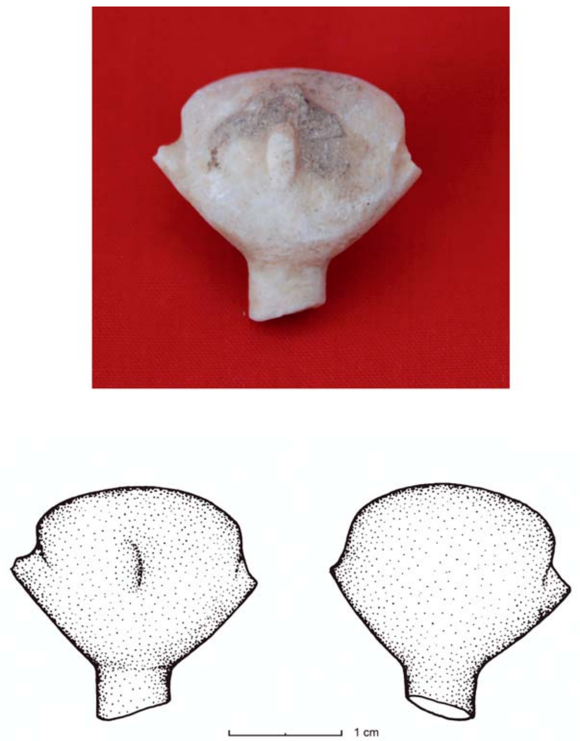
Pl. 5 A. Greyware pattern burnished bowl with crosshatched lines; B. Bowl with horizontal arched handle.



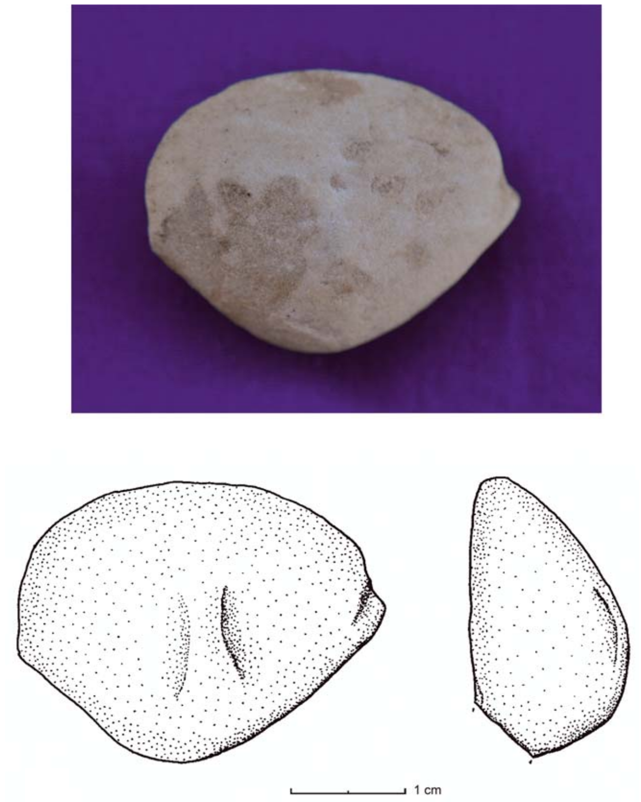
Pl. 6 Head of marble figurine, 'Kiliya type'; total length of head with neck: 4.94cm; length of head: 4.09cm; width of head: 4.53cm; total length of preserved neck part: 1.99cm; thickness of neck 1.43 × 1.14cm.



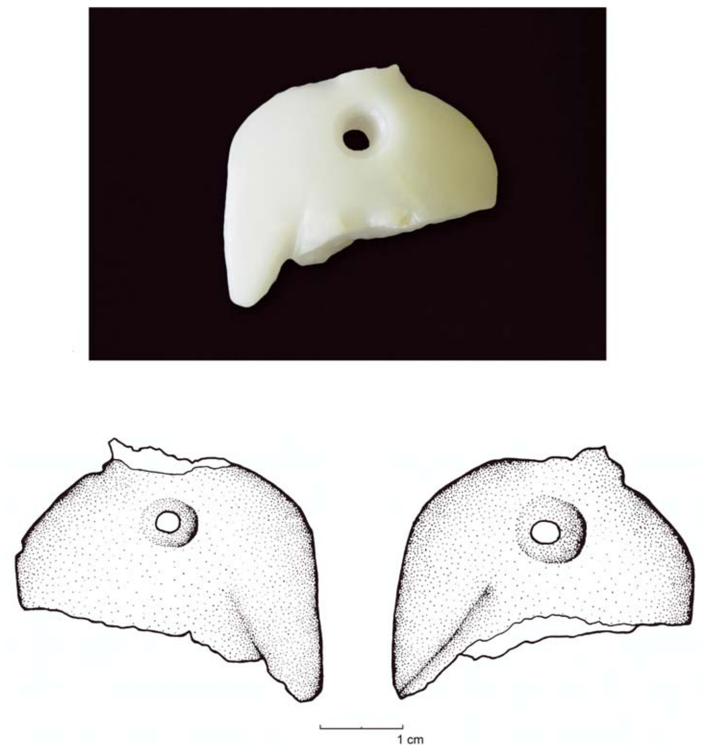
Pl. 7 Head of marble figurine, ‘Kiliya type’;
length of head: 5.04cm; width of head: 4.64cm; thickness of neck: 1.37 × 1.31cm.



Pl. 8 Head of marble figurine, ‘Kiliya type’;
total length of head with neck 2.52cm; length of head: 2.10cm; width of head: 2.31cm.



Pl. 9 Head of marble figurine, 'Kiliya type';
length of head: 1.62cm; width of head: 2.17cm; total length of neck fragment: 0.97cm; neck thickness: 0.95 × 0.85cm.



Pl. 10 Body of marble figure; 'Kiliya type';
fragment body length: 2.19cm; body width: 3.48cm; thickness: 0.82cm.

Pl. 11 A marble conical vessel fragment; length of sherd: 9.69 cm; thickness: 0.48–0.34cm.

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Iasos, the Carian Chalcolithic and its Relations with Northern Central Anatolia

Christoph Gerber[1]

Abstract: Research in prehistoric Caria (in the Latmos Mountains and in the Carian Chersonesos) led me to take a closer look at the prehistory of Iasos. The outset was the discovery of a marble vessel fragment almost identical with the examples of the necropolis of Iasos found on the Carian Chersonesos in a presumably Chalcolithic context. The prehistoric necropolis of Iasos was excavated in the 1960s and its pottery comparisons were published in great detail by the excavator D. Levi and in a 1984 monograph by P. E. Pecorella. The dating from Late Chalcolithic to the beginning of the EBA occurred in a time, when the settlement of central and western Anatolia seemed impossible before the beginning of the EBA. The 'Chalcolithic' in central Anatolia was termed 'EB Ia' by W. Orthmann in 1963 and placed at the very end of the 4th millennium BC. Likewise the 'Chalcolithic–EBA' terminology still used by Levi was classified as 'EBA 1–2' by Pecorella. Half a century later this scenario has changed fundamentally. The settlement of the Aegean eastern coast can be traced back to the Neolithic and in northern central Anatolia to the Early Chalcolithic. Earlier dates have to be reevaluated. Neolithic and (middle) Chalcolithic pottery are both present in Iasos, therefore, the evidence used to date the prehistoric necropolis to the Late Chalcolithic will be the main focus of this paper. Specifically, the dates of the beginning of the Cycladic culture and the gap between the Late Chalcolithic and the EBA levels at Beycesultan will be addressed. To a large extent, the material culture of Iasos belongs to the one known from the Cycladic Islands and to a lesser extent to that of Anatolia. The Carian Coast and the offshore Aegean Islands belong in the (middle) Chalcolithic to a very homogeneous culture (Latmos, Samos, Chios) that shows surprising links to northern central Anatolia (Alaca Höyük, Büyük Güllücek, İkiztepe). The most important of these will be presented and the dating of the references cited by Levi reevaluated. The contribution will close with a position on the implications of this interregional connection of the Carian Chalcolithic during the 5th and 4th millennia BC.

Keywords: Iasos, Chalcolithic period, settlement history, pottery assemblage, connections to Black Sea littoral

The excavations at Limantepe, west of Izmir, display the first evidence of important prehistoric settlements in the coastal region south of Troy and the Troas. However, it was only recently that several Neolithic and Chalcolithic sites in the vicinity of Izmir were excavated.[2] They illustrate that western coastal Anatolia was settled by at least the Late Neolithic/Early Chalcolithic.[3] Dedecik-Heybelitepe and Çukuriçi Höyük are two important sites located further to the south.[4] Dedecik-Heybelitepe was one the first Neolithic sites excavated in the region, while Çukuriçi is currently being excavated. All the mentioned sites have redefined our knowledge concerning the Neolithic and Chalcolithic periods in westernmost Anatolia – and are located north of ancient Caria.

The early settlement of Caria is still poorly understood. Researchers at Miletus and its hinterland were among the earliest to confirm the presence of settlement remains long before Greek occupation.[5] The first prehistoric excavation in Caria was conducted in Iasos by an Italian team

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1 Institut für Ur- und Frühgeschichte und Vorderasiatische Archäologie, Ruprechts-Karl-Universität Heidelberg (Institute of Prehistory and Early History and Near Eastern Archaeology, University of Heidelberg, Germany); e-mail: Christoph.gerber@zaw.uni-heidelberg.de.

2 Ulucak, Yeşilova Höyük, Ege Gübre: see reports in Özdoğan et al. 2012.

3 Terminology: the former 'Late Neolithic' is recently seen as 'Early Chalcolithic' along the Aegean coast, cf. Pecorella 1984 figs.16.4, 30–31; 17.46, 50; Schoop 2011, 150–152.

4 See the corresponding reports in Özdoğan et al. 2012; for Limantepe (and Baklatepe) see Şahoğlu 2008, 483–501.

5 Voigtländer, 1982, 30.

Fig. 1 Map of Caria with Chalcolithic sites (after Barrington, Atlas of the Greek and Roman World, Princeton 2000, pl. 61 – taken from A. Peschlow-Bindokat 2003).

under the direction of D. Levi in the 1960s.[6] Survey finds from Killiktepe in the vicinity of Miletus and Saplıadası were published by W. Voigtländer.[7] The discovery of the Latmian prehistoric rock paintings by A. Peschlow in 1994 led to new insights into the Carian Chalcolithic.[8] When I joined her team in the spring campaign of the year 2000, it became evident quite soon that there were not only isolated, single objects, but also early settlements. The discovery of the Malkayası Cave and the subsequent salvage excavation was pivotal for dating and understanding the early settlement of the Latmos range.[9] Malkayası yielded a shallow stratigraphy consisting of two levels related to the same period. The finds show that the main use of the cave should have occurred in a short period of occupation sometime during the middle Chalcolithic.[10] Nearly all of the surface finds from the Latmos range have very close counterparts with the material of Malkayası, indicating that this region must have been intensively settled during this period of the Chalcolithic. The closest comparison material is that of Kastro Tigani on Samos and Emporio on Chios.[11] Surprisingly no remnants were found from the Neolithic/Early Chalcolithic nor the Early Bronze Age.

W. Held surveyed the Hellenistic sites of Loryma (1995–2002) and Bybassos (since 2005) in the Carian Chersonesos at the very southern edge of Caria (Fig. 1). Prehistoric finds were recovered at both sites at the escarpments of rocky hills. The Acropolis of Loryma is situated at the easternmost end of a ridge where pottery sherds and obsidian fragments indicative of a settlement were found.[12] At Bybassos, the easternmost of the three rocky hills known as Oyuklu Tepe show traces of a Chalcolithic settlement.[13] Archaeological finds spilled down from its top included a fragment of a marble beaker with pierced lug-handles (Fig. 2A). A similar beaker was excavated in the prehistoric cemetery of Iasos (Fig. 2B). Taking into consideration the new excavation results mentioned above a reassessment of the date of the necropolis of Iasos and also of its prehistoric settlement seems appropriate.[14]

Iasos and the Carian Chalcolithic

The two beakers[15] – now in the Izmir Museum of Art and History – stay in a long tradition which shows a development from Chalcolithic slender pointed vessels to broad conical beakers in the Early Bronze Age (Pl. 1).[16] The exact chronology of this development is not settled so far, and the existence of 'intermediary' forms has to be proven. The fragment from Oyuklu Tepe seems to have an intermediary form: not pointed, but also not as broad as the examples dated to the EBA. This led to a reconsideration of the prehistoric necropolis of Iasos. P. Pecorella published it as 'prehistoric' and his Early Bronze Age date[17] was not contested and is still accepted.[18] The pottery from the necropolis may be divided into the following groups according to their quantity

6 Momigliano 2012, 6–12.
7 Voigtländer 1986, 613–667.
8 Peschlow-Bindokat 2003.
9 Peschlow 2006, 269–278.
10 Peschlow – Gerber 2012, 74–75.
11 Samos: Felsch 1988; Chios: Hood 1981.
12 Held 2003, 289–300.
13 Held et al. 2008, 365–380.
14 All the more, as very recently the volume on the Bronze Age of Iasos was published: Iasos IV Bronze Age Carian Iasos (Momigliano 2012), which was not available to me before the lecture given in Vienna. Consequently, this paper is an addition to this volume in respect to the Chalcolithic settlement of Iasos.
15 P. Pecorella 1984, fig. 10.65–66.
16 See Getz-Gentle 1996, figs. 23, 29.
17 Pecorella1986, 19–27.
18 See Momigliano 2012, 154 passim, but Momigliano generally refers to the early period as Late Chalcolithic/Early Bronze Age (10, 34, 37, 44, 143 passim).

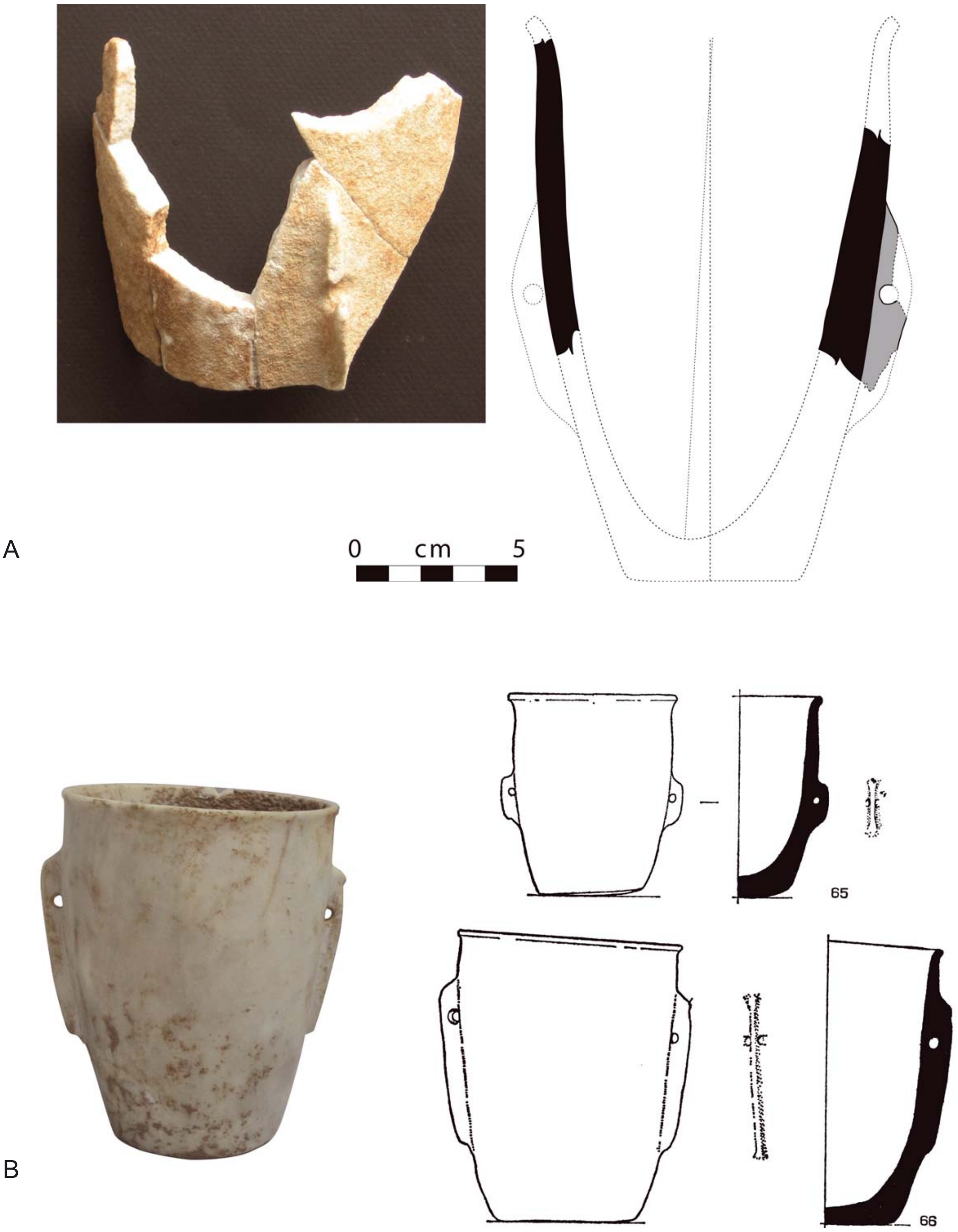

Fig. 2 Marble beakers; A Fragment from Bybassos – Oyuklu Tepe; B. from Iasos Necropolis, Tombs 19 and 81 (after Pecorella 1984, fig. 10) (photo: C. Gerber, in the Izmir Museum of Art and History).

(Pl. 2). Well represented forms are four-lugged jars with a globular body, a narrow neck and out-flaring opening (Pl. 2.1A); four-lugged jars with a squatted body, a high neck and relief decoration (Pl. 2/1B); long-spouted jugs with painted white decoration (Pl. 2.2); pots with one handle (Pl. 2.3); and cups (Pl. 2/4). Only in few examples are present (Pls. 3–4) bowls with a horizontal handle (Pl. 3.5); small globular *amphorae* (Pl. 3.6); three unique double-handled vessels (Pl. 3.7) and two tall beakers that resemble the marble beakers and are obviously pottery copies of them (Pl. 3.8).

D. Levi published the preliminary reports in the 'Annuario della Scuola Archeologica di Atene e delle Missione Italiane in Oriente' between 1963–1972.[19] In the first report, he lists many comparisons which range from the Aegean and Cretan 'Neolithic' to Troy II without subdividing them into periods. The closest links for the four-lugged jars are from Samos, Chios and the Dodecanese. According to western Anatolian terminology, these sites date to the Chalcolithic. Coastal sites such as Kumtepe and Beşiktepe, but also central Anatolian settlements, e.g. Alaca Höyük and Büyük Güllücek are now known to date to the Chalcolithic Period. Levi refers to the latter site as 'earliest Early Bronze Age'. This very point will be discussed later. Thus, Levi lists comparisons from the Aegean 'Neolithic' to the Anatolian Early Bronze Age II without going into detailed dating of the assemblage. Pecorella in his summary of the chronology, on the other hand, refers almost exclusively to the 'Early Bronze Age', and in a separate contribution he addresses only the 'Third Millennium'.[20] Of course, typical Late Chalcolithic manifestations like the white painting are known to last until at least the middle of the Early Bronze Age. However, this should not be invoked for a dating of the whole assemblage just to the EBA.

Most of the comparisons made by Pecorella point to the Aegean, this is not surprising because, in the 1960s when the necropolis was excavated, virtually no prehistoric sites in southwestern Turkey were known. Since the publication of Pecorella in 1984, new excavations and research have significantly changed our knowledge of the early periods in western Anatolia. Although a complete stratigraphic sequence for this region for the Chalcolithic period is still missing, we can observe different phases with their own stratigraphy: 1. the 'Late Chalcolithic' (LC1–4) from Beycesultan;[21] 2. the 'Late Chalcolithic' (LC1–4) from Aphrodisias – Pekmez;[22] 3. the 'Late Chalcolithic' (levels 6–3) from Kuruçay;[23] and 4. different Chalcolithic phases at Emporio on Chios (X–VI) and – without stratigraphy – Tigani on Samos (IV–I).[24]

How the main sequences from Beycesultan and Aphrodisias-Pekmez should be correlated, is still a matter of discussion. The four phases LC 1–4 from Beycesultan are often equated with LC 1–4 from Pekmez.[25] A diagram (Fig. 3) shows how the phases at both sites are represented by levels. Compare the short phases of Aphrodisias LC2 and LC3 with one rebuilding level and the single level of phase LC4 – all of which seem to be in architectural continuity as expressed in the assignment to period VII – with the much longer 'duration' represented in several burnt levels and many reconstructions in each phase at Beycesultan. This should be a caveat to correlate both stratigraphies one-to-one. Additionally, we do not know what happened between this 'Late Chalcolithic' and the 'Early Bronze Age'. In Beycesultan, there is evidently a larger settlement gap in the stratigraphy (Fig. 4) until the terracing of the mound at the beginning of the 'Early Bronze Age'. Level 20 is assigned to the Late Chalcolithic by the excavators,[26] but it should correspond to the Early Bronze Age levelling of the mound prior to the construction of level 19.[27] At levels 21 and 22 just underneath this terracing, are several slope deposits identified as burials. This example demonstrates just how incomplete our stratigraphies are in spite of the apparent continuity suggested by the terminology of 'Late Chalcolithic' and the following 'Early Bronze Age'. Accordingly, it should not be surprising that the Late Chalcolithic sequence of Kuruçay is dated by

19 Levi (1963; 1967, 529–546; 1972, 530–532). Indicated are the pages of the section referring to the prehistoric period.
20 Pecorella 1986.
21 Lloyd – Mellaart 1962.
22 Joukowsky 1986.
23 Duru 1996.
24 Hood 1981; Felsch 1988.
25 Cf. Joukowsky 1986, 476, tab. 139.
26 Lloyd – Mellaart 1962, 26.
27 Cf. Schoop 2005, 150, note 162: citing Seeher 1987, 59.

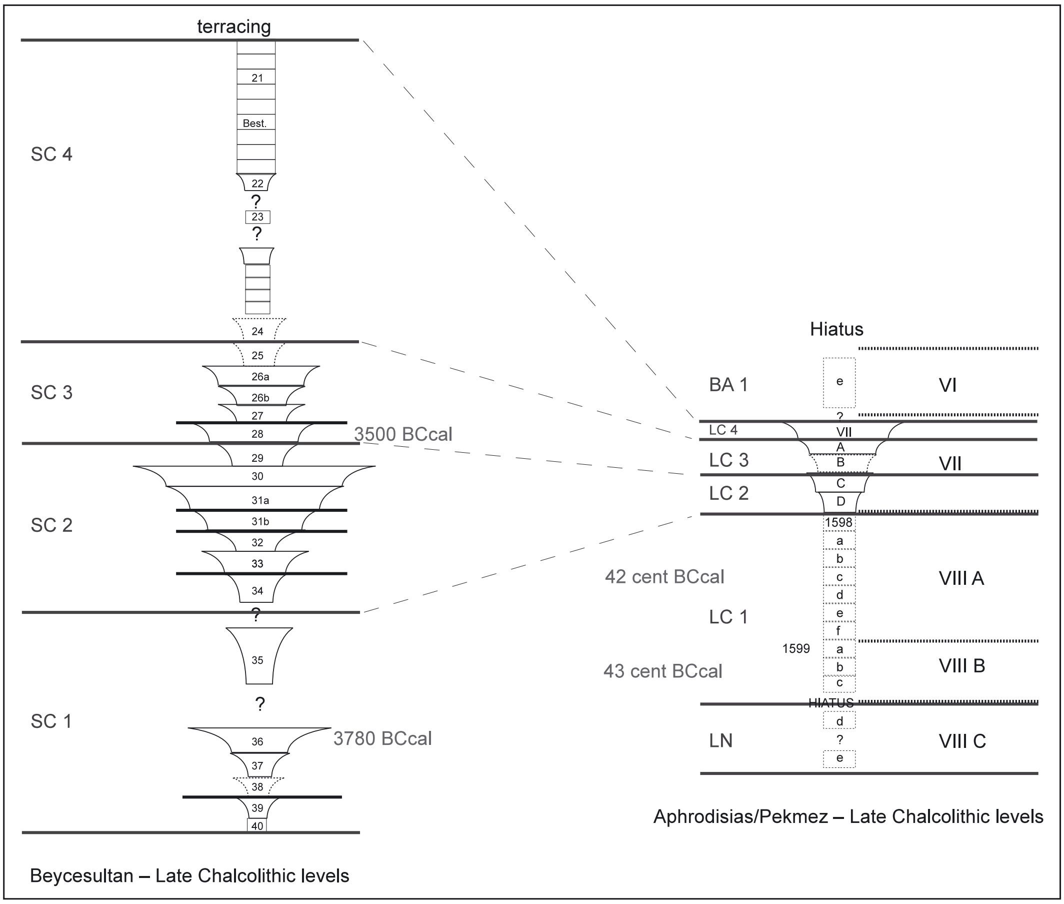

Fig. 3 Late Chalcolithic stratigraphies compared: Beycesultan (left) and Aphrodisias/Pekmez (right).

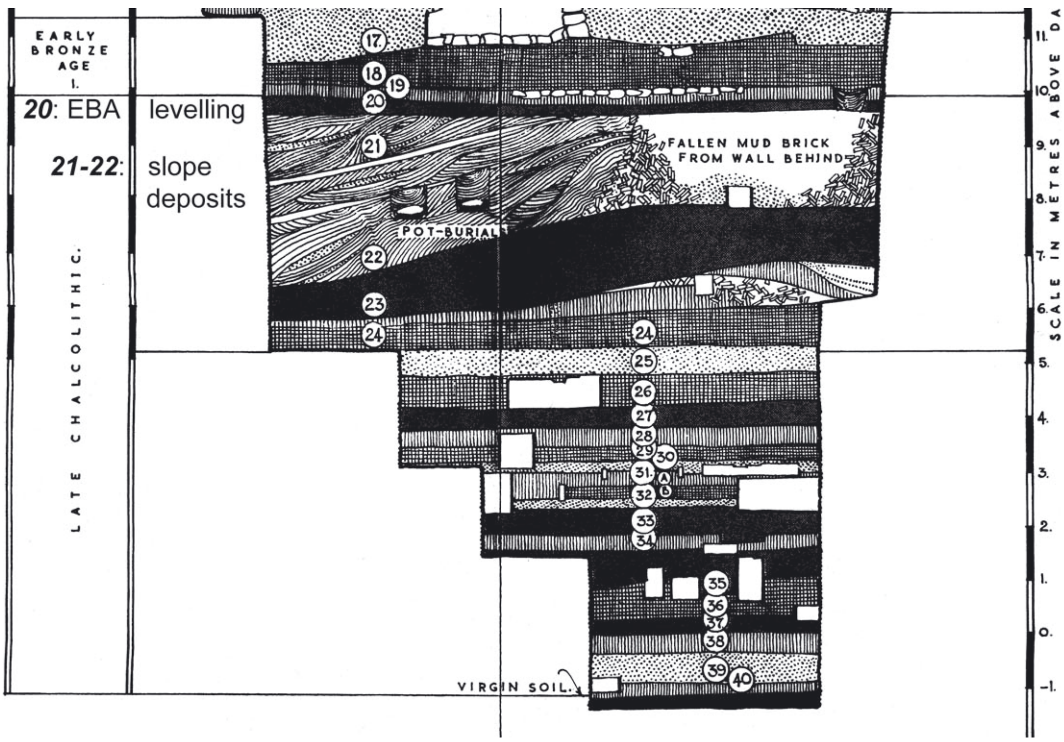

Fig. 4 Stratigraphy of the Chalcolithic levels at Beycesultan
(section from Lloyd – Mellaart 1962 fig. 3, cropped, with additions).

the excavator Refik Duru before the Beycesultan sequence, but by U.-D. Schoop thereafter.[28] Thus there may be space for a 'late' Late Chalcolithic in this region.[29] When the Early Bronze Age commences at this site is still an open question, perhaps with the end of Late Chalcolithic Beycesultan or the beginning of the Early Bronze Age.

Pecorella compares the most conspicuous pottery form in the cemetery – the four lugged jar – with the Cycladic stone vessels (Pl. 5A). The jars from Iasos were decorated with white painting, but in most cases it has decomposed and is only discernible as mat traces on the otherwise lustrous surface. This decoration has a long tradition and is known from the 'Late Chalcolithic' through the 'Early Bronze Age' in Anatolian chronology. Thus, only the formal aspects of the vessels may give hints to their date. In Anatolia, however, the form of these jars is rather Chalcolithic than Early Bronze Age and also has a long tradition as can be evidenced from the examples from Ulucak and Mersin (Pl. 5B).[30] Other common vessels in the necropolis, particularly spouted jugs with high rising spouts and cups, are of course well known forms from the Anatolian Early Bronze Age. However, they may have earlier predecessors since we should keep in mind that the transition from Late Chalcolithic to Early Bronze Age is almost unknown, leaving space for intermediary assemblages. The remaining forms are either too common for a closer dating or too specific, and only single comparisons may be found.

In summary, this pottery assemblage has no close comparisons with neighbouring regions. A satisfactorily solution, for the time being, would be to place it after the Beycesultan/Pekmez 'Late Chalcolithic' and before the 'Early Bronze Age', perhaps somewhere during the Late Chalcolithic sequence of Kuruçay or shortly after it.

The Late Chalcolithic is not the earliest period documented in Iasos. The oldest pottery find was assigned to the Neolithic by Pecorella (and Levi). It is a very typical vessel with red slip, vertical tubular lugs (in German *Tunnelösen*) and a disc base (Pl. 6A.1).[31] A closer inspection of the sherds retrieved at the findspot of this vessel shows that there were more examples: the straight rims, either open or closed, the disc base, and another lug (Pl. 6)[32] came from that findspot in Insula II, Room 17. We may assume a small Neolithic settlement was present at this area (Fig. 5), even if the only remains are some sherds wedged into a cleft of the rock underneath the Hellenistic buildings.[33] From Fenditura B came two additional tubular lugs, but these are associated with another group of rims.[34] This group may date to a following phase. Just as remarkable is a small group of incised sherds from the slope of the acropolis (Taglio 1 and Taglio 2) (Pl. 6B.19–21).[35] They belong to the largest prehistoric pottery collection from the settlement at Iasos. After removing all the simple profile forms which cannot be dated more precisely, a small group of three sherds remained: one handle fragment with a knob, another mushroom-like handle and a handle that was plugged through the body of the vessel (Pl. 6B).[36] The incised decoration has close affinities to the pieces from Malkayası, where the other pieces mentioned and also the remaining common sherds – handle fragments, simple bowl rims and flat bases – are present. This sherd collection may belong to a 'middle' Chalcolithic phase. The sherds from Fenditura H may belong

28 Duru 1996, 144; Schoop 2005, 184–185.

29 The pottery in the levels above the Late Chalcolithic levels in Aphrodisias is difficult to date by comparison; thus, the excavator divided it into 'Bronze Age 1–4' and then adapted it to Mellink's Anatolian Scheme EBA I, II, IIIA and IIIB (Joukowsky 1986, 161). Further, a stratigraphic discontinuity may be documented between the strata of level VII (Neolithic/Late Chalcolithic) and level VI (Bronze Age), as mentioned by Kadish 1971, cited after Schoop 2005, 158 with note 164.

30 Ulucak: Çilingiroğlu et al. 2004, fig. 22/12; Mersin: Garstang 1953, fig. 91.1–3.

31 Pecorella 1984, fig.15/1. See also Momigliano 2012, 154.

32 Pecorella 1984, figs.16/4. 30–31; 17/46, 50.

33 'Neolithic' in fact means early Chalcolithic according to the latest development in terminology and is dated just after 6000 BC – see Schoop 2005, 270 and note 3.

34 Pecorella 1984, figs. 16.24–29; 17.44–45.

35 Pecorella 1984, fig. 16.19–22.

36 Pecorella 1984, fig. 17.32–33, 47; also fig. 16.16.

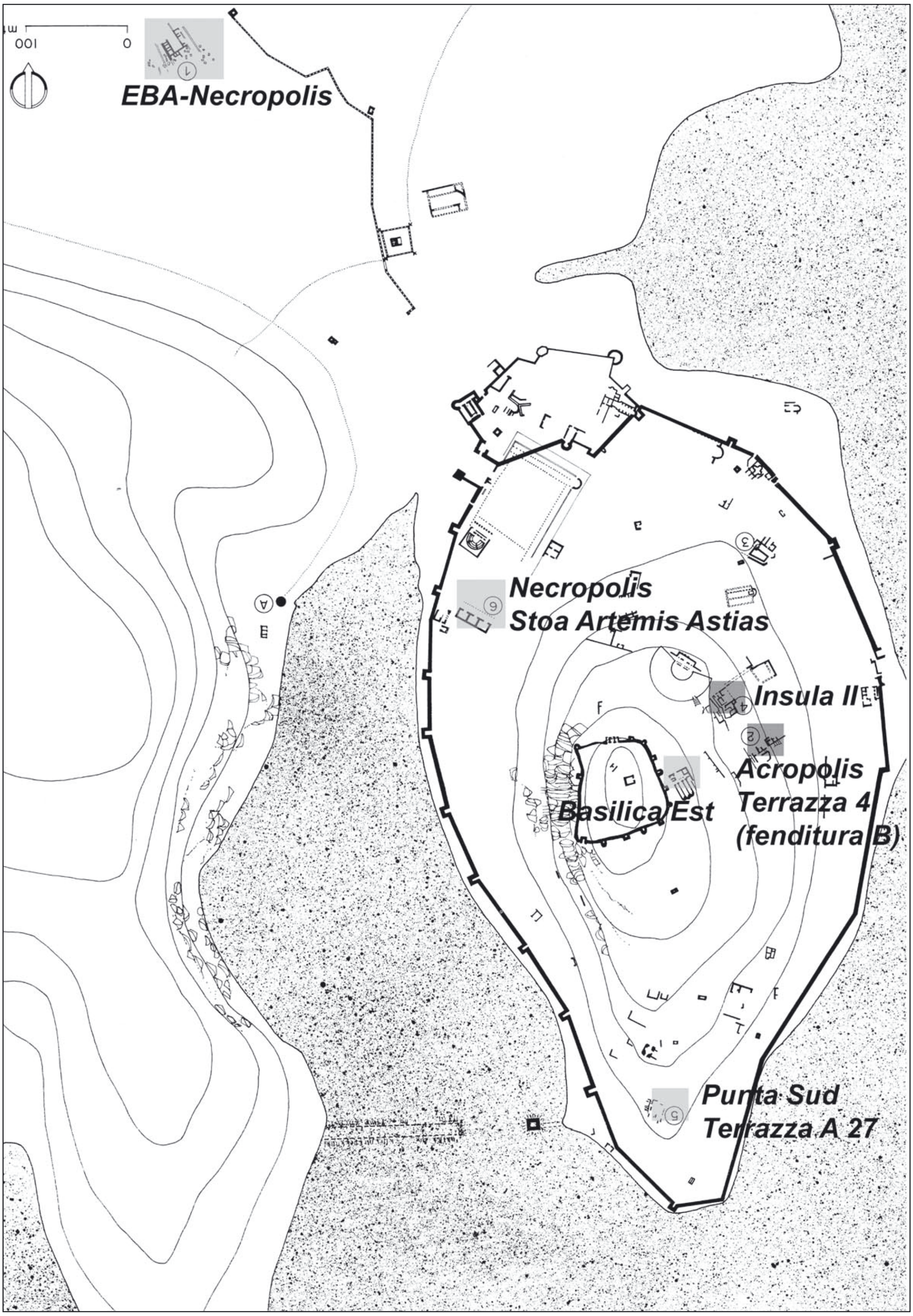

Fig. 5 Chalcolithic findspots at Iasos: Early Chalcolithic (dark grey), Middle and Late Chalcolithic (light grey) (map from Pecorella 1984, fig. A; with additions).

to the same period.[37] Then of course we have the large assemblage of the necropolis, which may be dated very 'late' in the Chalcolithic.

This demonstrates that even a seemingly non-datable collection of sherds can be split up into different groups when separated into single findspots and regional *comparanda* are available. Despite the tenuous prehistoric material recovered and published, it is conceivable to suggest a continuous settlement at Iasos from the 'Late Neolithic' into the Late Chalcolithic/Early Bronze Age,[38] and it gives us a hint on the settlement activity at this site during the 5th and 4th millennia BC.

The settlement on the acropolis, a rocky outcrop overseeing the sea, may be adopted as typical for the Carian coast in the Chalcolithic Period. At the Oyuklu Tepe at Bybassos, which was presumably used as a cult area in the Carian Period, we found prehistoric remains in rock clefts or displaced at the foot of the hill. A similar scenario was encountered in Loryma. We assume that during the Chalcolithic Period Oyuklu Tepe may have been at the end of a bay just like Iasos is still today.

Another local element of the assemblage is the presence of emery as an alternative to flint (respectively *silex*), which is not locally available. Emery is found as gravel stones in the area of Pinarcik just west of the Bafa plain at the east end of the Bafa Lake. Emery is a metamorphic bauxit (cf. *Metabauxit* in German) and has properties similarly to flint. It is used for the fabric of small adzes and other types of tools like hammers and pestles. However, it is not suitable for blade and arrow-head production, which were made of imported flintstone or obsidian.[39] Emery is present in Iasos, though it is not described as such in the literature and is generally described as 'black' or 'basaltic' (as Pecorella did in the publication of Iasos). An excellently preserved emery adze[40] was recovered together with the 'Neolihic' pottery in Insula II. Emery tools are not datable in and of themselves: they were produced and used in the 'Neolithic' at Killiktepe and Iasos, and in the ('middle') Chalcolithic in the Latmos mountains. It is not uncommon to also find them in Late Chalcolithic contexts, but it is currently not known if they survive into the Early Bronze Age.

In short, we have got an impression of the published find assemblage of early prehistoric Iasos – and these remains may be assigned to the whole Chalcolithic period.

Northern Central Anatolia and the Southern Caucasian Region

Levi – with Pecorella following him – showed some close comparisons with sites in central Anatolia. The chronology of this region was established by W. Orthmann in 1963, with his monography 'Die Keramik der Frühbronzezeit in Zentralanatolien'. By the beginning of the 1960s K. Bittel, and subsequently followed by Orthmann, assumed that (northern) central Anatolia could not have been settled before the beginning of the Bronze Age, this is to say before 3000 BC. The levels labelled as 'Chalcolithic' found at sites like Alişar and Alaca Höyük were dated to the very late 4th millennium, but they were termed 'EB Ia', suggesting that the term 'Chalcolithic' designates just the very first phase of the Early Bronze Age in central Anatolia. This monograph was seminal and has not been replaced by any later study. Therefore, it was – and still is – influential despite the discoveries and the early radiocarbon dates retrieved in later years. Pecorella's report – published in 1984 – seems to take over the dating terminology of Orthmann. Büyük Güllücek in

[37] Pecorella 1984, figs. 16.5, 7, 11–12, 15, 17; 17.48, 51.
[38] Remarkably, no traces of the (later) EBA nor the early MBA (MBA I) are till now known from Iasos (Momigliano 2012, 155).
[39] See Peschlow – Gerber 2012, fig. 40.
[40] Pecorella 1984, pl. 57.228.

northern central Anatolia and Ikiztepe on the Black Sea shore were, therefore, dated to the EBA.[41] Both, Büyük Güllücek and Ikiztepe 'BB' show several similarities in the pottery assemblage with that from the East Aegean-Carian area (Fig. 12). Knobbed handles and white painting are the two salient features connecting the pottery of both regions. This was recognized in the late 1950s, but the chronological ties could not be established until the publication of Samos-Tigani by Felsch in 1988. Laurens Thissen[42] proposed a correlation of Büyük Güllücek with Tigani II/III. The links include bowls with in-turned rims and horned handles that were very popular and long-lasting in the Aegean; bowls with long necks are present only in Tigani III; jars with tapered necks are present from Emporio VIII until Tigani III; rim lugs with horns (*randständige Röhrenösen mit Hornaufsatz*) are replaced in Tigani II/III by the so-called *samische Stabhenkel*, which constitutes a vertical rod which begins on a pierced lug on the vessel body and ends above the rim in a mushroom; low incised pedestals are also present in Tigani III.

The most conspicuous parallel is found in the incised decoration of Tigani III. They consist of horizontal triangles filled with hatching or fields of points (*Stichverzierung*). Schoop points to the difference between the motifs in central Anatolia and the Aegean. In both areas, we find white painting on the interior of bowls just below the rim, but there are no formal correlations in the shapes of the vessels. Schoop concludes that most similarities between Büyük Güllücek and the Aegean occur in the period dated to the second quarter of the 5th millennium.[43]

L. Thissen proposes that the most conspicuous Aegean parallels that are all remarkably similar in detail include technique, location and structure of motifs of white-painted decoration, several vessel shapes, tab handles raised above the rim of hemispherical bowls, and horned handles with rounded or animal endings. He also argues [44] for a strong contact during the end of the 5th millennium BC between north and central Anatolia, the islands in the eastern Aegean, northern Greece (Thrace and Macedonia), Bulgaria and the region around Anza. The degree of contact was variable in between these areas. Remarkable, however, are the strong correspondences between Samos Tigani II–III and Büyük Güllücek, in view of the geographical distance and the lack of similar material in Western Anatolia. It is not impossible that these contacts occurred through seafaring.

In fact, the parallels between Büyük Güllücek in central Anatolia and Samos-Chios in the Aegean are also observed at Ikiztepe and in the Karanovo IV Culture on the Balkan side. I want to emphasize that we are only dealing with some aspects of pottery assemblages; there are some close parallels in both regions, but whole assemblages are too distinct to postulate a tight connection between the two (or the three) regions. Nevertheless, many of the *comparanda* cited by Pecorella currently date to the Late Chalcolithic and not to the Early Bronze Age. The exact chronological assignation of the necropolis of Iasos in the Late Chalcolithic, however, remains open to discussion, as do the nature of relations between the southeast Aegean and north central Anatolia.

One unexpected fact may be added to this issue; far away from the Black Sea, on the plains leading to the Caspian Sea in Azerbaijan, the local pottery shows two amazing features that are common in the east Aegean, vessels of the so-called 'cheese pot' type with a characteristic row of holes below the rim, and the notched rims. Both traits are common in the Malkayası Cave, but the latter is less well represented in the Aegean. The similarity of both of these features is remarkable. Vessels with holes are generally deep bowls, but one of the examples – from Boyuk

41 There is nothing wrong in doing so because it was the state of the art in those times. However, we should be careful and not perpetuate out-of-date views of earlier research. S. Dönmez (2006, 94) termed the Late Chalcolithic of Ikiztepe as 'EB Ia' in consensus with Orthmann, shifting the end of the 'Late Chalcolithic' and the beginning of the 'Early Bronze Age' into the 5th millennium (!). U.-D. Schoop does not use these terms and groups the finds from the different mounds and levels into 'Complexes' AA to DD. He labelled the presumed middle Chalcolithic levels as 'Complex BB' (Schoop 2005, 312–314).

42 Thissen 1993, 207–237.

43 Schoop 2005, 326–327.

44 Thissen 1993, 220.

Kesik[45] – shows characteristics of the Aegean parallels. It is low and seems to be open on one side, similar to examples from Tigani and Malkayası[46] (Fig. 13). The notched rims are characteristic and particular to the Sioni Culture – a Late Chalcolithic culture which eventually evolves into the so-called Early Transcaucasian Culture. The Sioni Culture is dated to either the late 5th or the early 4th millennium. While the notched rims seem to be ubiquitous in the Transcaucasian region and therefore may represent a local development, the presence of 'cheese pot' related features is striking. They may be alien elements because of their variation from site to site.

Southeast Aegean – northern Anatolia – Transcaucasia – and 5th–4th millennia: What ties them together? One interpretation may be seen in the shifting metallurgy of that period. The Carpatho-Balkan metallurgical province represents the climax of metal production in the Balkans at the end of the 5th millennium. It is followed in the middle of the 4th millennium by the Circumpontic Metallurgical Province,[47] and characterised by the spread of arsenical copper both in the Near East and Middle Europe.[48] Several reasons for this shift were proposed, but the most convincing relates to the climatic change as suggested by H. Todorova.[49] While a number of reasons may account for this shift from west to east in the copper sources: the shared similarities in the pottery aspects between the east Aegean, north central Anatolia and the Transcaucasian Area may be relics related to the search for new copper sources in the mountain ranges of Pontos and Caucasus – and perhaps in western Anatolia. The later legendary Argonauts may have had predecessors in much earlier times. Of course, there is no direct relation between the pottery traits presented in this paper and the search for copper sources. However, future research may tell us if such a hypothesis can be correlated.

In summary, the main aim of this paper is the reassessment of the early settlement history of Iasos. It can be shown that it may range from the early to the very late Late Chalcolithic. One group of pottery with affinities to that of the Latmos Range may date to the middle Chalcolithic. In this period some close parallels to north central Anatolia and north Anatolia are evident, and also (but less apparent) to the south Caucasian region. The nature of relationship between these areas remains to be established, nevertheless, a plausible explanation may lie in the search for new copper ore resources. The prehistoric settlement of Iasos represented in the 'prehistoric necropolis' may end rather in the Late Chalcolithic than in the Early Bronze Age.

During the whole Chalcolithic Period Iasos may have been an important Carian site, perhaps linked to the interregional exchange at the fringes of the Black Sea. The importance of Iasos in the Chalcolithic period seems to have ended at the transition from Late Chalcolithic to Early Bronze Age, since almost no remains from the EBA were detected during the excavations.

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45 Akhundov, 2007, 118, fig. 18:4. For bowls see the contribution of Palumbi 2007, 71, fig. 3.1–3.
46 Felsch 1988, pl. 35.8; Peschlow – Gerber 2012, fig. 47.
47 Chernykh 1978, cited by Todorova 1998, 42–45.
48 Begemann et al. 1994, 203; Todorova 1998.
49 Cf. Todorova 1998.

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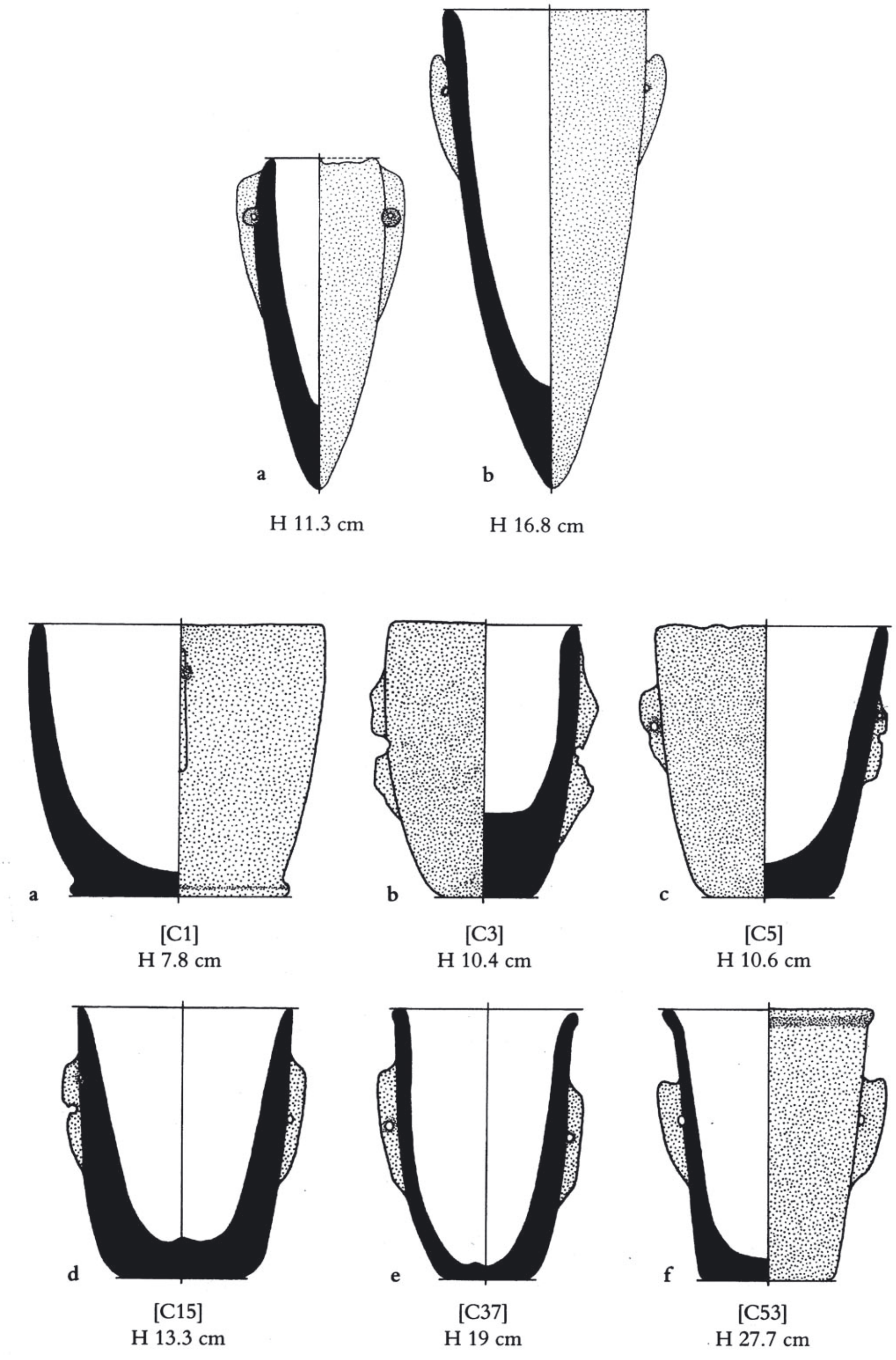
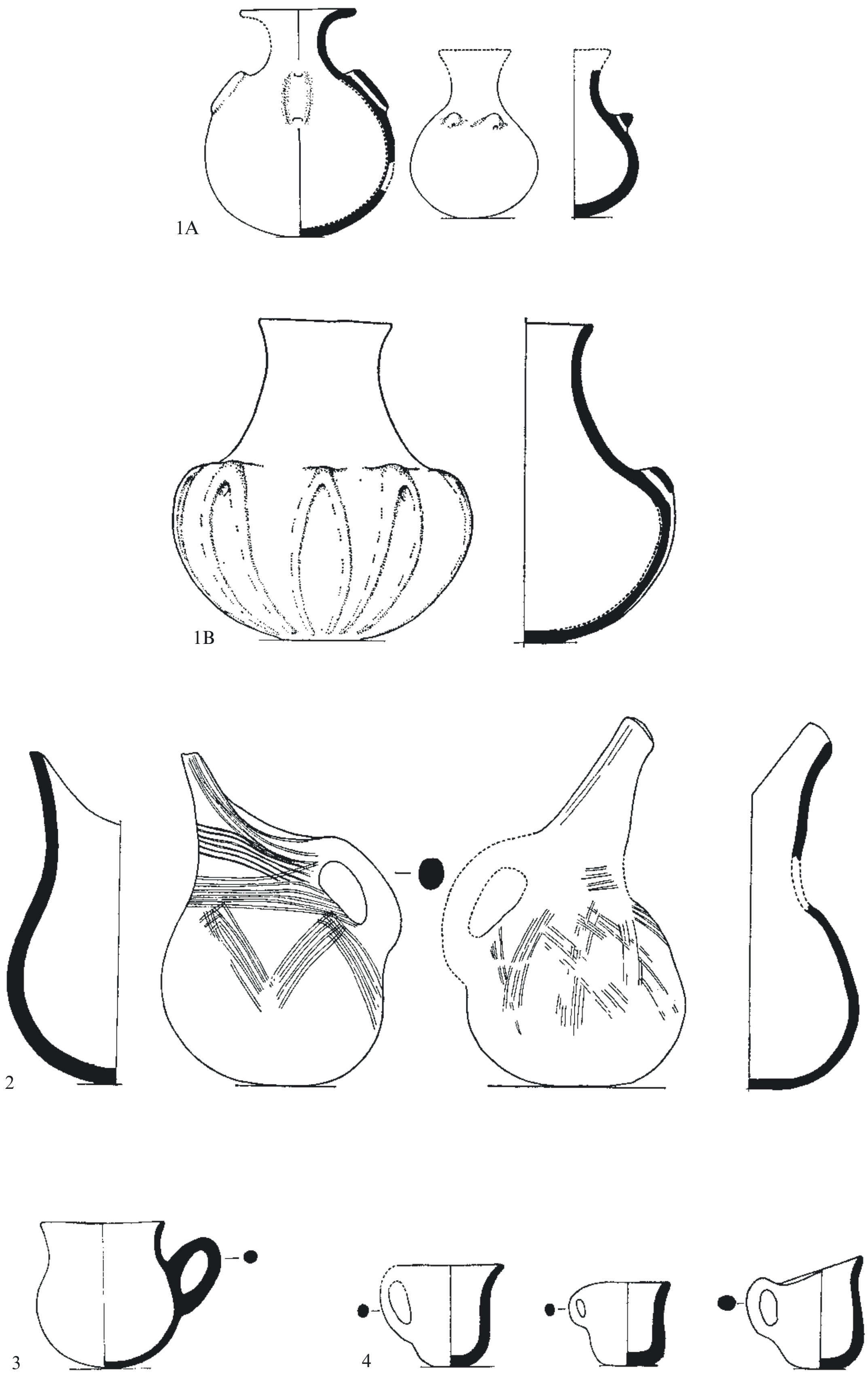
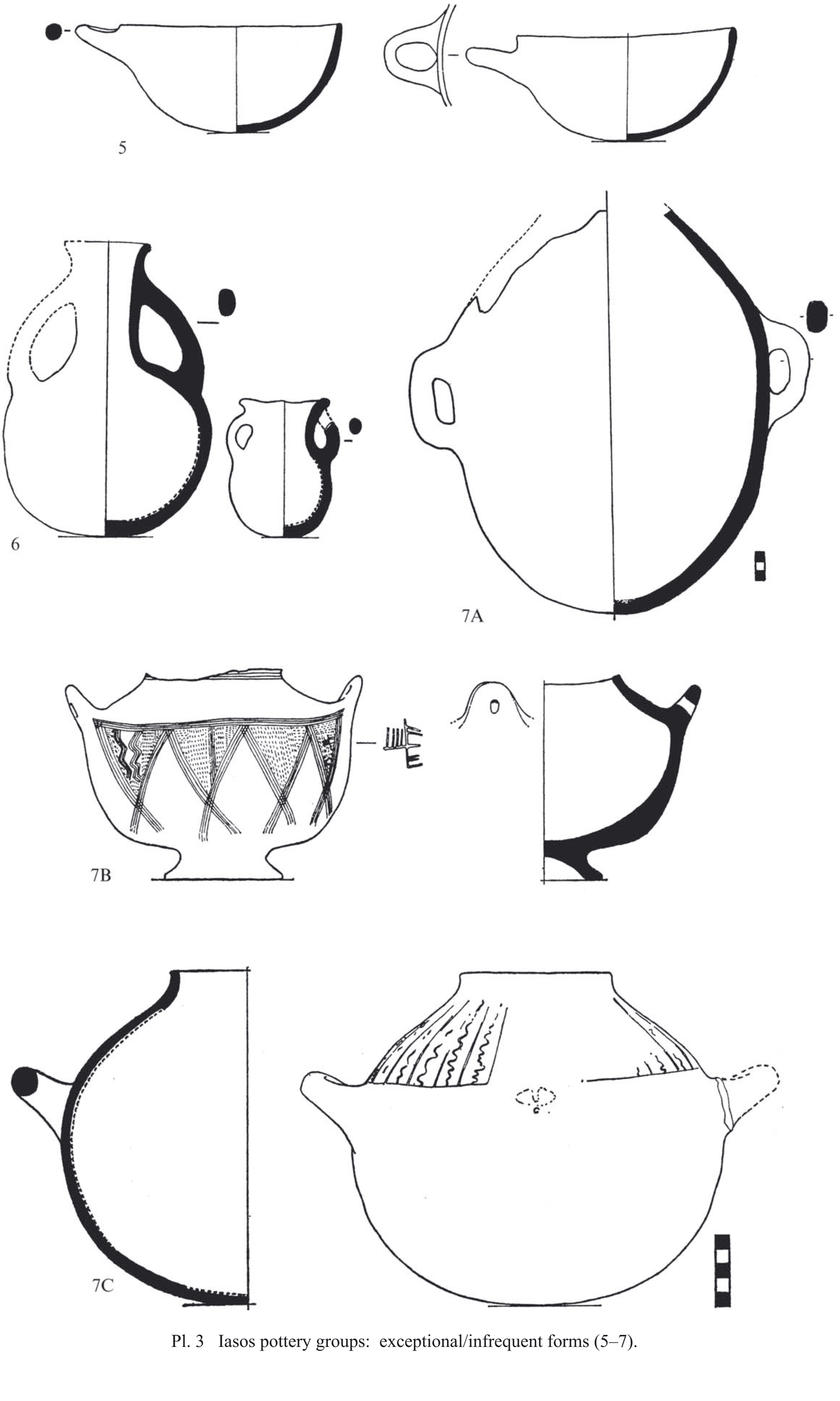


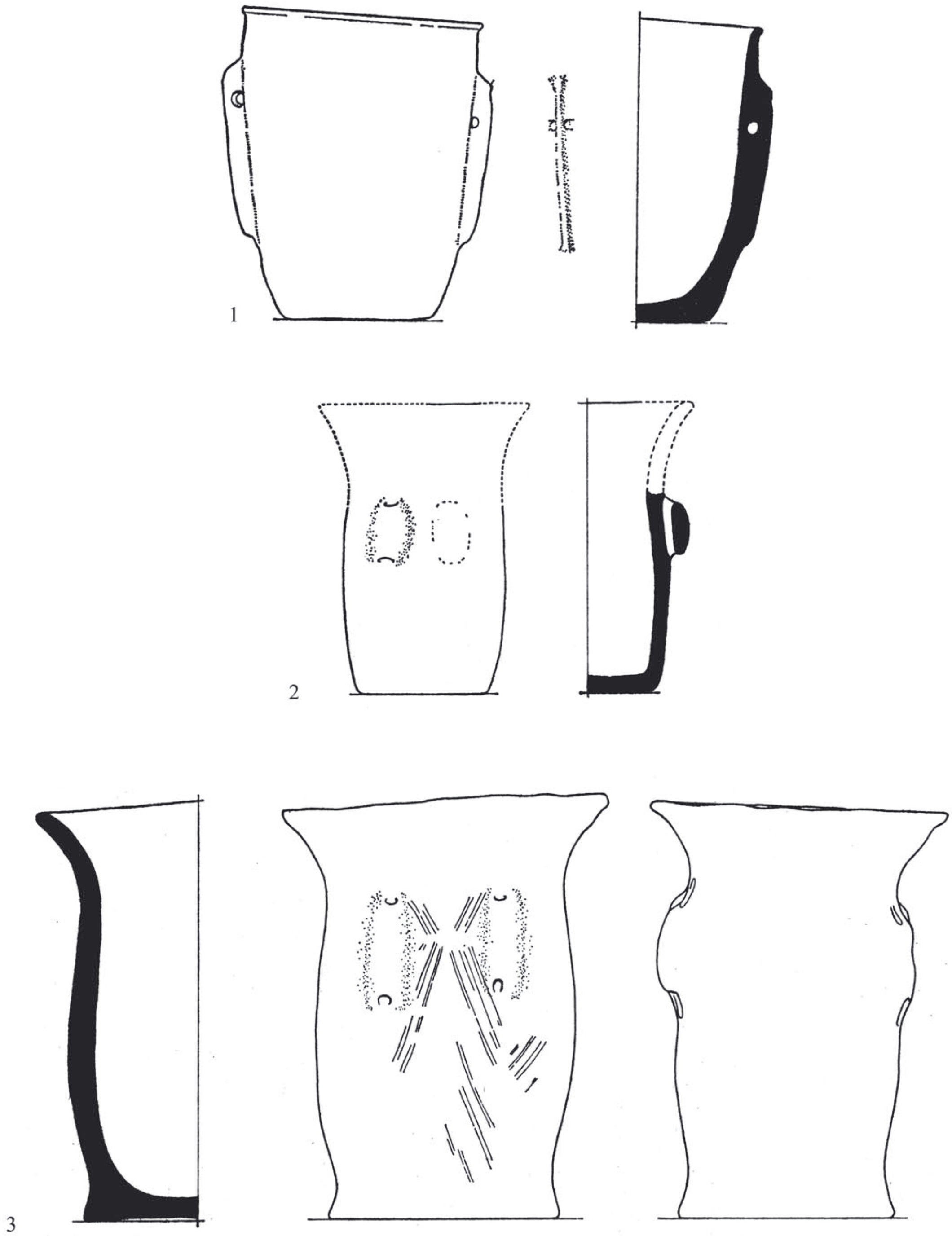
Pl. 1 Formal development of Aegean marble beakers: Chalcolithic (upper: a–b) and Early Bronze Age (lower: a–f) (after Getz-Gentle 1996, figs. 23. 29).



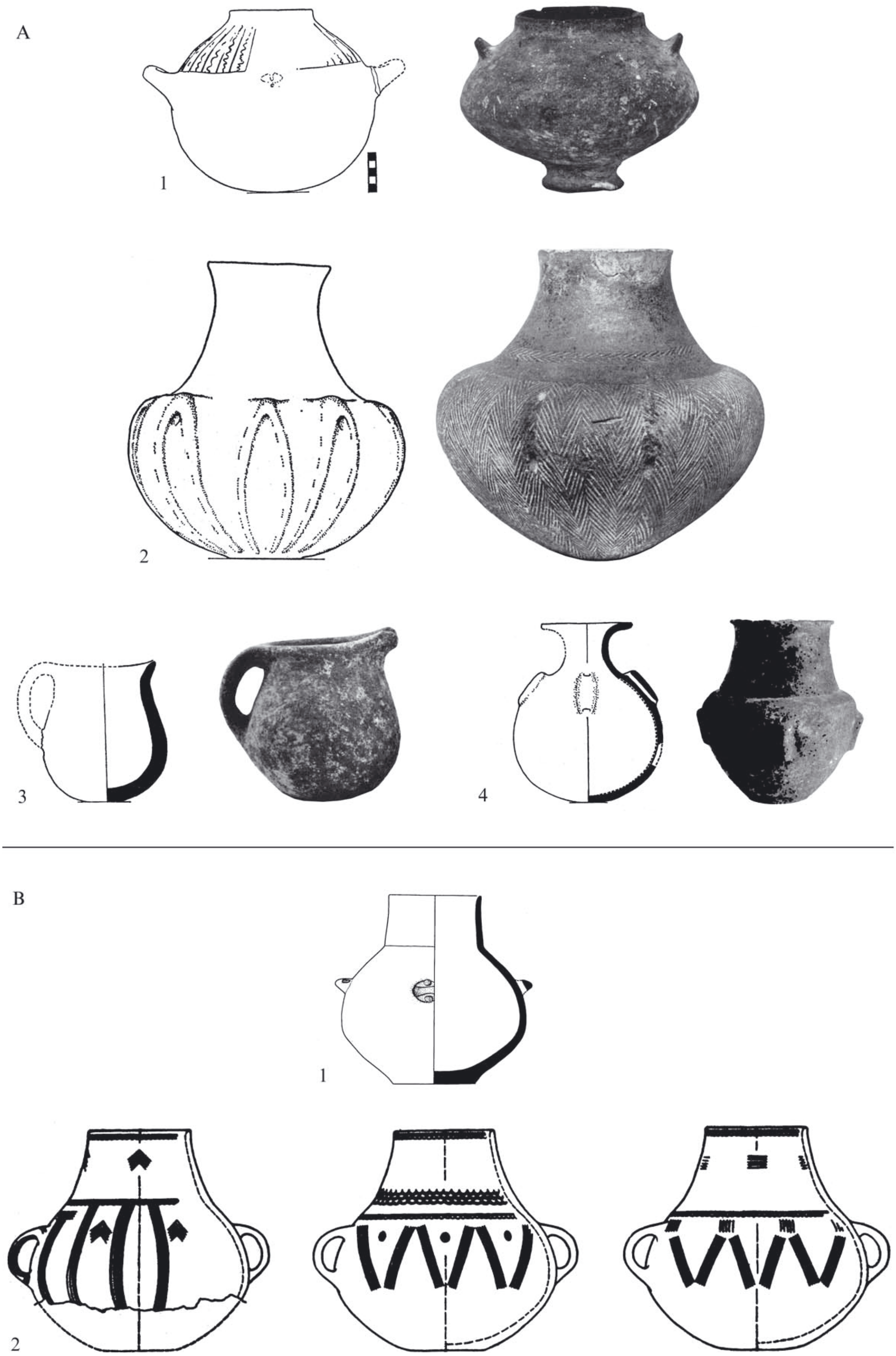
Pl. 2 Iasos pottery groups: abundant forms (1–4).



Pl. 3 Iasos pottery groups: exceptional/infrequent forms (5–7).

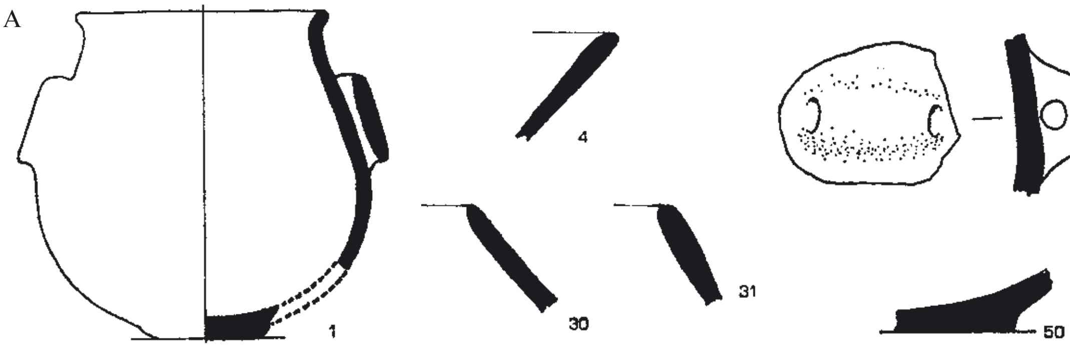


Pl. 4 Imitation of marble beakers in clay (2–3), marble beaker (1).



Pl. 5 A 1–4. Pottery vessels from Iasos and Cycladic stone vessels (after Zervos 1957, pls. 62, 68, 70, 71); B. Vessels from Chalcolithic Anatolia: Ulucak (1: Neolithic) (after Çilingiroğlu 2004, fig. 22,12) and Mersin (2–4: Chalcolithic) (after Garstang 1953, fig. 91,1–3).

A



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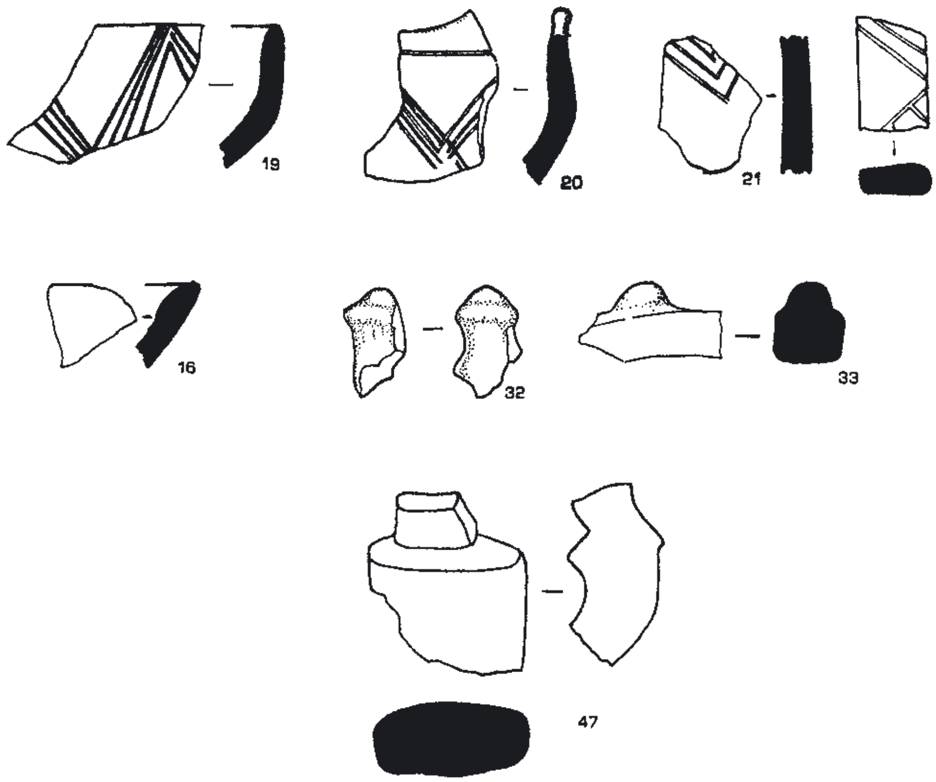
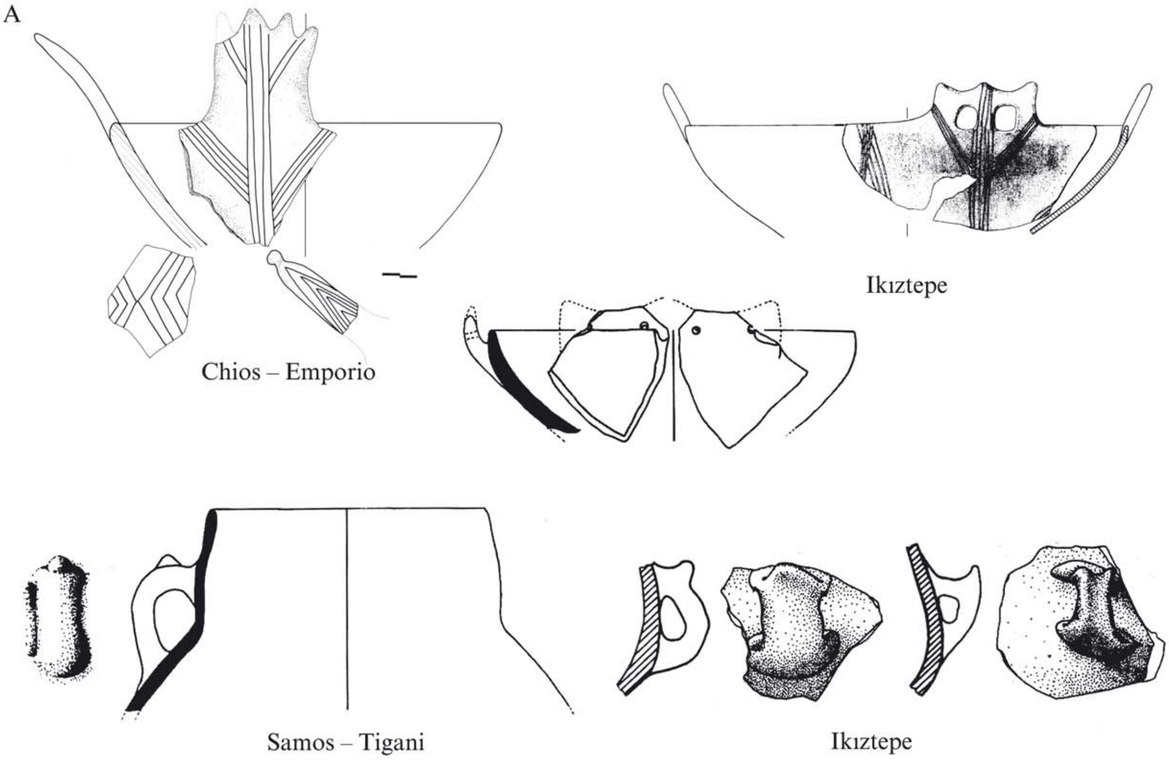
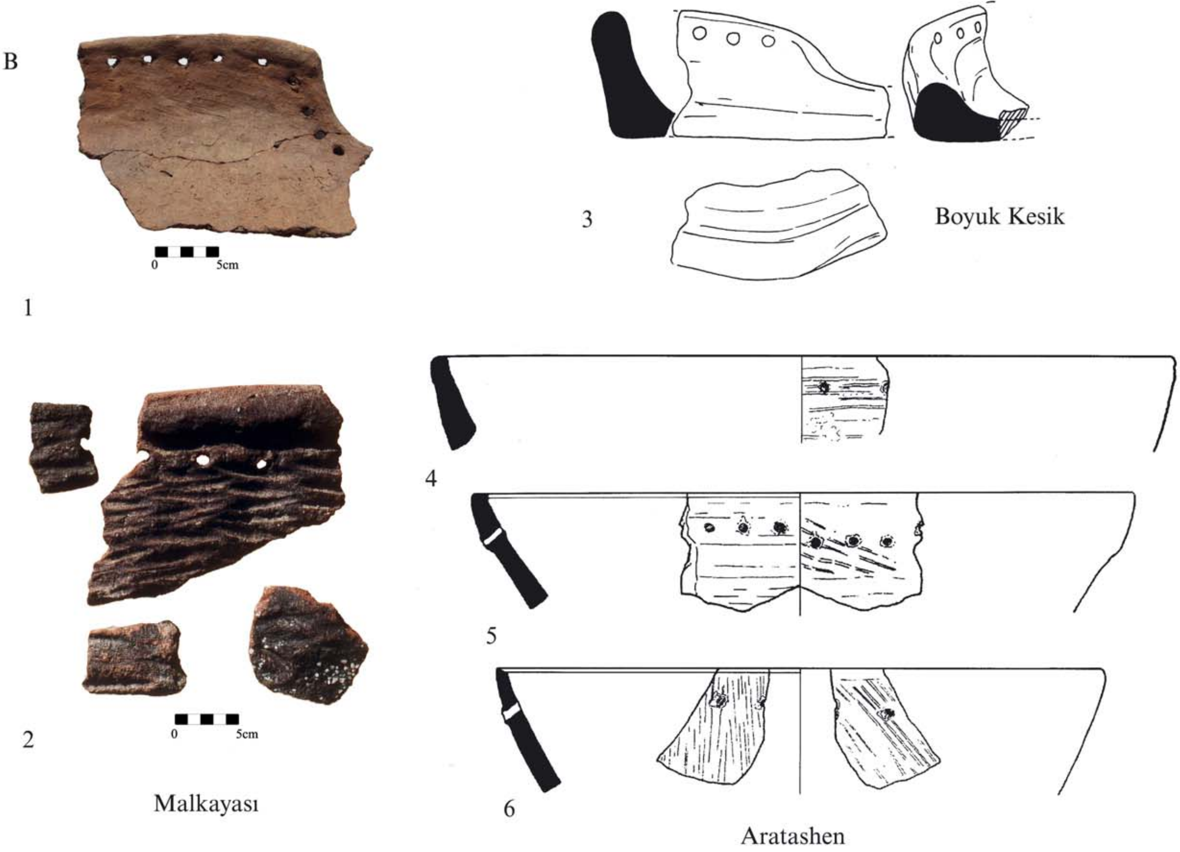


Pl. 6 Pottery from Iasos: A. Early Chalcolithic ('Late Neolithic') Pottery from Insula II, vano 17 (after Pecorella 1984, figs. 15–17); B. Middle Chalcolithic Pottery from Taglio 1 and Taglio 2 (after Pecorella 1984, figs. 16–17).

A



B



Pl. 7 A. Links between and the Aegean (Tigani and Chios) and north/central Anatolia (Ikiztepe) (after L. Thissen 1993, 209); Chios-Emporio (after Sampson 1987, fig. 55); Samos-Tigani (after U.-D. Schoop 2005 pl. 150.2, 10); Ikiztepe (after U.-D. Schoop 2005 pls. 182.17; 183.24–25);
B. 1–2. Links between Aegean (Malkayası) and 3–6. Southern Caucasus (Boyuk Kesik and Aratashen) (after Akhundov 2007, 118 fig. 18.4 and Palumbi 2007, fig. 2.1–3).

The Middle Chalcolithic Cultural Sequence of the Troad (Northwest Anatolia): Chronological and Interregional Assessment

Stephan W. E. Blum[1]

Abstract: While the first half of the northwest Anatolian Middle Chalcolithic is comprehensively characterised by the artefact inventories of Ilıpınar, İkiztepe, Kumtepe IA and Beşik-Sivritepe the time between 4500 and 4250/4000 BC remains relatively unknown. All the more surprising is the cross-cultural comparison of mid-5th to early 4th millennium BC Anatolia with the contemporary southeast European Chalcolithic – as represented by Karanovo V/Marica and Kodžadermen/Gumelniţa/Karanovo VI – with its huge burial mounds, rich grave offerings, highly developed metallurgy, and a hierarchically structured interregional interacting society. At Alacalıgöl, a comparatively small settlement located approximately 4 km west of Troy, a material complex was recorded which – although unmistakably Middle Chalcolithic in its general typological habits – can be dated later than those of other sites of the period concerned (e.g. Beşik-Sivritepe). Particularly the presence of early rolled rim bowls clearly indicates the transition to the northwest Anatolian Late Chalcolithic. On the basis of the finds from Alacalıgöl, the long existing gap in the chronological sequence of the Middle Chalcolithic can now be adequately closed and the cultural development of the Troad in the 5th and 4th millennia BC – and beyond that of western Anatolia and its neighboring regions (e.g. the Balkans, the Aegean, central and south Anatolia) – can finally be reconstructed without larger interruptions.

Keywords: Turkey, northwestern Anatolia, Troad, Alacalıgöl, Middle Chalcolithic, chronology, cultural sequence

Of all post-Neolithic periods in northwestern Anatolia the late Middle Chalcolithic is the least known. While the first half of the era is comprehensively characterized by the inventories of Aşağı Pınar 5–2, Hoca Çeşme I, Kumtepe IA, Beşik-Sivritepe and Gülpınar, the period between 4500 and 4000 BC still appears as a major chronological gap or lengthy occupational hiatus. A similar situation can be seen in the eastern contact zones, especially in central Anatolia; and since the few contemporary settlements in southeast Turkey share distinctive elements with those of the Syro-Mesopotamian cultural sphere, it seems that the vast Anatolian land-mass from Cilicia in the east to Turkish Thrace in the west was temporarily uninhabited (Fig. 1).[2] All the more unexpected, therefore, is a cross-cultural comparison in the mid-5th – early 4th millennium BC between Anatolia and the Chalcolithic of southeast Europe – as represented by the complexes Karanovo V-Marica and Kodžadermen-Gumelniţa-Karanovo VI, with their huge burial mounds, extremely rich graves, their high-level metallurgy and hierarchically structured societies.[3] At Alacalıgöl, a comparatively small settlement located about 4km west of Troy, a material assemblage has been identified which, while unmistakably Middle Chalcolithic in its general typological habits,[4] clearly belongs at the transition to the northwest Anatolian Late Chalcolithic of the type known from Barcın Höyük, Ilıpınar,[5] and Kumtepe IB.[6] On the basis of the finds from Alacalıgöl, the gap in the chronological sequence of the Middle Chalcolithic can now at last be closed. At the same time the cultural development of the Troad in the 5th and 4th millennia BC and, beyond it, of western

1 Institute of Pre- and Protohistory and Mediaeval Archaeology, Eberhard Karls University, Tübingen, Germany; email: stephan.blum@uni-tuebingen.de.

2 Cf. Schoop 2011a, 157–165, fig. 7.3–4; Schoop 2011b, 29–32; Seeher 2012, 123.

3 Renfrew 1986, 144–152, 160–164; cf. Kienlin 1999, 54–56, 74.

4 Gabriel et al. 2004, 124–132.

5 Cf. Seeher 2012, 117, 119–123.

6 Özdoğan 1970, 173–174, 196; Sperling 1976, 327–344.

Fig. 1 Middle Chalcolithic sites in Turkey (selection) (illustration: S. Blum).

Anatolia and its neighbouring regions (e.g. the Balkans, the Aegean, central and south Anatolia), can finally be reconstructed without major interruptions.

The Early Middle Chalcolithic in the Troad: Kumtepe IA and the 'Beşik-Sivritepe Horizon'

In the Troad, there are so far seven sites which can be assigned with certainty to the Middle Chalcolithic, of which three have been at least partially excavated (Fig. 2).[7] The beginning of the cultural sequence is marked by the early inventory of Kumtepe, a tell-site located at the southern exit of the Dardanelles about five kilometers west of Troy.[8] The stratigraphic sequence observed

7 Blum et al. 2014.

8 Blegen 1932, 431–432; Blegen 1934, 223–224; Blegen 1935a, 31; Blegen 1935b, 303–305; Koşay – Sperling 1936, 24–50; Blegen et al. 1950, 7; Sperling 1976, 305, 308, 311–316, 323, 326, figs. 1–3; cf. Özdoğan 1993a, 183; Korfmann et al. 1995, 237–246; Korfmann 1996, 51; Gabriel 2000, 233–235; Gabriel 2001a, 343–346; Gabriel 2001b, 84–87; Gabriel 2006, 355–356; Blum et al. 2011, 120. Regarding the specific location of Kumtepe and its geomorphological development, see Kayan 1995, 228–230, fig. 2; Kayan 2001, 313–314; Kayan 2002, 995–1004. For its role as a point of reference for Aegean and Anatolian chronology, see Özdoğan 1970, 2–19; Renfrew 1972, 76; Felsch 1988, 71–98, 128, tab. 2; Hiller 1992, 233–240; Parzinger 1993, 199; Alram-Stern 1996, 97, 107, 588–589; Gabriel 2000, 233–236; Özdoğan 2002, 70–73; Schoop 2005, 248–254, 261–263.

Fig. 2 Middle Chalcolithic sites in the Troad (illustration: S. Blum).

at Kumtepe is divided into four main phases. Layers IA and IB cover the early Middle and Late Chalcolithic, whereas units IC and II – corresponding to Troy I, II, and V – must be assigned to the Early Bronze Age and the beginning of the Middle Bronze Age.[9] According to calibrated radiocarbon dates the initial habitation stage of Kumtepe started around 5000 BC and lasted for about 250 years.[10] Within the chronological range of ca. 4750–4500 BC there follows the second phase of the early Middle Chalcolithic,[11] as represented by the typologically slightly more developed

9 Özdoğan 1970, 162–164, 171–172; Sperling 1976, 308, fig. 4; cf. Blum 2012, 356–358.

10 Kromer et al. 2003, 45–46, fig. C; Schoop 2005, 197–199, 213–226, 238–241, 244–246, 254–261, 270, fig. 6.10; Gabriel 2006, 358–359; Blum et al. 2011, 120; Gabriel 2014. See also Korfmann – Kromer 1993, 145, 164; Parzinger 2005, 59–61, fig. 17.

11 Cf. Schoop 2005, 262–263; Schoop 2011a, 157–161, fig. 7.1.

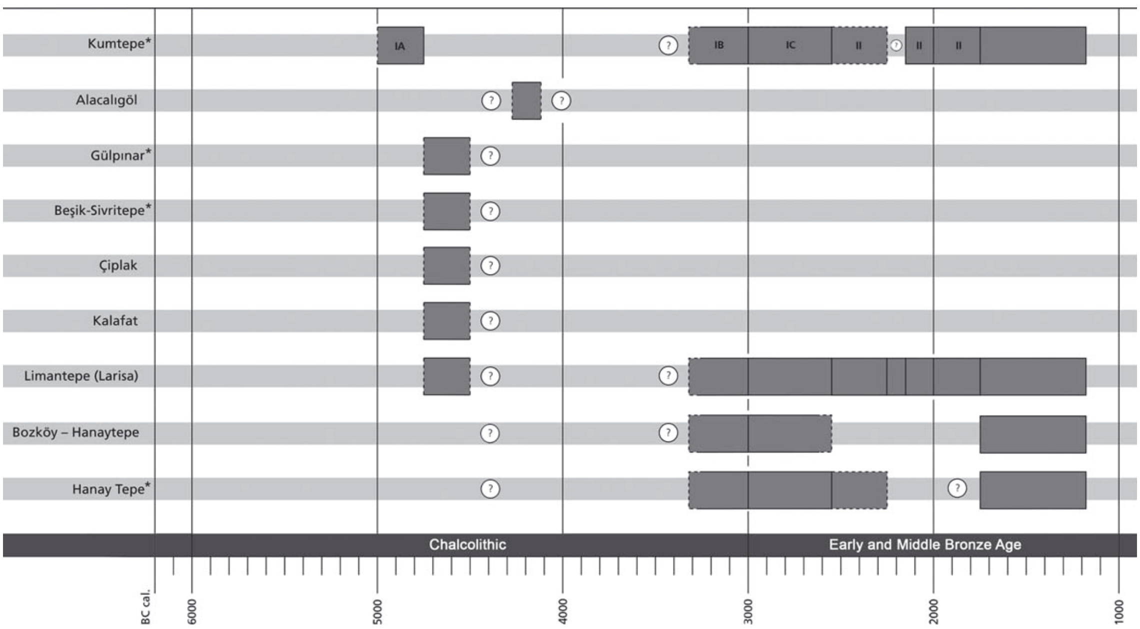


Fig. 3 Chronological sequence of Middle Chalcolithic sites in the Troad (*partially excavated) (illustration: S. Blum).

assemblages of Beşik-Sivritepe,[12] Limantepe (Larisa), Gülpınar,[13] Çıplak,[14] Kalafat, and possibly Hanay Tepe[15] and Bozköy-Hanaytepe (Fig. 3).[16]

In both chronological phases, bowls with steep or slightly convex sides, simple rounded rims, and flat bases constitute the most common shape (Fig. 4/1–7).[17] Specimens with uprising high handles are most typical; fragments of such handles with decorative knobs were recovered in great quantity at sites contemporary with Beşik-Sivritepe, e.g. Gülpınar,[18] Limantepe (Larisa),[19] and Çıplak (Fig. 5/1–6),[20] although twisted and incised strap varieties are also present (Fig. 5/7–8).[21] Knobbed or twisted uprising high handles on bowls are strongly reminiscent of types found in central western Anatolia, e. g. at Kulaksızlar,[22] as well as in the eastern Aegean islands, e.g. on Chios (Emporio X–VIII), Samos (Tigani Level II), and Kalymnos (Vathy Cave).[23] Another vessel type commonly attested in the pottery assemblages of the Beşik-Sivritepe horizon is

12 Seeher 1985, 172–182, figs. 16.LL83-65.2; 18.LL83-40.5, LL83-46.8; 18 LL83-43.4; Seeher 1987, 548; Seeher 1992, 156–157, figs. 3c, 4c; Gabriel 2000, 235–236; Schoop 2005, 242–243, pls. 157.9–27; 158; Gabriel 2006, 357–358, fig. b2; Blum et al. 2011, 120, 138; Blum et al. 2014; Gabriel 2014; cf. Korfmann 1984a, 170; Korfmann 1984b, 208; Korfmann 1985a, 167–171; Korfmann 1985b, 182; Korfmann 1985c, 111–113; Korfmann 1986a, 309–310; Korfmann 1986b, 229–230; Korfmann 1988a, 391–397; Korfmann 1988b, 193; Korfmann 1989a, 474–481; Korfmann 1989b, 323–324; Korfmann 1999, 28–29; Korfmann 2000, 41–43. See also Parzinger 1993, 248–250, App. 5; Hansen 2007, 107–109, pl. 77.10.

13 Seeher 1987, 533–555; Schoop 2005, 246, pl. 159; Takaoğlu 2006, 289–301, 307; Takaoğlu 2007, 131–132, figs. 18–19.

14 Gabriel 2014.

15 Schachner 1999, 22. See also Schoop 2005, 243–246, 253–254.

16 Blum et al. 2011, 120, 138; Blum et al. 2014.

17 Cf. Schoop 2005, 242–246.

18 Takaoğlu 2006, 295 fig. 6.1–4.

19 Blum et al. 2014, pls. 16.9; 23, A0 434, 03.

20 E.g., Gabriel 2014, pls. 6, 8; cf. Takaoğlu 2001, pl. 115; Takaoğlu 2006, figs. 6.1–4; 7–8.

21 Takaoğlu 2006, 295, figs. 6.5, 7; Blum et al. 2014, pls. 16.10; 23, A0 434.11.

22 Takaoğlu 2001, pls. 116, 287–290.

23 E.g., Hood 1981, 278, fig. 134; Felsch 1988, figs. 47.2, 5; 74.5.

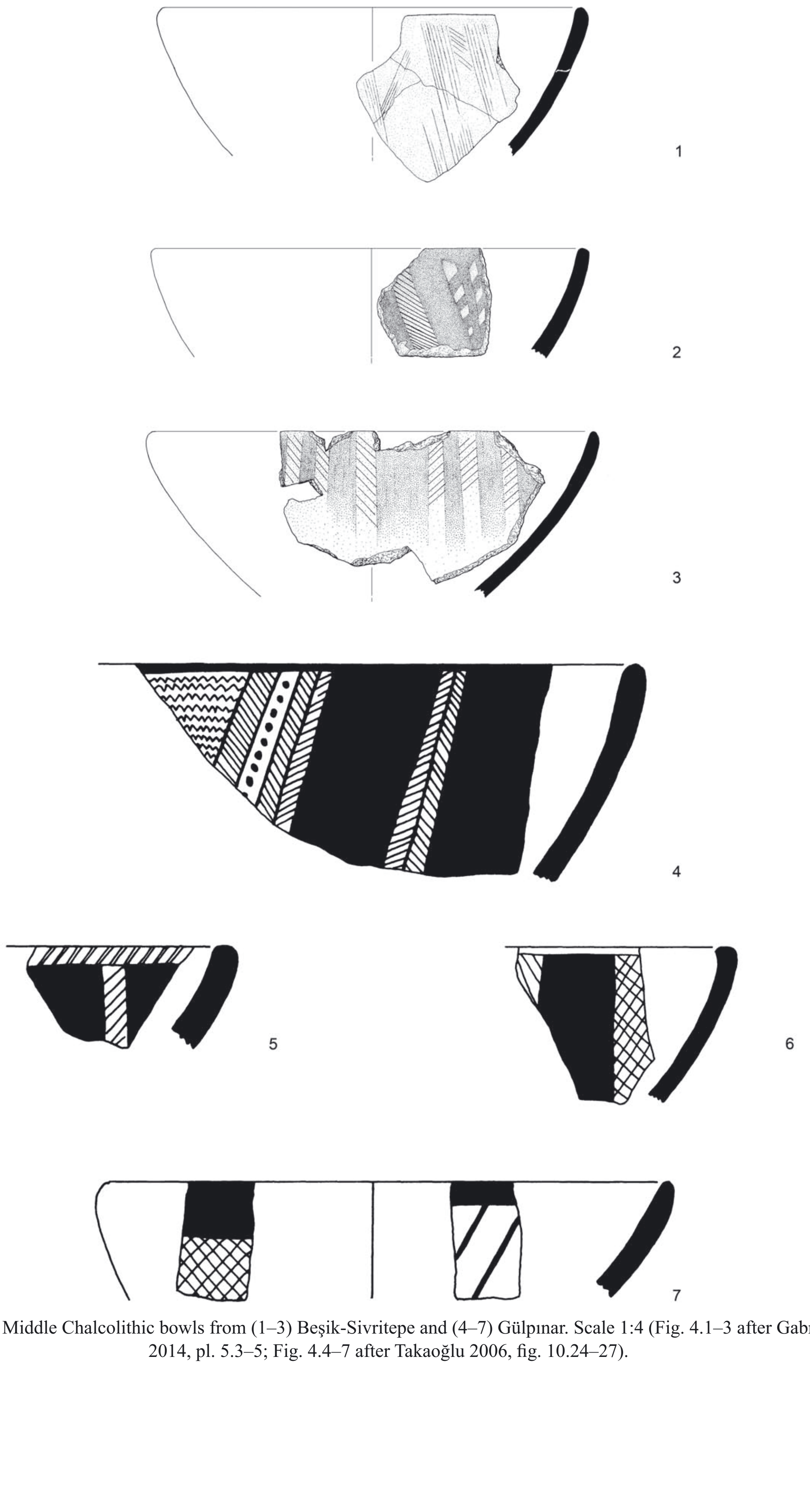


Fig. 4 Middle Chalcolithic bowls from (1–3) Beşik-Sivritepe and (4–7) Gülpınar. Scale 1:4 (Fig. 4.1–3 after Gabriel 2014, pl. 5.3–5; Fig. 4.4–7 after Takaoğlu 2006, fig. 10.24–27).

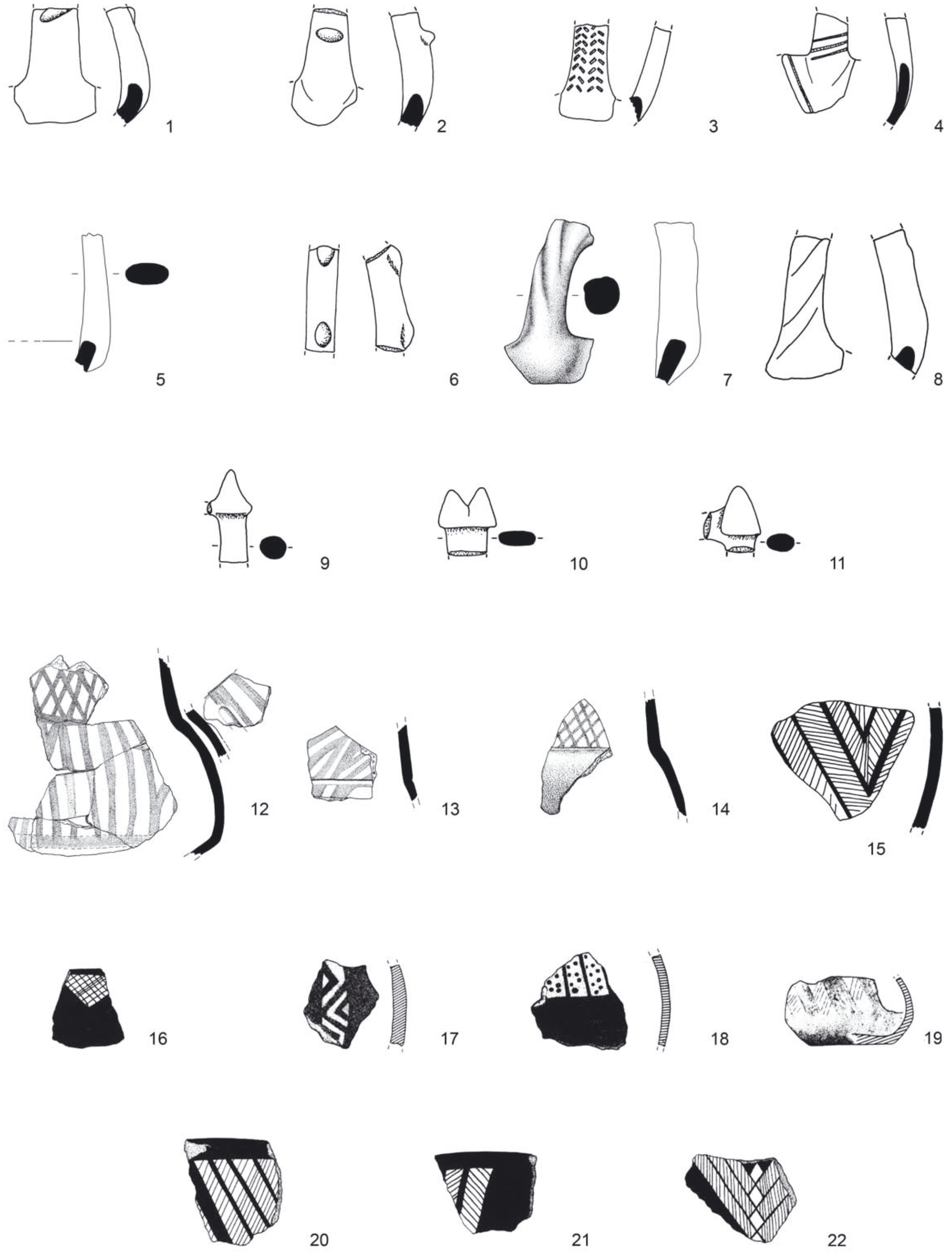


Fig. 5 Knobbed, incised, twisted, and pronged handles from (1–4, 6, 8–11) Gülpınar and (5, 7) Limantepe (Larisa); pattern-burnished ceramic from (12–14) Kumtepe IA, (15) Gülpınar, and (16–22) Beşik-Sivritepe. Scale 1:4 (Fig. 5.1–4, 6, 8, 9–11, 15 after Takaoğlu 2006, figs. 6.1, 2, 4, 5, 7–11; 10.29; Fig. 5.5, 7 after Blum et al. 2012, pl. 16.9–10; Fig. 5.12–14 after Gabriel 2014, pl. 2.2, 4–5; Fig. 5.16–22 after Schoop 2005, pl. 158.16–22).

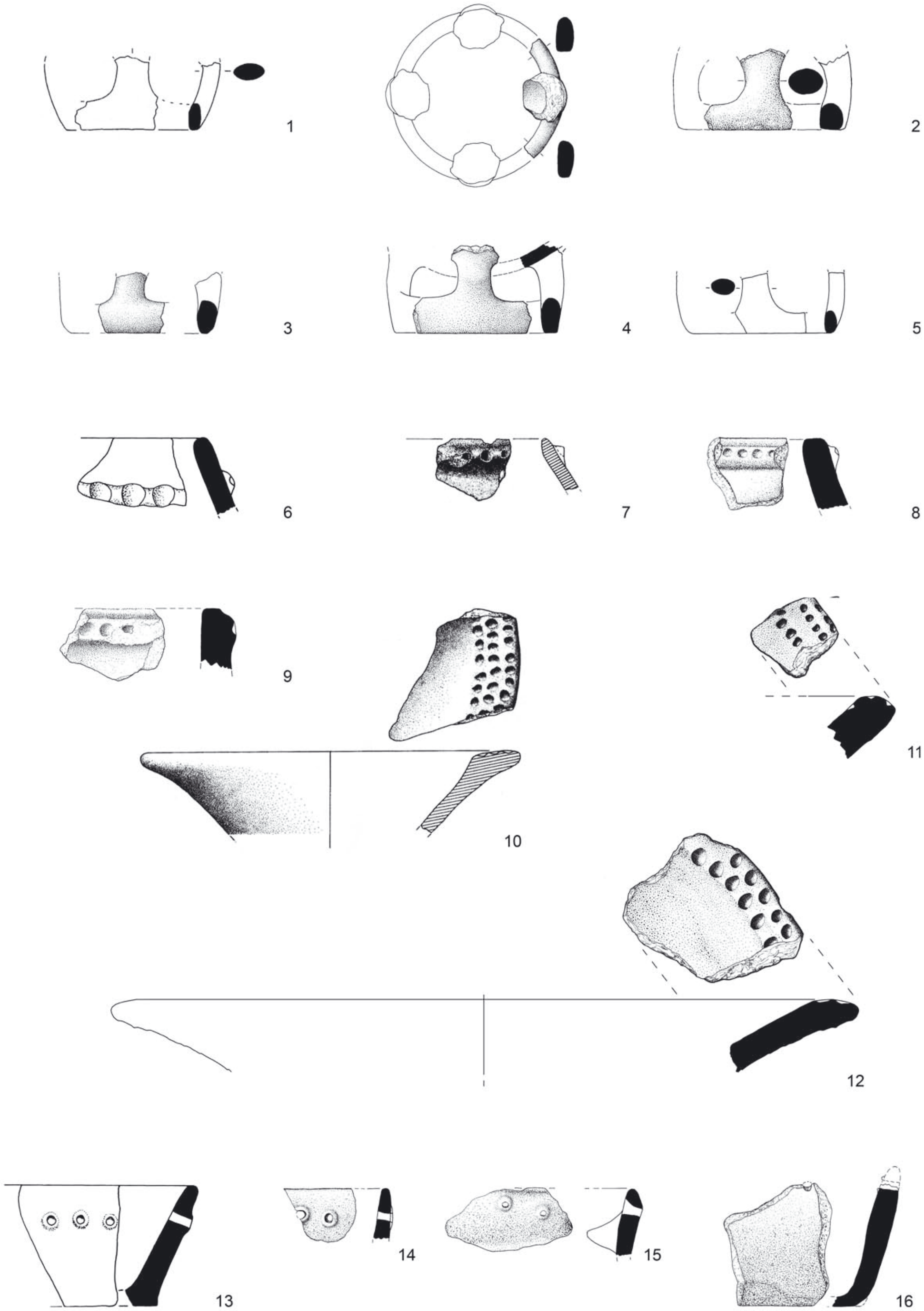


Fig. 6 Ring bases from (1, 3–4) Beşik-Sivritepe, (2) Çıplak, and (5) Gülpınar; open jars with raised decorative bands from (6) Gülpınar and (7–9) Beşik-Sivritepe; flaring bowls with decorated rims and encircling lines of holes from (10) Beşik-Sivritepe and (11–12) Limantepe (Larisa); cheese pots from (13) Gülpınar and (14–16) Beşik-Sivritepe. Scale 1:4 (Fig. 6.1, 7, 10 after Schoop 2005, pls. 157.23, 27; 158.11; Fig. 6.2–4, 8–9, 14–16 after Gabriel 2014, pls. 8.3, 5, 10–12; 9.2–3; 10.13; Fig. 6.5–6, 13 after Takaoğlu 2006, figs. 9.21; 11.31–32; Fig. 6.11–12 after Blum et al. 2012, pl. 16.1–2).

the open bowl with pronged handles (Fig. 5.9–11).[24] These forms suggest close parallels in the Aegean and the Balkans, for example at Tigani II on Samos, Ftelia on Mykonos, Paradimi and Sitagroi in eastern Macedonia, and Karanovo in Bulgaria.[25] Pattern-burnished decoration, although a comparatively widespread phenomenon dating back to the Aegean Late Neolithic I, is certainly the most distinctive characteristic of the early Middle Chalcolithic pottery assemblages in the Troad (Fig. 5.12–22; cf. Fig. 4).[26] Several of the recorded decorative motifs, e.g. from Beşik-Sivritepe and Çıplak,[27] have remarkably close parallels at Ulucak Hoyük III in the İzmir region.[28] Similar finds are known from Çine-Tepecik in central west Anatolia,[29] Aşağı Pınar in the northwestern part of the country,[30] from sites on the Aegean Islands such as Ayios Sostis, Tharrounia 3, Tigani II, Kalymnos, Ftelia, Emporio X–VIII, and Kephala, and as well as from the Greek mainland.[31] Ring bases and pedestals occur frequently in the ceramic assemblages of the Troadian early Middle Chalcolithic (v. i.), just as prevalent are open jars with raised bands set below the rim, large flaring bowls with decorated rims and encircling lines of holes, and so-called cheese pots (Fig. 6.1–16).[32]

The Late Middle Chalcolithic and the Transition to the Late Chalcolithic in the Troad: Alacalıgöl

Judging from the total lack of pattern-burnished decoration and a certain degree of typological distance, the material assemblage of Alacalıgöl is very likely to post-date the Beşik-Sivritepe horizon. A comparison of the classified pieces with those of the late 5th-millennium Balkans points in the same direction, especially since several tool and vessel types have direct equivalents in the KGK VI-Complex.[33]

The archaeological site was discovered in the course of geomorphological explorations in the Troad, undertaken by İlhan Kayan from İzmir University during the summer of 2003. It is located on the southwest of the Kesik Plain, which occupies an area of approximately one square kilometer on the eastern edge of the so-called Yeniköy ridge, a low and narrow plateau between the lower Karamenderes valley and the Aegean Sea (Fig. 7.1–2; Pl. 1).[34] Rapid environmental changes took place here during the Holocene, and the geographical environment of Alacalıgöl in the initial stages of settlement must have been very different from how it appears now.[35] Climatic changes caused the sea level to rise and to intrude into the lower Karamenderes valley, reaching its furthest extent in the middle Holocene around 5000 BC. From around 4000 BC, once the sea had ceased to rise, alluvial deposition and deltaic progradation transformed the southern part

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24 Cf. Takaoğlu 2006, 295.

25 Cf. Lamb 1932, 115, fig 2.15, 16; Bakalakis – Sakellariou 1981, 13; Keighley 1986, 363–366, fig. 11.6.3, 7, 10–11, pl. 529.1; Felsch 1988, 55; Nikolov 1997, 22, 26–27; Nikolov 2002, 127, pl. 4.2, 4–6, 10; Sampson 2002, 102, fig. 113.

26 E.g. Lamb 1932, fig. 13; Özdoğan 1970, Lev. 56, a-318, c-396, d-405, e-404; Sperling 1976, pls. 72.113; 101; 112; Seeher 1985, fig. 16.LL83-14.26, LL83-56, LL83-65.2, LL83-68.9, PP83-10.2; Seeher 1987, 544, fig. 6.1–2; Gabriel 2006, figs. 1.2; 2.1; Takaoğlu 2006, fig 10; Gabriel 2014, pls. 2.2–5; 5.1–5; 6.1–4.

27 Cf. Gabriel 2014, pl. 10.1–3.

28 E.g. Çilingiroğlu 2004, fig 20.18.

29 E.g. Günel 2008, fig. 12a. See also Efe 2001, 43, figs. 4.69; 11.181–183.

30 Cf. Parzinger 2005, 27, 30, pl. 18.7–9.

31 Cf. Vasić 1936, figs. 100–101; Furness 1956, 187; Fischer 1967, 24, fig. 1; Hauptmann – Milojčić 1969, 23–25; Jacobsen 1973, 273; Coleman 1977, 11–12, pls. 40–43, 86–88; Hood 1981, figs. 120, 129, 131; Gallis 1987, 155, fig. 7; Gropengiesser 1987, 34, 44; Felsch 1988, fig. 78; Overbeck 1989, 5; Sampson 1993, 298; Zachos 1999, 155; Sampson 2002, 103–104, fig. 115; Benzi 2008, 88, fig. 20.

32 Cf. Gabriel 2014; Blum et al. 2014.

33 Cf. Schlor 2005.

34 Gabriel et al. 2004, 121–122.

35 Kayan 2009, 120.

Fig. 7 Panoramic view of the Kesik Plain in summer 2012
(1) from southeast and (2) from northwest (photos: S. Blum).

of the Karamenderes valley into land. Between 3000 and 2000 BC the costal zones of the delta reached the Kesik inlet. Thereafter it was cut off, and in the interior of the depression a new, and purely local, phase of sedimentation processes began. Fine-textured colluvial sediments from the surrounding slopes slowly filled the bottom of the divided Kesik depression so that the chalcolithic settlement area, which originally lay on the tip of a narrow and low-lying ridge about 4–5m above sea level, was gradually absorbed into the present-day plain (Pl. 2).[36]

The settlement lies immediately over bedrock and lacks topsoil (Fig. 8). The resulting infertility was a serious problem for the current land owner, which he tried in 2003 to solve by ploughing the surface to a depth of about 50 cm – apparently unaware of its archaeological significance.[37] In the following years the area has been repeatedly ploughed and irrigated for agricultural use (Pl. 3.1–3). Today two to three acres of the surface area are covered by a thick layer of light colored sediment including particles of carbonised matter, with numerous potsherds, stone tools, and marine shells – generally large Cerostoderma, Ceridium and Ostrea (Fig. 9).[38]

Among the small finds collected, spindle whorls, clay disks, blades (one made of obsidian), scrapers, hatchets, querns, grinders, pounders and hammerstones predominate (Pl. 4.1–12).[39] The ceramic inventory of Alacalıgöl should be mainly seen as an eclectic continuation of the Middle Chalcolithic pottery production of the region. Several shapes and types of ware introduced in the preceding chronological horizons, that is Kumtepe IA and Beşik-Sivritepe, are still present.[40] On the other hand, it also clearly anticipates the Late Chalcolithic, for example with the occurrence of early bowls with rolled rims. Ring bases and pedestals with slotted or oval openings (Pl. 5.1–3) are well-known from Kumtepe IA,[41] as well as from Beşik-Sivritepe,[42] Çıplak[43] and Gülpınar (cf.

36 Kayan 2009, 117, fig. 10.
37 Gabriel et al. 2004, 121, figs. 2–3; cf. Kayan 2009, 119, figs. 6, 8, 23.
38 Gabriel et al. 2004, figs. 3, 20; Kayan 2009, 119–120, figs. 8, 23.
39 Cf. Gabriel et al. 2004, figs. 18, 20.
40 Cf. Gabriel et al. 2004, 130–132. See also Parzinger 2005, 62–63.
41 E.g. Özdoğan 1970, Lev. 52, a-269, b-7, c-3; Sperling 1976, pl. 72.18.
42 E.g. Seeher 1985, fig. 18.LL83-43.4; Gabriel 2006, fig. 2.11; Gabriel 2014, pl. 9.1–6.
43 Gabriel 2014, pl. 10.12–13.

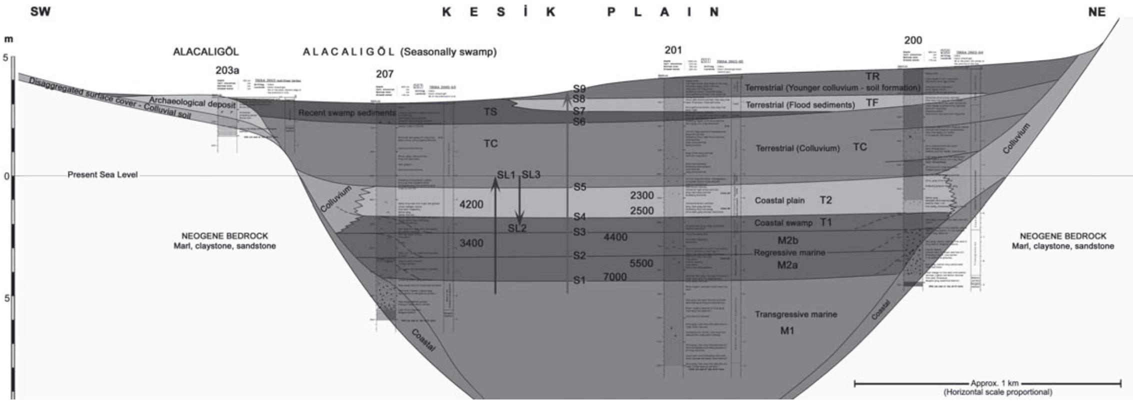

Fig. 8 Southwest–northeast cross-section of the Kesik plain (after Kayan 2009, fig. 15).

Fig. 9 Alacalıgöl, surface artefact scatter in summer 2012 (photo: S. Blum).

Fig. 6.1–5);[44] they also occur in Aşağı Pınar 2 to 3 in Turkish Thrace,[45] at Sitagroi I and Paradimi in eastern Macedonia,[46] Pevkakia-Magula in Thessaly[47] and in Karanovo III–IV in Bulgaria.[48] The same applies to eight fragments of so-called cheese pots, which are basically shallow pans with a row of perforations below the rim (Pl. 5.4–9).[49] Cheese-pots were in use over a long period of time and have been found at various sites in the Cyclades and Dodecanese, e.g. Parheni on Leros and Ftelia on Mykonos.[50] They are also sparsely represented at Aghio Gala Upper Cave on Chios and Emporio X–VIII.[51] The closest parallels for globular jars with cylindrical, collar- or outward-leaning necks and for wide-mouthed jars with inward-leaning rims[52] (Pl. 6.1–8) come from Beşik-Sivritepe, Çıplak and Kumtepe IB.[53] Open jars with raised bands set below the rim or on the body

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44 Gabriel 2006, fig. 2.11–12; Takaoğlu 2006, 297, fig. 9.21; Blum et al. 2011, 132.
45 Parzinger 2005, 13–14.
46 Bakalakis – Sakellariou 1981, fig. 28.4; Keighley 1986, 379, fig. 11.10.
47 Weißhaar 1989, 130.
48 E.g. Nikolov 2002, pls. IV2.22–23; IV5/4, 6, 8; cf. Bozhilov 2002, 83–93; Bozhilov 2005, 61–72.
49 Cf. Gabriel et al. 2004, fig. 8.1–2.
50 Sotirakopoulou 2008, 537–538, fig. 2.2. Cf. Schoop 2005, pls. 142.22; 145.25; 150.14; 157.9; Takaoğlu 2006, 301, fig. 11.32, 34–35; Benzi 2008, 96, fig. 37–38; Sampson 2008, 506; Gabriel 2014. See also Weißhaar 1989, 40, 130; Christmann 1996, pl. 139.19; Alram-Stern this volume.
51 Cf. Hood 1981, 37, 247–249, fig. 20.91–93; 119.14–31.
52 Cf. Gabriel et al. 2004, fig. 12, 13.
53 E.g. Sperling 1976, figs. 13.306–308; 19.624–627; cf. Takaoğlu 2001, 91, pls. 111–113; Parzinger 2005, pls. 6.4–10; 7.5; 9.6.

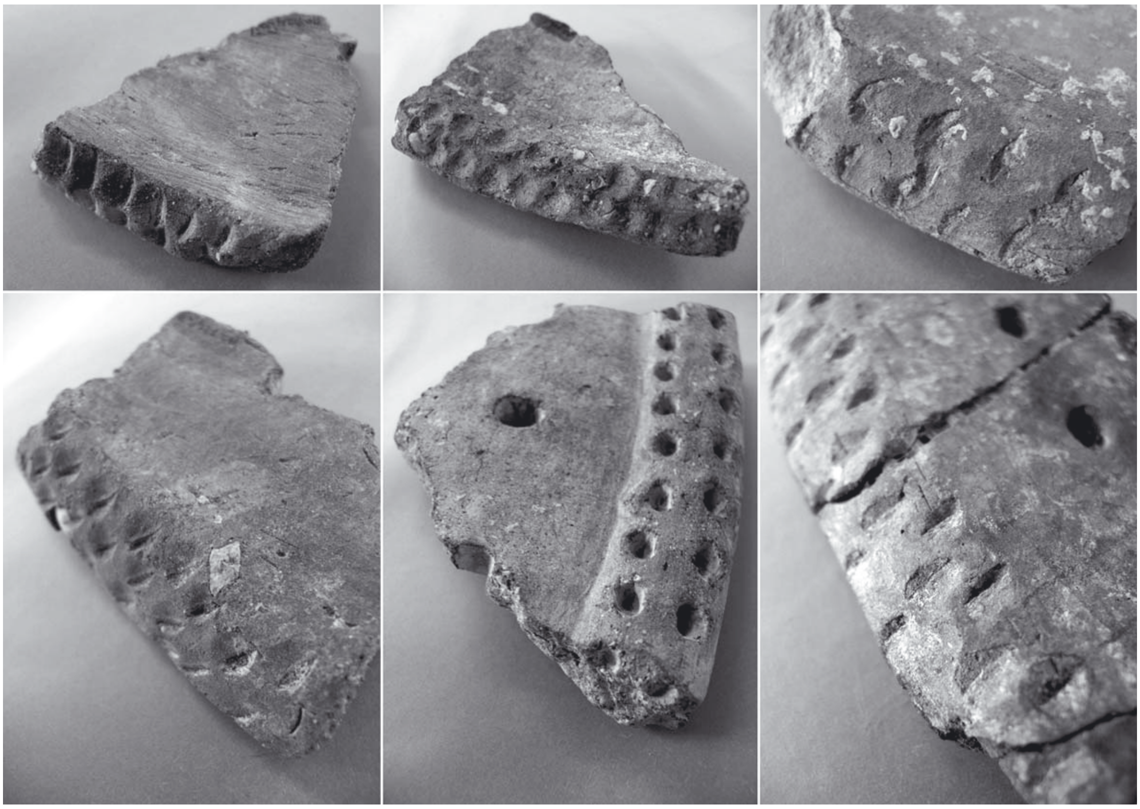

Fig. 10 Alacalıgöl, flaring bowls with decorated rims and encircling lines of holes (photos: S. Blum).

and decorated with impressions placed at more or less regular intervals (Pl. 6.8)[54] are also found at Gülpınar,[55] Beşik-Sivritepe,[56] Bozköy-Hanaytepe[57] and Kumtepe IB (cf. Fig. 6.6–9).[58] They are also present at Saliagos, Paradimi, Dimitra, Aşağı Pınar and at Karanovo III–IV.[59] Decoration is otherwise rare at Alacalıgöl. Two cup-like vessels bear incised ornaments on their bodies and shoulders (Pl. 6.9–10);[60] one bowl with very close parallels in the KGK VI-complex features a line of small notches running around it on the shoulder (Pl. 7.1);[61] one handle is twisted and several have decorative knobs (Pl. 7.2–5);[62] and two vertical handles are decorated with incised line motifs on their backs (Pl. 7.6–7). A single fragment made of fine black burnished ware with white-painted decoration stands out in the otherwise unpolished monochrome ceramic repertoire of Alacalıgöl (Pl. 7.10). Bowls with slightly convex or inverted sides, flat bases and various types of handles constitute the most common shape in the Alacalıgöl pottery assemblage (Pls. 8.1–8; 9.1–7); they clearly have prototypes in the earlier phases of the regional Middle Chalcolithic

54 Cf. Gabriel et al. 2004, fig. 11.1–2.
55 Takaoğlu 2006, 301, fig. 11.31.
56 Seeher 1987, fig. 18.LL83-34.17.
57 Blum et al. 2011, 131, 138, pl. 3.4; cf. Seeher 1985, fig. 18.LL83-34.17; Gabriel et al. 2004, 129, fig. 11.1–2, 15; Takaoğlu 2006, fig. 11.31.
58 Sperling 1976, fig. 16.314; cf. Özdoğan 1970, res. 94.
59 E.g. Evans – Renfrew 1968, 42–43, figs. 42–43; Bakalakis – Sakellariou 1981, figs. 19–20; Nikolov 1997, fig. 6.17; cf. Parzinger 2005, 25, pls. 6.8, 10.
60 Gabriel et al. 2004, fig. 4.1; cf. Georgieva 1993, fig. 2.1.
61 Gabriel et al. 2004, fig. 4.6; cf. Parzinger 2005, pl. 23.6.
62 Cf. Gabriel et al. 2004, figs. 16–17.

Fig. 11 Alacalıgöl, bowls with short rounded shoulders, pointy rims, and straight lips (photos: S. Blum).

since they are clearly observed at Çıplak,[63] Beşik-Sivritepe[64] and Gülpınar.[65] The same applies to a group of relatively large flaring bowls with decorated rims and encircling lines of holes (Fig. 10; Pls. 10.1–4; 11.1–4);[66] comparable pieces are known from Beşik-Sivritepe,[67] Limantepe (Larisa),[68] and Gülpınar (cf. Fig. 6.10–12).[69] Among the younger types of ceramic vessels in the Alacalıgöl repertoire are bowls with rolled rims (Pl. 12.7);[70] they already foreshadow the regional Late Chalcolithic in which they have a defining status, for example, in phase Kumtepe IB.[71] The occurrence of bowls with short rounded shoulders, pointy rims, and straight vertical to slightly inverted lips provides, however – at least at the moment – the strongest argument for dating the site in the chronological range of 4500 to 4000 BC (Fig. 11; Pl. 12.1–6). Typologically exact matches with motifs of graphite decoration are well attested in the Balkans, for example at Karanovo VI.1, where they constitute one of most characteristic vessel type in this horizon.[72]

Conclusion

Although it is fundamentally northwest Anatolian in its character, the material assemblage of Alacalıgöl has unmistakable typological traits in common with those of the complexes Karanovo V-Marica and Kodžadermen-Gumelniţa-Karanovo VI. The similarities are certainly not accidental since the cultural links between northwest Anatolia and the Balkans seem to have been already established in the early phases of the Middle Chalcolithic as attested, for example, by the occurrence of pedestal bowls and knob- and prong-handled vessels in both zones. Between 5000 and c. 4000 BC the Troad seems to have been part of a more or less unified cultural entity based on a system of several interacting sub-regions, i.e. northwest Anatolia, Turkish Thrace, and southeast Europe (Fig. 12).[73] These sub-regions developed simultaneously and under comparable socio-economic

63 Gabriel 2014, pl. 10.1–4.

64 E.g. Seeher 1985, figs. 16.LL83-56, LL83-65.2, PP83-10.2; 17.LL83-40.4, LL83-34.14, LL83-24.13, LL83-14.8, LL83-31.1; Korfmann 1989, 478, fig. 4; Gabriel 2014, pls. 5.1–5; 6.1–7.

65 Takaoğlu 2006, 295 figs. 6.1–8; 7; 10.24–27; cf. Seeher 2012, 121–122; see also Parzinger 2005, 19–20.

66 Gabriel et al. 2004, 129 fig. 6.3–4; 7.1–6.

67 Korfmann 1989, fig. 4.

68 Blum et al. 2014, pl. 16.1–2.

69 Seeher 1987, 541, 546, fig. 4.6; Takaoğlu 2006, 301, fig. 11.33.

70 Cf. Gabriel et al. 2004, fig. 5.1.

71 E.g. Koşay – Sperling 1936, 41; Özdoğan 1970, Lev. 10, 11; Renfrew 1972, 122–123, 153–154, 161–163, fig. 10.1.2–16; pl. 4; Sperling 1976, 327, 330, 332–333, 338–339, 343; Korfmann et al. 1995, 240, figs. 29.2; 32.1; 37.4; 38.8; Schoop 2005, 269–270; Sotirakopoulou 2008, 538–539, fig. 2.3.

72 Cf. Schlor 2005, 91, 138, pls. 126; 127.1–5.

73 Cf. Özdoğan 1993a, 183–184, pls. 1, 3; Gabriel et al. 2004, 130–132. See also Weißhaar 1989, 130–131; Özdoğan 1991, 217, 220; Parzinger 2005, 43–61, 66; Schoop 2011b, 33–38.

conditions.[74] However, region-specific demands appear to have been met by the employment of unique strategies, for each sub-region developed its own set of types and decorative motifs despite being open to influences from the others. Consequently, there are as many similarities as there are differences between the Alacalıgöl inventory and those of the adjacent cultural spheres. Several significant features of the Alacalıgöl repertoire of pottery and small finds are represented at sites in southeastern Europe. Conversely elements typical of these Balkan sites can occur at Alacalıgöl but do not always do so.

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Fig. 12 Middle Chalcolithic Sites in Turkey, cultural affiliation (illustration: S. Blum).

[74] Cf. Özdoğan 1993a, 177; Özdoğan 1993b, 154–156.

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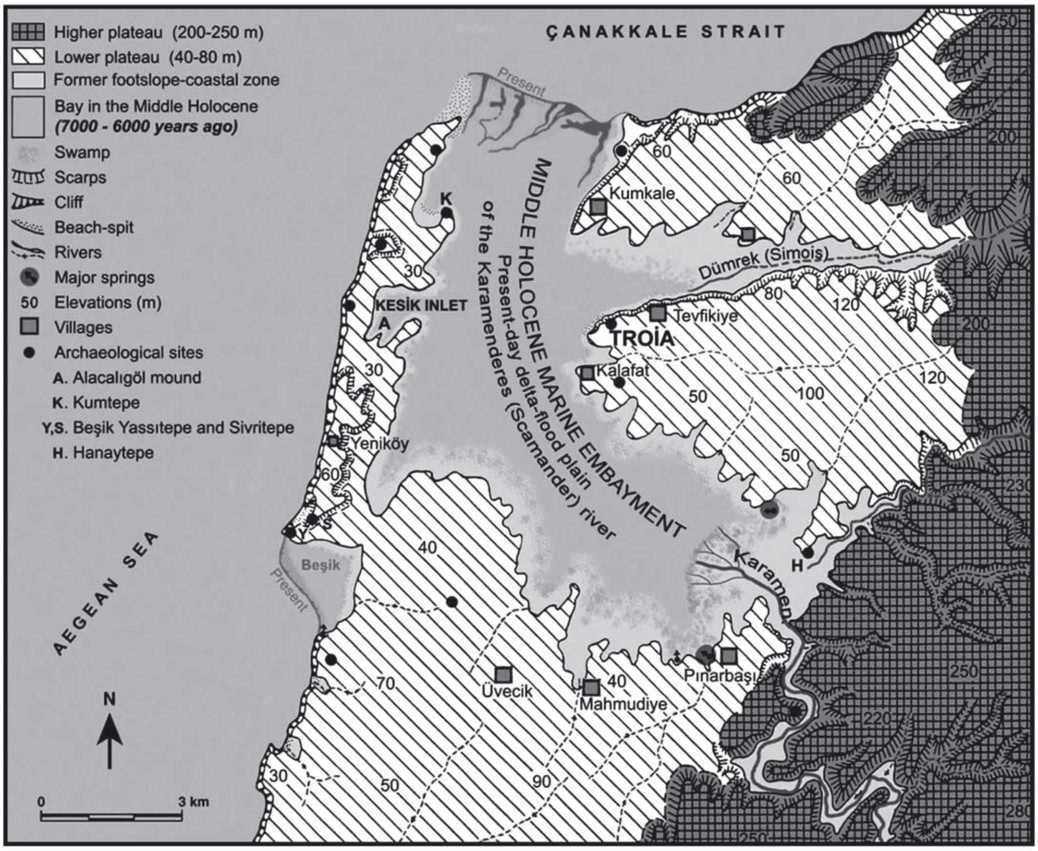
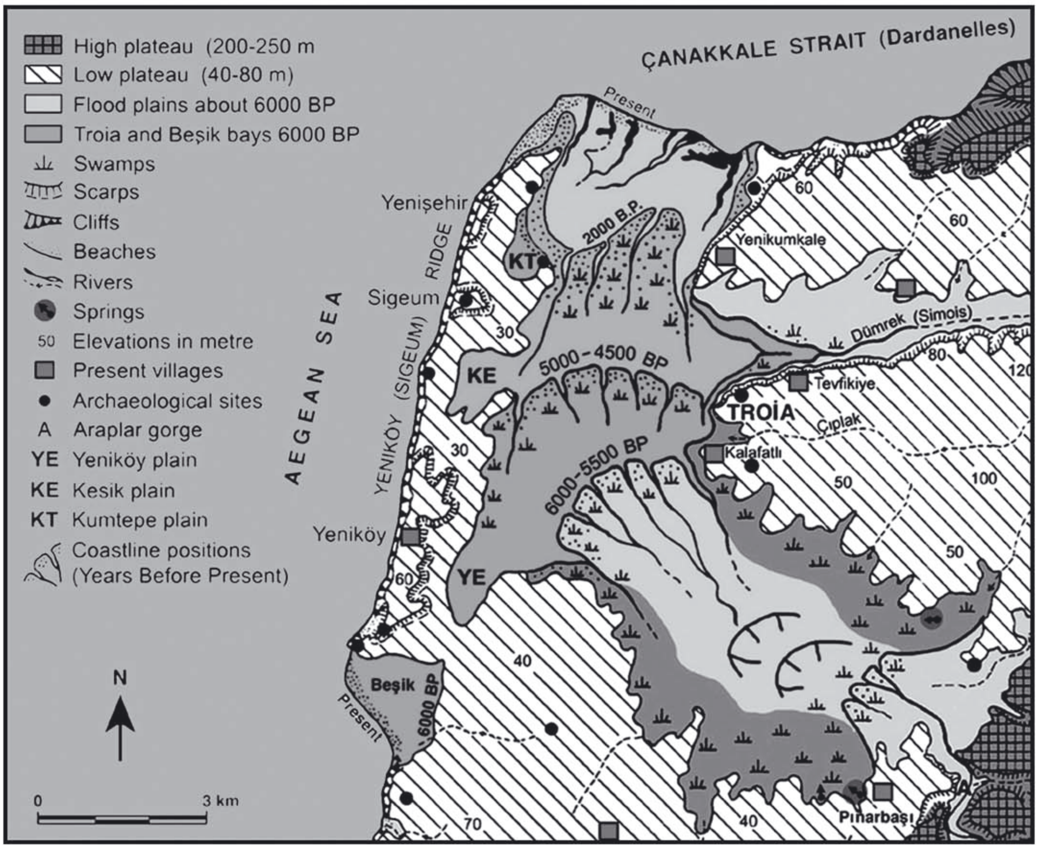
Pl. 1 Northwestern Troad, Middle Chalcolithic settlements (NASA and IKONOS, Space Imaging Inc. 2001).



1



2

Pl. 2 Palaeogeographical reconstruction (1) and geomorphological development of the Karamenderes (Scamander) plain (2) (after Kayan 2009, figs. 9–10).

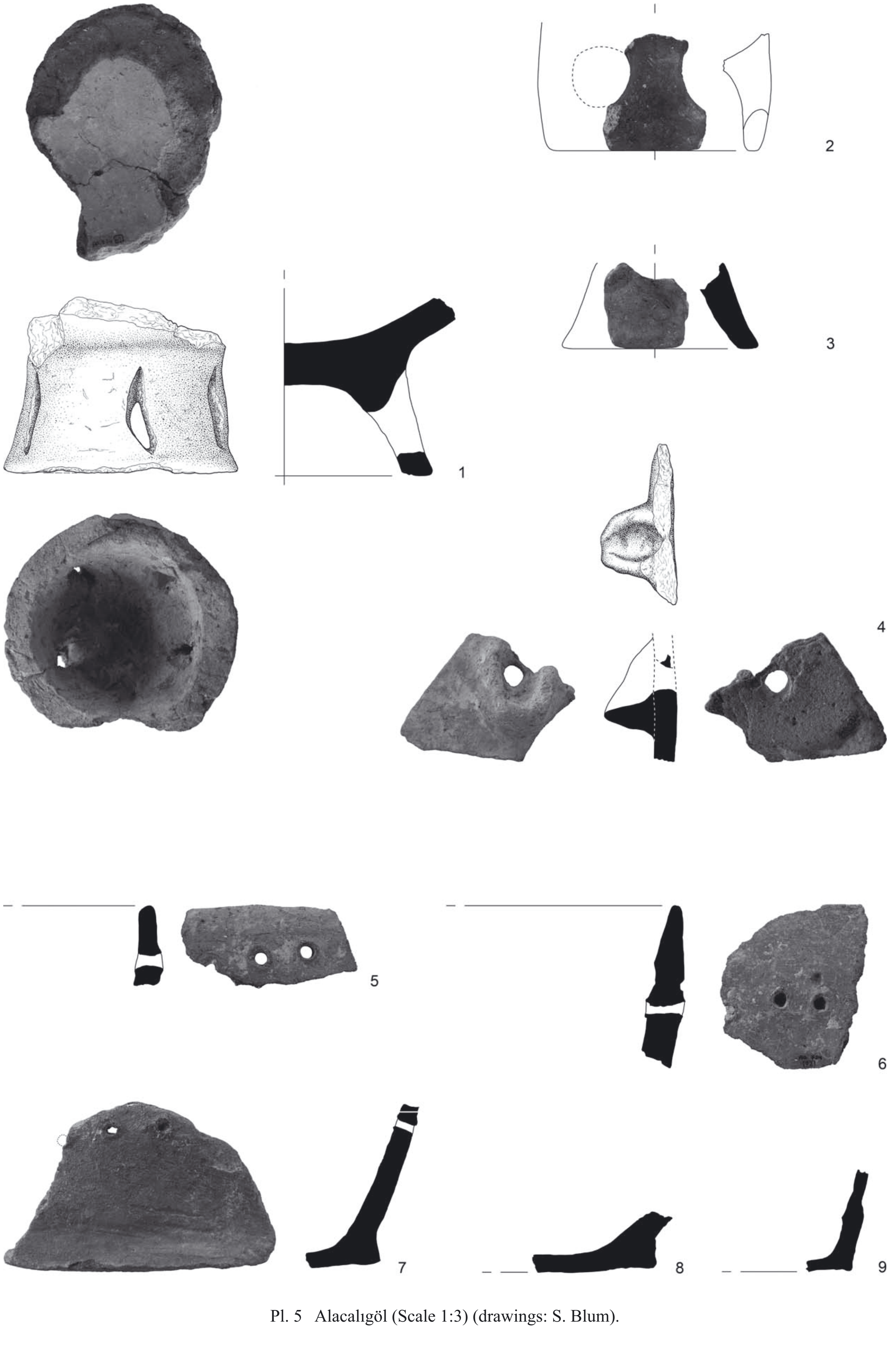

2003


2011

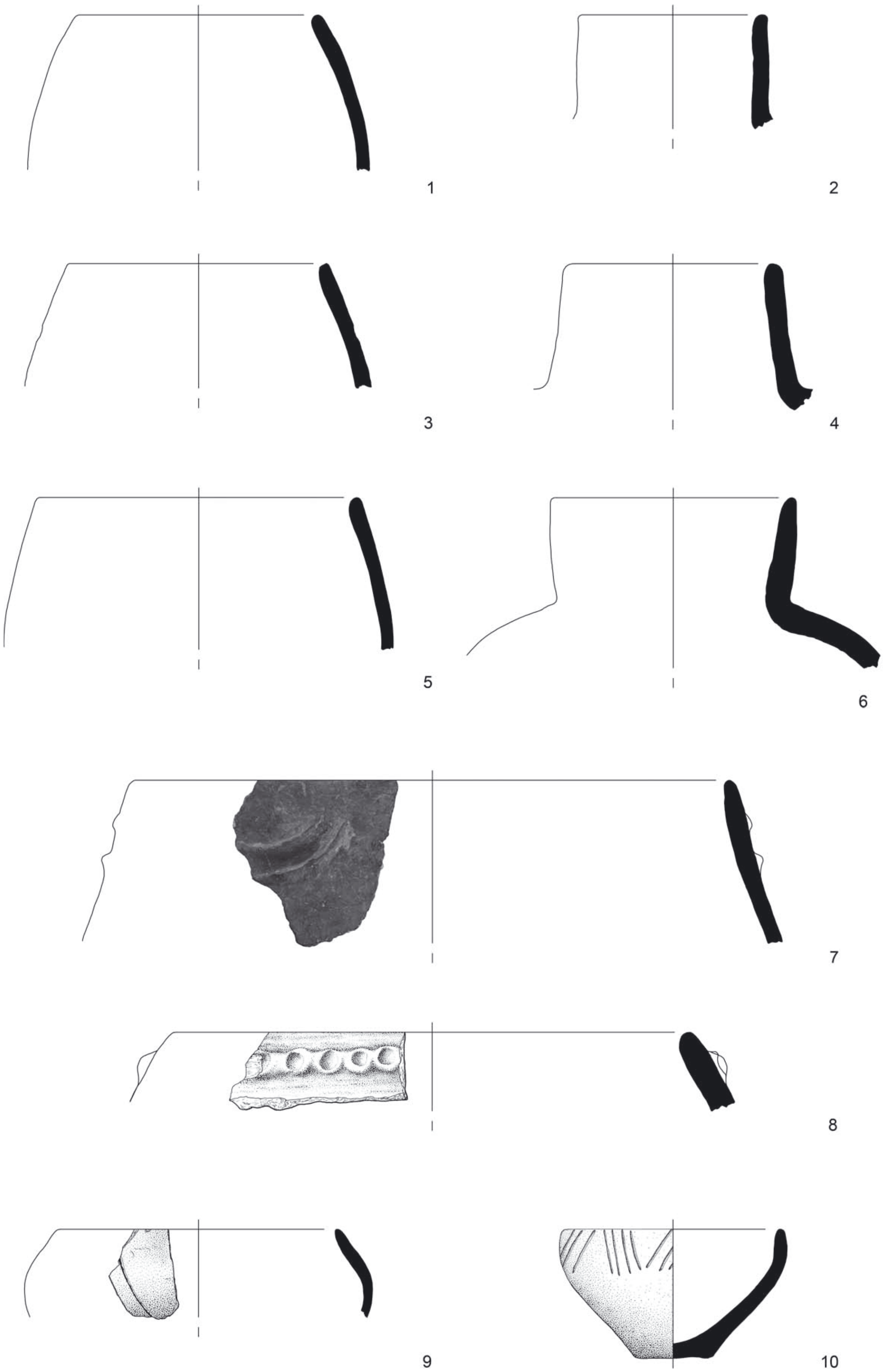

2012

Pl. 3 Alacalıgöl (photos: S. Blum).

Pl. 4 Alacalıgöl (Scale 1:3) (drawings: S. Blum).

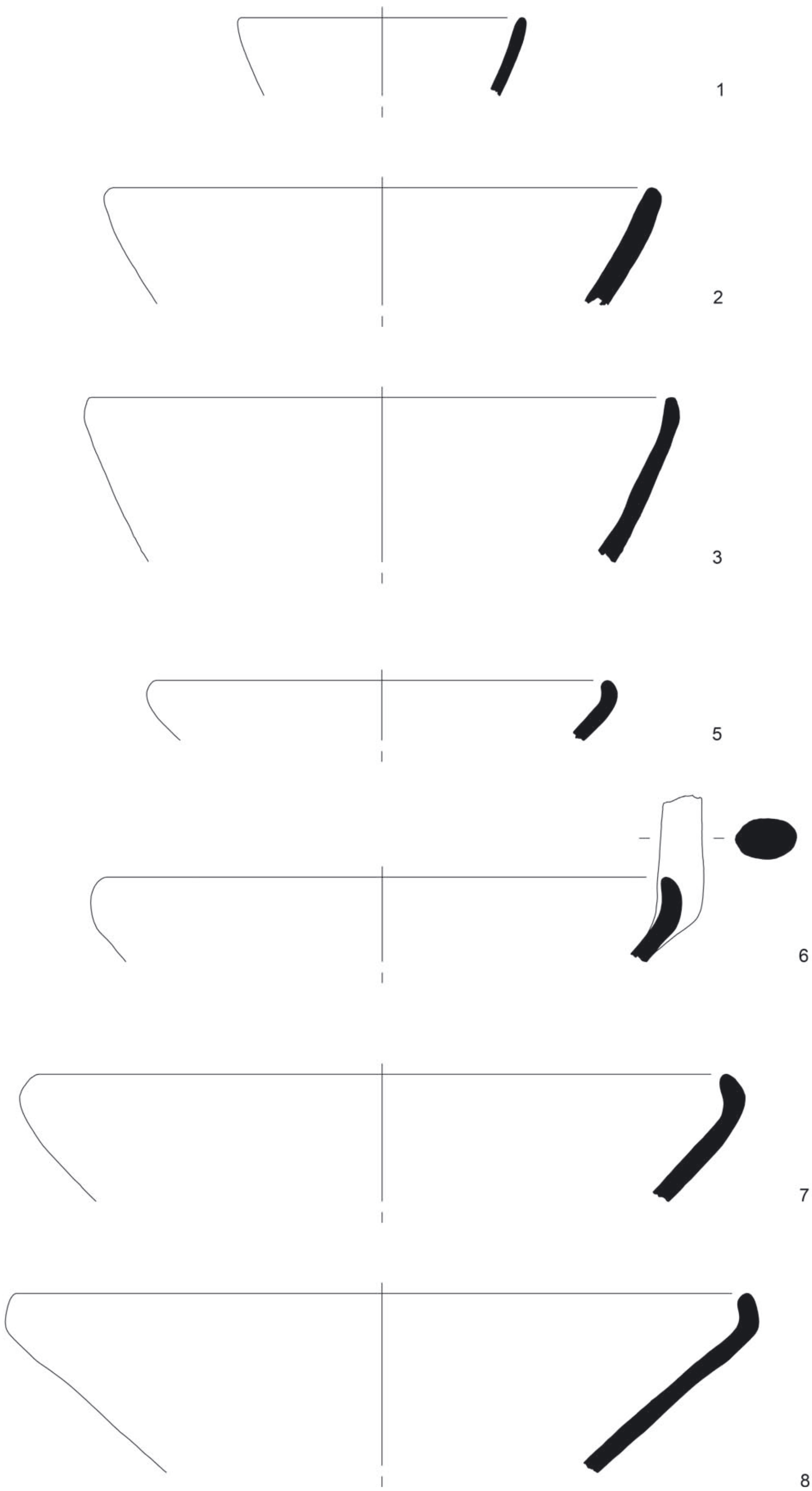


Pl. 5 Alacalıgöl (Scale 1:3) (drawings: S. Blum).

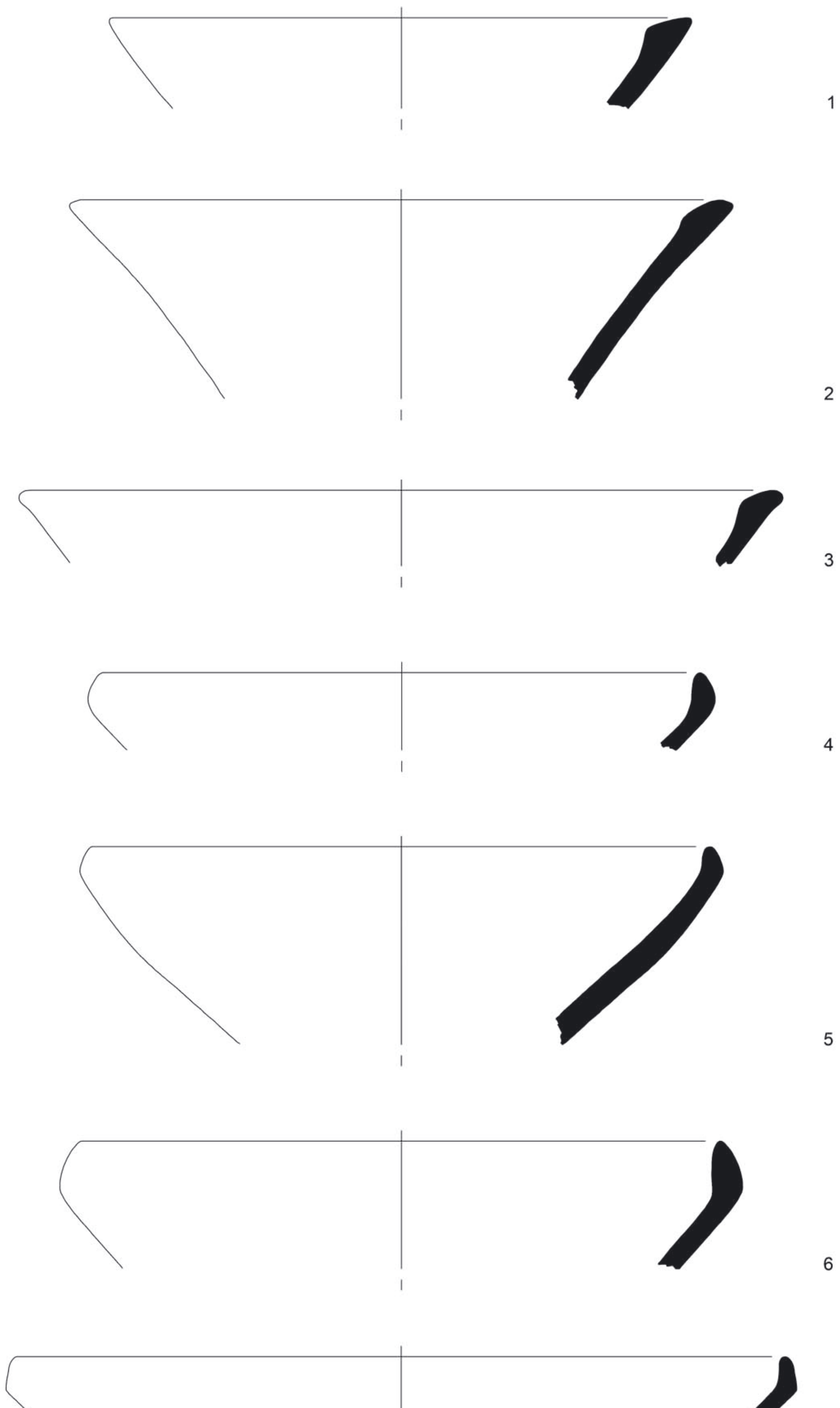


Pl. 6 Alacalıgöl (Scale 1:3) (drawings: S. Blum).

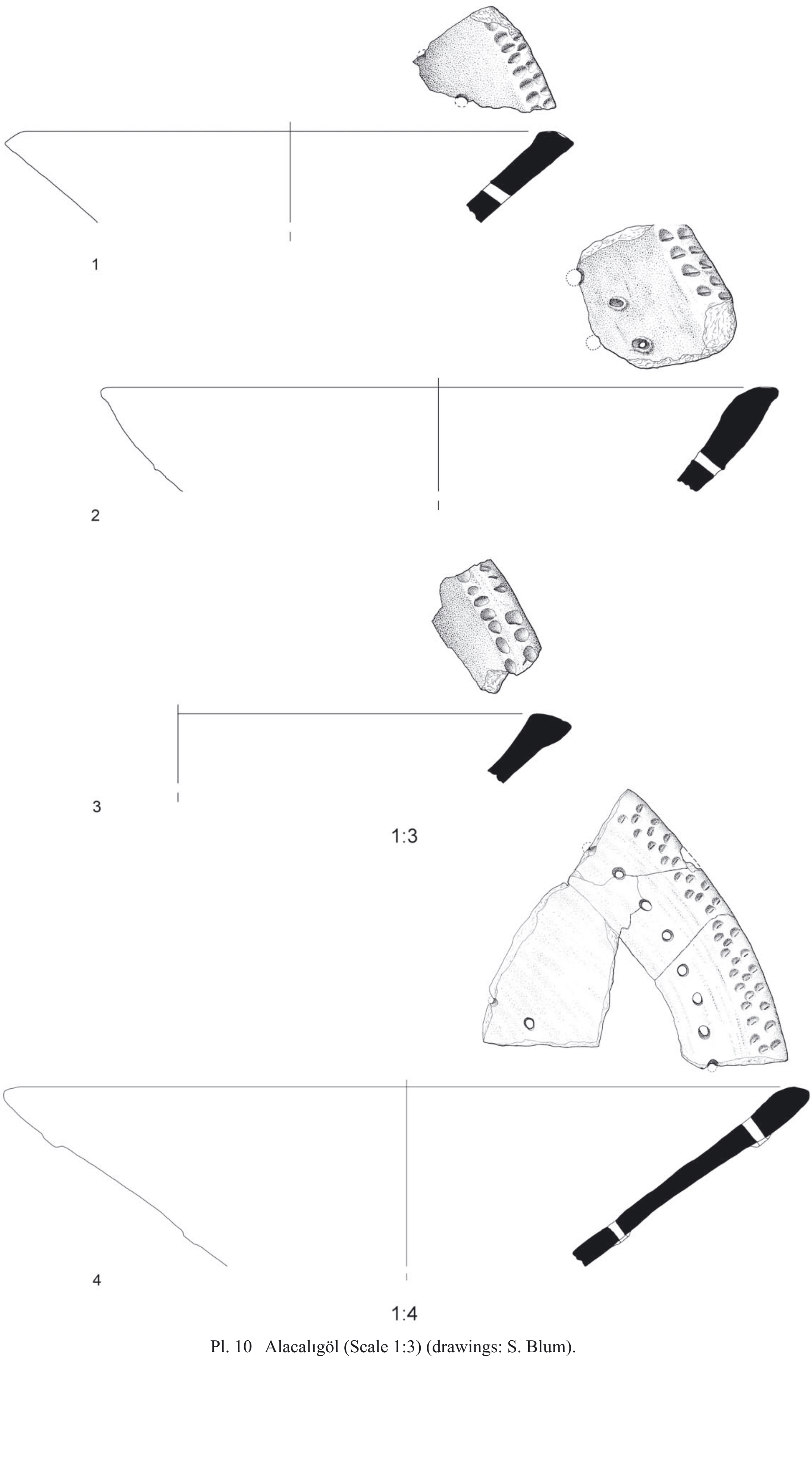
Pl. 7 Alacalıgöl (no. 10 scale 1:2; otherwise scale 1:3) (drawings: S. Blum).



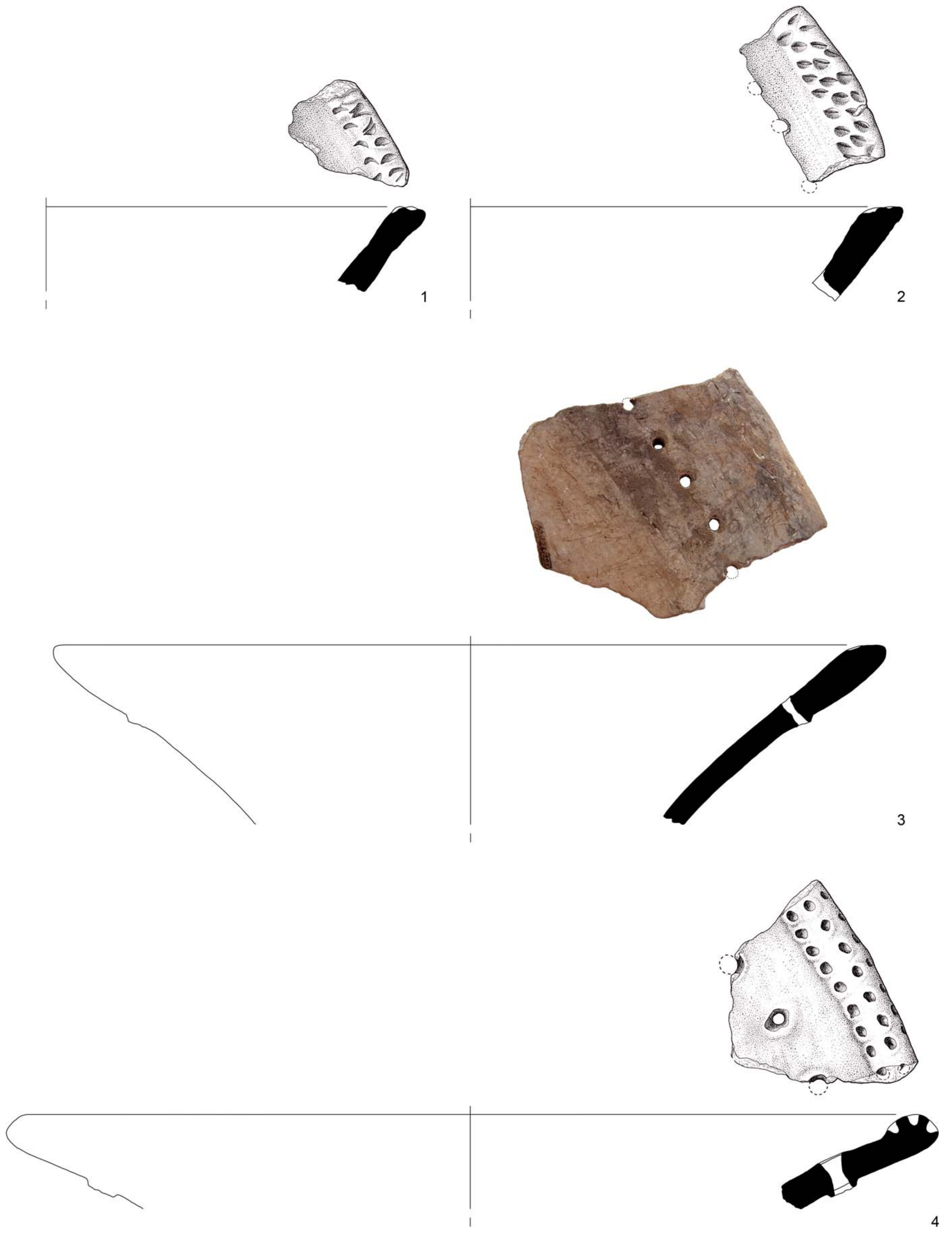
Pl. 8 Alacalıgöl (Scale 1:3) (drawings: S. Blum).



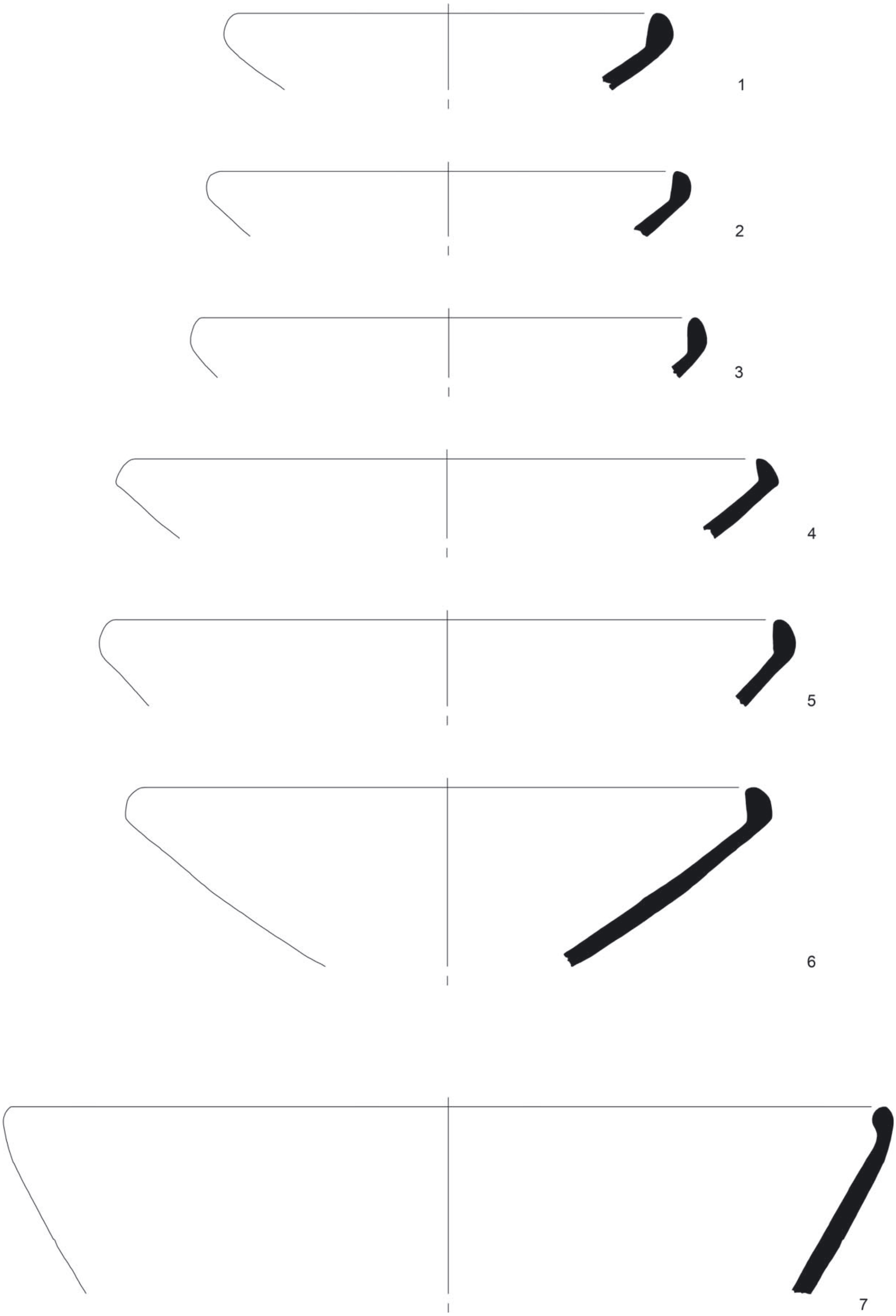
Pl. 9 Alacalıgöl (Scale 1:3) (drawings: S. Blum).



Pl. 10 Alacalıgöl (Scale 1:3) (drawings: S. Blum).



Pl. 11 Alacalıgöl (Scale 1:3) (drawings: S. Blum).



Pl. 12 Alacalıgöl (Scale 1:3) (drawings: S. Blum).

The Early Bronze Age Chronology of Troy (Periods I–III): Pottery Seriation, Radiocarbon Dating and the Gap

Bernhard Weninger,[1] *Donald Easton*[2]

Abstract: Detailed re-analysis of N=76 previously published ^{14}C-ages from Early Bronze Age (EBA) Troy (northwestern Anatolia) provides an absolute chronology for periods I–III with dating precision ± 30 yrs (68% confidence). As shown by pottery seriation (Correspondence Analysis: CA) of Blegen vessel shapes for periods I–V, there are indications for an extended (multi-phase) gap in the EBA-sequence between periods III and IV. A similar gap can be recognized in the ^{14}C-dates from Troy IV and V. As it appears, following desertion at the end of Troy III around 2150 calBC, the site was abandoned for some (estimated) 100–200 years. However, we were unable to identify the gap in the pottery data of Schliemann. The possibility of a break in the Troy EBA-sequence deserves further studies.

Keywords: Turkey, northwestern Anatolia, Troy, Early Bronze Age, radiocarbon, chronology

In this paper we present a re-analysis of Early Bronze Age (EBA) radiocarbon dates from Troy (periods I–III), all of which have been previously published.[3] The large majority of these dates derive from the very earliest years of the excavation,[4] that is, from a phase of archaeological research long before it was possible to use the ^{14}C-AMS-technology for dating of small (milligram-sized) samples, e.g. short-lived animal bone and grain. All available ^{14}C-dates were measured by ß-decay counting, for which large amounts of carbon (typically: many grams) were required. In consequence, the ^{14}C-database consists almost entirely of measurements made on archaeological charcoals. This non-ideal sample selection immediately complicates the analysis by introducing samples which may be significantly older than the deposits they appear to date. Furthermore, although some large numbers of ^{14}C-ages are available for Troy IV and V,[5] the present studies are restricted to the periods Troy I–III. The reasons for this decision will be described below.

Radiocarbon Database

The radiocarbon database for Troy I–III is assembled in Appendix, Tab. A. It contains a total number of 76 ^{14}C-ages. For each dated sample we provide the following information: Laboratory code (*Lab Code,* to be used in the following as sample identifier), architectural *phase*, dated *material*, excavation unit (*Behälter Nr.,* according to the Tübingen documentation system), conventional ^{14}C-age [BP], and metric coordinates to identify the spot at which each sample was found (stratigraphic depth: *height, x, y*). The majority of this data is taken from Korfmann and Kromer.[6] An important exception is a change in the stratigraphic position of the charred wooden-beam from Quadrat D5 (*Beh.Nr.* D5.365; Appendix, Tab. A, Nos. 60–68) that was initially attributed to Troy

1 Institut für Ur- und Frühgeschichte, Universität zu Köln, Germany; email: b.weninger@uni-koeln.de.
2 12, Weltje Road, London W6 9TG; email: donaldfeaston@hotmail.com.
3 Korfmann – Kromer 1993; Sazcı 2001; Ünlüsoy 2010.
4 Korfmann – Kromer 1993.
5 Blum 2012.
6 Korfmann – Kromer 1993.

Ib/c,[7] but which more likely belongs to Troy Id or to a later phase of Troy I.[8] Further information as to the stratigraphic position and architectural dating is based on Sazcı and Ünlüsoy.[9] Missing values, and in particular the stratigraphic depths for samples Appendix, Tab. A, Nos. 15–32 from the Pinnacle were kindly provided by Sinan Ünlüsoy, using the primary excavation documents (*Tagebücher*) that are stored in the Institute of Prehistory at the University of Tübingen. The large majority (82%) of ^{14}C-ages were measured at the Heidelberg Radiocarbon Laboratory (Lab Code Hd: Bernd Kromer). Further laboratories participating in the ^{14}C-dating project are Berlin (Bln: Jochen Görsdorf) and Köln (KN: Jürgen Freundlich). As mentioned above, the radiocarbon ages under study in the present paper were all measured by (large sample) ß-decay counting.

The radiocarbon database (Appendix, Tab. A) contains a supplementary column (on the far right) which is headed by 'model age' calBC (68%). This specific column provides a documentation of dating results we have obtained in the present paper for each individual sample. Strictly speaking, these results should not be referenced as *calibrated ages* (we use this terminology only for simplification), but rather as *modelled calibrated ages*. This is because these results were obtained, not by single-age calibration, but by stratigraphic-statistical modelling. The model-analysis was performed using stratigraphic data subsets, as shown below in Fig. 1.

Time-Scales and Data Notation

All absolute dates given in this paper are based on tree-ring calibrated ^{14}C-ages, with results referenced to the calendric scale time [calBC] (yrs before Christ). Conventional ^{14}C-ages are given on the ^{14}C-scale with units [BP]. When addressing the ^{14}C-ages, we always provide the measured (uncalibrated) ^{14}C-age value (e.g. 3797 ± 25 BP) in combination with its Laboratory code/sample identifier (Hd-20174). A typical notation is therefore Hd-20174 (3797 ± 25 BP). This citation corresponds to recommendations of the radiocarbon community.[10] It can be extended to cover calibrated ages, in which case we use the notation: Hd-20174: 3797 ± 25 BP (2230 ± 40 calBC). This specific notation does not conform to international agreement. Normally, the '±'-symbol is reserved for Gaussian-shaped probability distributions. We nevertheless use it, quite pragmatically, to replace the otherwise unreadably long list of alternative calendric-scale intervals, with their equally complex interval-internal mixture of logically exclusive [either/or] and logically inclusive [both/and] readings, the assigned 'probability' values of which do not add up to 100% anyway.[11]

Technically, what we refer to as calibrated ^{14}C-ages (with 'median' and '±' values) are based on the *shortest* interval that covers 95% of the total area of the calibrated probability, optimised in direction of the calendric time-scale (e.g. for Hd-20174: 2330–2130 calBC). The centre half of this interval is taken to define the calibrated '±' value. The centre of the interval defines the calibrated 'median'. This simple procedure works acceptably for the majority of archaeological ^{14}C-ages available today, which have $\sigma \geq 25$ BP. For increasingly Gaussian-shaped distributions, it produces results that converge to the normal definition of 'median' and of '±' (68% confidence). In particular, since the median values are defined so that they sensitively lock into the middle of what the observer recognises as *wiggles/plateaus* of the calibration curve, this notation corresponds in *ideal* manner to the non-commutative algebra and corresponding quantum probability theory that is so characteristic for all ^{14}C-ages.[12]

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7 Korfmann – Kromer 1993, 157.
8 Easton – Weninger in preparation.
9 Sazcı 2001; Ünlüsoy 2010.
10 Most recently: Reimer et al. 2013.
11 Weninger et al. 2011.
12 Weninger et al. 2011.

Dörpfeld	Blegen	Korfmann	Ünlüsoy (2010)	Radiocarbon Data Sets Under Study in this Paper
	TROIA III	not studied		Historical Set (Tab. A, Nos. 1–13) Not analysed
TROIA III	IIg	(Phase 44)	Troia III	
	IIf	(Phase 42)		
TROIA II	IIe	(Phase 41)	IIc3	Pinnacle E4/5
	IId	(Phase 40)	IIc2	
II.3	IIc	Iu (Phase 39)	IIc1	
		It (Phase 38)	IIb4	
II.2		Is (Phase 37)	IIb3	Troia IIa1 – Troia III (end) (Tab. A, Nos. 15–32, 33–39)
		Ir (Phase 36)	IIb2	
		Iq (Phase 35)	IIb1	
	IIb	Ip (Phase 34)	IIa2	
II.1	IIa	Io (Phase 33)	IIa1	
TROIA I		In (Phase 32)	In	
		Im (Phase 31)	Im	Phases Il–Im not ^{14}C-dated
		Il (Phase 30)	Il	
	(Ik)	(Ik)	(Ik)	‘Phase Ik’ excluded from age-models
	Ij	Ij	Ij	
	Ii	Ii	Ii	
	Ih	Ih	Ih	
	Ig	Ig	Ig	
	If	If	If	Troia Ia–Ij (Tab. A, Nos. 69–74, 40–59)
	Ie	Ie	Ie	
	Id	Id	Id	Troia Id Beam (Tab. A, Nos. 60–68)
	Ic	Ic	Ic	
	Ib	Ib	Ib	
	Ia	Ia	Ia	Troia Ia (Nos. 69-74)
				‘Older than Ia’ (Tab. A, Nos. 75-76) Not analysed

Fig. 1 Periodization of Early Bronze Age Troy (periods I–III) according to Dörpfeld (1902), Blegen et al. (1950; 1951), Korfmann (1999), and Ünlüsoy (2010). The vertical lines (Fig. 1, right) indicate the architectural time-spans covered by the separately analysed (floating) ^{14}C-data subsets.

Methods

All radiocarbon determinations were age-calibrated by employing the INTCAL13-database,[13] which is integrated into the CalPal-software we use here for ^{14}C-age calibration.[14] As discussed below, the ^{14}C-analysis is strictly (technically) speaking not based directly on INTCAL13-data,

13 Reimer et al. 2013.

14 Weninger – Jöris 2008.

but rather on a spline-representation of the calibration curve that uses INTCAL13-data as support points. We use this spline to produce a continuous (annual-spaced) calibration curve through the discontinuous (5-yr spaced) INTCAL13-data. Although of relatively minor importance, we nevertheless report on the error-analytical implications of this approach (cf. below). CalPal further incorporates a database that contains the primary raw-data used in construction of INTCAL13. For all laboratories that participated in the construction of INTCAL13, in CalPal-software the laboratory raw-data can be selected, either to produce a calibration curve, or else simply to project the laboratory raw-data onto the specific calibration curve under study. In the present paper we apply this projection to the INTCAL13-data sets called SET 1 (Belfast), SET 2 (Seattle) and SET 5 (Pretoria), which are the components relevant to our studies. Before continuing, we would like to emphasise our gratitude to all researchers involved in calibration curve construction[15] and, in particular, to the authors of the extremely useful INTCAL13-database available online at the Belfast home-site[16] from which we have obtained these specific (and other) laboratory data sets.

Periodization of EBA-Troy

Over the course of the last 130 years, the nomenclature used to describe the stratigraphy at Troy in terms of architecture and material culture has become increasingly complex. In the present paper we make use of the nomenclature shown in Fig. 1. This periodization has the following historical background. As a result of his initial excavations, Heinrich Schliemann was able to identify a threefold number of 'Cities' or '*Schichten'* (i.e. layers) which he called First, Second and Third *Schicht*. His architect Wilhelm Dörpfeld then provided further subdivisions, called Troy II.1, II.2 and II.3. These are defined mainly by the threefold extension of the Troy II fortification system.[17] As a result of excavations undertaken in 1932–1938 for the University of Cincinnati, Carl Blegen and his team were able to refine Dörpfeld's periodization by the introduction of sub-phases (written with small letters e.g. Troy I a, b, c; Troy IIa–IIg, etc.[18]

The intention was not only to establish a more detailed architectural framework, but also to define a sequence of architectural/stratigraphic units that could be used on-site to synchronise, by pottery comparisons, the large number of 'floating' local stratigraphic sequences that had survived the partially destructive earlier excavations. To this end, Blegen and his team-members are quite particular in emphasizing that certain pottery assemblages represent finds (collected in baskets) from 'certified' or 'safely attributed' architectural phases. However, since the envisaged certification was not always possible (e.g. for clearly reworked deposits), as an alternative to leaving these finds undocumented, the Cincinnati team introduced a number of broader designations in order to describe the position of each pottery assemblage, with as much detail as possible. With reference to profiles and deep soundings, this concept led to descriptions such as 'Upper/Middle/Lower'. With the same intention, the Cincinnati team introduced a number of subperiods (e.g. Troy I Early with phases Ia–c; Middle (d–f) and Late (g–k). Although this broader subdivision is widely used even today, and is indeed convenient, we have refrained from applying it to the ^{14}C-data, for reasons described below.

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15 Reimer et al. 2013.

16 <http://intcal.qub.ac.uk/intcal13/> (last accessed 28.02.2014).

17 Dörpfeld 1902.

18 Blegen et al. 1950.

^{14}C-Dating of EBA-Troy: General Approach

The general dating strategy used in the present paper is to independently analyse the different 'floating' sub-sets of ^{14}C-data and finally combine the results to achieve a continuous ^{14}C-chronology for Troy I–III. Obviously, prior to this analysis, we must first optimize the ^{14}C-dating on the sample level, and to this end each sample must be attributed as precisely as possible to some specific stratigraphic or architectural unit. Simultaneously, the dating results must also be optimized in terms of the pre-established stratigraphic/architectural periodization. As it appears, the targeted highest possible *joint* (^{14}C-radiometric and stratigraphic/architectural) dating precision can presently be obtained only by referencing the results to the *mixed* nomenclature shown in Fig. 1. Closer inspection of Fig. 1, however, shows that the specific periodization proposed by Ünlüsoy[19] not only covers Blegen's subdivision for Troy I (phases Ia–Ij), with Ik representing a levelling phase prior to the construction of the first Troy II fortification wall; it also allows for three previously unknown phases of Troy I (called phase 30–32 by Korfmann, or alternatively 'Blegen Il–In' by Ünlüsoy). In particular, Ünlüsoy introduces a more refined architectural sequence for Troy II, which allows for the introduction of five new phases (IIb1–IIb4) in the transition from Early Troy II to Middle Troy II. Hence, by using his nomenclature, we can back-reference all published ^{14}C-ages to all previous periodizations, including those of Dörpfeld and Blegen, and in particular those of Korfmann.

Prior to the ^{14}C-analysis, we have undertaken efforts to maintain control over the ^{14}C-sample sequence. To this aim, the present studies include a re-analysis of results achieved by seriation of the EBA-pottery.[20]

^{14}C-Dating at EBA-Troy: Limitations of Single-Date-Analysis

What first complicates the ^{14}C-analysis, following this decision, is that the majority of available ^{14}C-dates, when calibrated individually, actually provide only limited support for the targeted high-resolution chronology. This is due to the extremely wiggly character of the ^{14}C-age calibration curve in the time-window under study. The indeed quite devastating impact of the shape of the calibration curve on the precision (and accuracy) of the individually calibrated ^{14}C-ages is illustrated in Fig. 2 for the overall time-window 3100–1900 calBC.

The two vertical lines at 2820 and 2630 calBC and corresponding horizontal line at 4100 BP demonstrate that two samples of quite different calendric age (for example 2820 and 2630 calBC) may have the same ^{14}C-age (4100 BP). Allowing for the finite dating precision of real ^{14}C-measurements (even for the high-precision measurement Hd-20174: 3797 ± 25 BP), the folding properties of the calibration curve lead to an extreme widening (and age-distortion) of the initially Gaussian-shaped ^{14}C-dating probability distribution. In consequence, it is impossible to use single calibrated ^{14}C-ages to precisely date any one of the architectural phases for Troy I–III.

The existence of such difficulties becomes all the more apparent, when we take a closer look at the structure of the calibration curve. We illustrate this for the presently recommended calibration data set INTCAL13 (Fig. 3), noting that in this section of the Holocene the INTCAL13-data set is identical to the previous datasets underlying INTCAL09 and INTCAL04. With minimal variations (max 10 yrs) this also applies to the corresponding CalPal-splines. As mentioned above, for technical reasons it is necessary to run a continuous (1-yr spaced) spline-curve through the given (5-yr spaced) INTCAL-data. However, as shown in Fig. 3, the CalPal-generated curve does not perfectly reproduce the INTCAL-data. Although the deviations are generally small (~ 10 yrs), at certain points (e.g. ~ 2460 calBC) the CalPal-spline does show

19 Ünlüsoy 2010.
20 Weninger 2002.

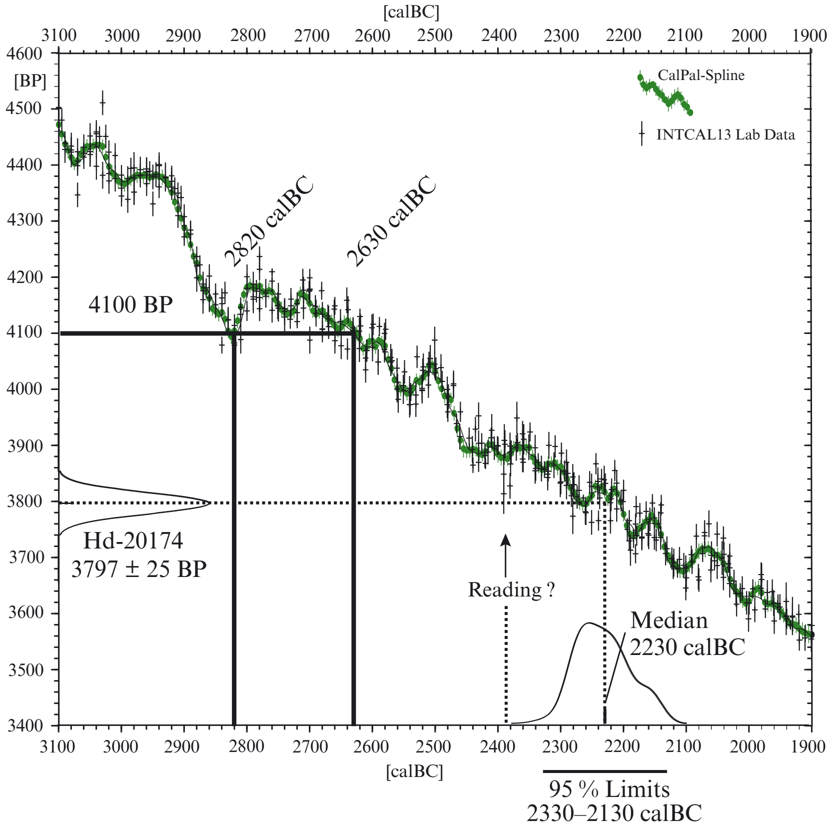


Fig. 2 High-precision ^{14}C-age calibration curve (Reimer et al. 2013) in the time-window 3100–1900 calBC. The CalPal-spline is built from 5-yr spaced INTCAL13-data (shown but not visible). The graph also shows the lab-data of Belfast, Seattle and Pretoria (error bars with ± 1 σ length). The calibration procedure is illustrated for Hd-20174: 3797 ± 25 BP (2230 ± 50 calBC).

larger variations (max. 20 yrs) from INTCAL, and these variations occur on both scales (^{14}C and calendric). Technical difficulties with similar magnitude (some few decades) can also be observed, when the INTCAL13-data is itself compared with the underlying laboratory raw-data (Fig. 3). Since it is technically hardly possible to presently achieve yet higher precision, in the present paper we make allowance for such variability by three complementary approaches, two of which are analytical and one is graphical. First, for single ^{14}C-ages, an additional error of σ = 10 BP is added (squared) to the given standard deviation. Second, for wiggle-matching studies, an additional error of σ = 10 BP is added to the CalPal-spline during Monte Carlo simulation. Third, and this is an optional graphic procedure, it is possible to show the tree-ring calibration *curve (*as wiggly line) in context with the laboratory raw-data (± 1 σ data bars). This graphic approach is especially useful, since it enables visual evaluation of the age-position obtained for the archaeological ^{14}C-data, in comparison to the laboratory raw-data. As is well-known, there are certain age-intervals (e.g. ~1180 and ~1330 calBC) for which the INTCAL04 calibration curve appears to be over-smoothed.[21] Irrespective of whether these particular wiggles are confirmed in future, or not, in the analysis of archaeological ^{14}C-data it is advisable at least to allow for the possibility that the (real-world) calibration curve does not necessarily reflect the exact amplitude and frequency of the atmospheric ^{14}C-variations. However, for the (large: multi-ring) charcoal samples under study in the present paper, we may reasonably expect some in-built smoothing

[21] Weninger – Jung 2009.

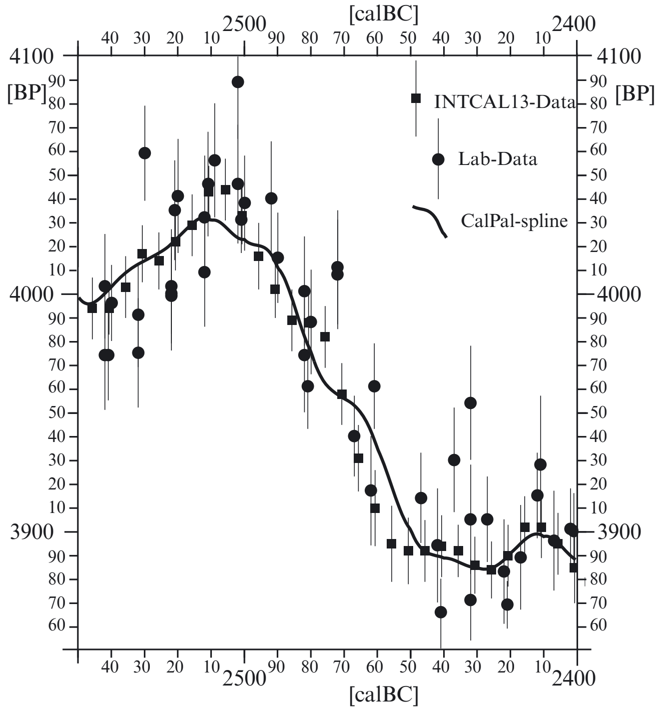


Fig. 3 Zoom into the ^{14}C-age calibration curve (Reimer et al. 2009) in the time-window 2550–2400 calBC (3850–4100 BP). INTCAL13 5-yr-spaced support points are shown as square dots with error bars (± 1 σ). Underlying Lab-data of Belfast, Seattle and Pretoria are shown as circular dots with error bars (± 1 σ). The spline-representation of the ^{14}C-age calibration curve generated by CalPal from INTCAL13 support points is shown as a continuous line.

(decadal scale) of the calibration curve.[22] In this case the possible existence of such unresolved wiggles is unlikely to be significant for the ^{14}C-ages at Troy.

Closer inspection of Fig. 2 shows that, around 2400 calBC, a number of high-precision measurements are (seemingly) not well-represented by the INTCAL13-curve. Indeed, as indicated by the vertical dashed line (headed with an arrow), there could exist an older reading ~ 2400 calBC for Hd-20174 (3797 ± 25 BP) that is not covered by the given distribution of calibrated ages. From the perspective of carbon-cycle modelling, short-lived (grain) samples are indeed capable of recording atmospheric ^{14}C-variations at a higher frequency than is possible with long-lived charcoal. However, in this specific case, we judge that the older reading is not a real option, since such extremely high-frequency atmospheric ^{14}C-variability does not appear possible due to the growth width of 10 rings in the relevant sample.

For the time-window under study (~3100–1900 calBC), the radiocarbon laboratories participating in construction of INTCAL13 are Seattle, Belfast and Pretoria. The accuracy and precision of the measurements provided by these laboratories is under direct quality control by the INTCAL group[23] and therefore beyond reasonable doubt. Due to their regular participation in the Interlaboratory Comparison Projects organised by the ^{14}C-Community,[24] this further applies in particular to the Heidelberg laboratory that has measured the large majority of archaeological ^{14}C-ages, but also to Köln and Berlin.

22 Mook 1983.
23 E.g. Reimer et al. 2009; Reimer et al. 2013.
24 Most recently: Scott et al. 2010.

Gaussian Monte Carlo Wiggle Matching (GMCWM)

In the analysis, and applied to all data subsets, we have used the method called Gaussian Monte Carlo Wiggle Matching (GMCWM). In general terms, the application of GMCWM requires *prior* construction of an archaeological age model, in which each sample is distinguished on the calendric time-scale from its immediate (or far away) stratigraphic neighbour. This time-separation can be achieved, either on an ordinal scale (*younger/older*), or else by specifying a certain age distance. Whereas for trees this distance is readily available by direct ring-counting, for samples that derive from a complex tell-stratigraphy the construction of an adequate sequence of distances is not only more demanding, but as such immediately more error-prone. In consequence, when studying the properties of ^{14}C-dates from tell-sites, additional emphasis must be placed on the error analysis.

Basically, the approach taken in GMWCM is to systematically (step-by-step) expand the time-span covered by the sample sequence on the calendric time-scale in order to identify the best-fitting position of the ^{14}C-ages on the calibration curve.[25] In this respect GMCWM is quite similar to the well-known method of dendrochronological wiggle matching, except that the algorithms have been generalised to allow for the calendric-scale expansion. GMWCM is also, to some extent, similar to Bayesian Sequencing (BS) in that – if only in its most elementary application – BS assumes what is called a *uniform prior*, whereas in GMWCM we speak of a *linear age model*. In terms of error-management, the specific concept underlying GMCWM is that it is possible to distinguish between basically three different types of dating errors, which can readily be quantified according to their different sources. For samples from archaeological sites, such as Troy, the main three error sources are: Type 1 (calendric scale): potential secondary deposition or misallocation of samples, Type 2 (^{14}C-scale): errors associated with the archaeological ^{14}C-ages, and Type 3 (both scales): errors in construction of the calibration curve. Since all these error types can be taken into account by GMCWM, in the following we call them 'basic' or 'fundamental'. Notwithstanding how large (or small) these 'basic' errors are, they can at least in principle be quantified. This does not immediately apply to the 'old-wood' effect. This (fourth) error type requires additional attention (cf. below).

To begin, we may reasonably assume that the three 'basic' errors are uncorrelated, such that they can be independently quantified. For this purpose, in their technical implementation in CalPal-software, the GMWCM algorithm uses a set of three independently running (Gaussian-steering) random number generators. These are used in a Monte Carlo procedure to simultaneously allow for errors that occur (1) on the calendric time-scale, (2) on the ^{14}C-scale, and (3) on the calibration curve (which interconnects these two scales). For the data under study here, the calendric-scale (i.e. stratigraphic: Type 1) errors are typically set to a Gaussian distribution with 1σ width of ± 30 yrs (68% confidence). The first random number generator is then used to provide a large number of age-models, in which the sample sequence is not only incrementally expanded, but during each expansion step the initially entered sample order is changed, over and over again, up to (max) 10,000 times. Such wide errors (which have an overall width of ~ 120 yrs at 95% confidence) should allow for the majority of sample misallocations, including potential switching of samples between phases.

Although typically much smaller than the stratigraphic errors, further allowance is made for (Type 3) errors that occur in calibration curve construction. The corresponding Gaussian is set to ± 10 BP (68%), and the calibration curve spline is rebuilt dynamically (again 1–10,000 times) during run-time by applying the third random number generator. Finally, the ^{14}C-scale errors (again of Type 2) are dynamically simulated by applying the third (Gaussian-steering) random number generator to the dating errors given by the respective laboratories for each individual archaeological ^{14}C-age.

25 Benz et al. 2012.

Let us now turn to the question, how to combine this Monte Carlo method with the (pre-established) architectural periodization as well as with the (given) archaeological ^{14}C-data.

In age-modelling, the solution we apply is to construct an artificial (relative, but linear) metric 'time-scale', onto which the architectural-phase position of each dated sample is projected. For convenience, this time-scale is constructed from old to young, with the 'begin' of the oldest phase assigned a value 0 (rel-yrs). Each phase is taken to be 100 time-units long. Having defined this basic scale (e.g. begin Troy Ia = 0, end Troy Ij = 1000 time-units), intermediate sample positions are then given intermediate values. These values can be varied, slightly, to avoid graphic overlap of the error bars. The advantage of this procedure is that it can also be applied to double-phase samples (e.g. Iab or Igh) for which the exact phase-assignation is not known. For future reference, and in particular for future control purposes (as well as for analysis by alternative methods), in the Appendix (Tabs. C, D, E, F, G) we provide an exact documentation of all age-models used in the present paper. Note that we do not provide explicit numerical age-models for the ^{14}C-ages with database Nos. 3–13, nor for Nos. 75–76 (Appendix, Tab. A), which were excluded from the present studies.

Why not use the Method of Bayesing Sequencing ?

At this point the reader may reasonably ask: *Instead of developing such complicated numeric age models and applying GMWCM, why not use the method of Bayesian Sequencing (BS), for which all you need to know is the older/younger sequence of samples?* There are a number of reasons for this. To begin, already under ideal testing conditions, BS has been shown to optimise the dating precision, but only at the cost of a reduction in dating accuracy.[26] From a wider mathematical view-point, this is because BS is based on classical probability algebra, which is not applicable to ^{14}C-data.[27] A direct consequence of what we call *radiocarbon quantum theory* is that, although BS in many cases does produce seemingly satisfactory results, even the experienced user may encounter difficulties in recognising the true extent of the analytical errors. We think this applies to the studies (for example) by Sevink et al.;[28] at any rate, definitely problematic are the application of BS to the (for whatever reason) *inverted* grave sequence of the Varna cemetery,[29] and the misinterpretation of the parallel dating of samples on calibration curve plateaus as a cultural overlap of the Tiszapolgár and Bodrokerestúr cultures.[30] This second case requires further methodological attention. Given that a certain (assumed known) number of archaeological time units (say 20 Linearbandkeramik [LBK] house-phases) are uniformly distributed over a plateau (or otherwise wiggly section) of the calibration curve and given that the wiggly-plateau has a length of some 400–500 yrs (as is the case for the LBK), then the BS-method will indeed provide an average LBK phase-length of 20–25 yrs. Unfortunately (for the user), this result is not a *wonderful confirmation of the power of the BS-algorithm,* as has been stated in the early BS-literature. It is trivial. Indeed, it is true as well. But there are more truth values than just Aristotelian true and false. The result is *misleadingly* true. Namely, the same result can be achieved for the LBK-chronology (both by BS and by GMWCM) if the sample order is exactly inverted. [Or any other order is chosen. Please try it out. This applies to the majority of published BS-studies].

In general terms, to enable the BS algorithm (and this applies equally to GMWCM), to reconstruct the *true* (in a probabilistic sense) sequence of sample ages, exactly this *true* sequence must be entered as a *prior*.[31] Now, what we may also expect, but what is equally problematic, is that the closer the *prior* (alias *age-model*) corresponds to the actual sample sequence, the better

26 Steier – Rom 2000.
27 Weninger et al. 2011.
28 Sevink et al. 2010, cf. Jung 2013, 239.
29 Higham et al. 2007, cf. Krauß et al. 2014.
30 Razky – Siklósi 2013.
31 Benz et al. 2012.

the results will be (idem for *worse*). Unfortunately, due to the increasingly strong impact of lock-in (quantisation) effects with increasing measuring precision, BS can only be expected to work properly for coarser chronologies. For these, the application of BS (or GMWCM) may not necessarily be worthwhile.

Anyway, and even recognizing that (specifically) the BS-method does work properly under certain conditions, as has been demonstrated many times over, it cannot be applied to the present data. In Bayesian terminology, for the Troy charcoals it is simply not possible to define the correct *prior* probability distribution, which would be a necessary condition for BS to produce reliable dating results,[32] for the following reason.

Normally, the approach taken in Bayesian Sequencing would be to use the known (*older/younger*) sample order (the so-called *prior),* in order to calculate a chronologically more refined *posterior probability distribution for the calibrated ages.* Unfortunately, simply by providing the dated charcoals with a reliable sequence (e.g. stratigraphic order) does not automatically mean that this sequence will accurately reflect the (charcoal-internal) order of the actually dated growth-rings. Indeed, for any given (both small and large) charcoal samples, the two sequences are quite likely to have little in common. Namely, in the (very useful) terminology of Patrick Ashmore, archaeological charcoals do not represent *single entities*.[33] Nor should we look on them as if they were simply *objects,* for which a unique order in time is pre-established. A more realistic view would be to call them *complex temporal structures.* Whatever name is chosen (and later we call them wild animals, to be tamed), even assuming that the *object sequence* could be reliably established (in terms of *younger/older)* and further even assuming that this *object sequence* corresponded perfectly to the architectural periodization under study, the problem remains that the calendric-scale reliability of the sequence is immediately counteracted by the 'old-wood' effect.

Getting to Grips with Radiocarbon Determinations on Charcoal

As is well-known, radiocarbon determinations on charred wood can only provide a *terminus post quem* for the targeted event (e.g. fire destruction). The problem hereby is the existence of a plethora of different 'old-wood' effects. To begin, and perhaps most obvious, the dated (inner) tree-rings are unlikely to cover the targeted cutting year. We may call this the *primary 'old-wood'* effect. It has a biological background. In addition, the wood used in any specific house construction may (or may not) have been recycled from an earlier building. This may cause a *secondary 'old-wood'* effect, which has its background in the human use of wood/charcoal. We must also allow for the additive impact of such biological and taphonomic processes. This is best-illustrated by considering the life-history of a wooden beam used in the construction of a large house. To begin, the dated charcoal will surely be older than the cutting year of the tree. However, due to the cylindrical geometry of all trees, and assuming equal ring-widths for a standard tree with 100 growth-rings, we can calculate that the tree has its centre of gravity (in terms of charcoal weight) at around ring 70 (counted from old to young). Hence, when large numbers of large charcoal samples are under study, it appears justified to expect an average 'inner ring' effect which is some 30 years older than the targeted cutting year. This can be generalised to cover trees with more, or less, rings. In any case, the 'inner ring' effect will amount to some 30% of the total number of rings.

Perhaps the most intricate of 'old-wood' effects, however, is a different type of 'old-wood' effect that is due to the life-span of the building under study. We may base this expectation on the inevitable fact that the remaining charcoal will have only been produced, and therefore conserved, following some fire-event. Note that the burning event itself does not produce any measurable change in the ^{14}C-age of the sample (at least not for charcoal; bones can be different). Furthermore, the firing

32 Bronk Ramsey 2000.
33 Ashmore 1999.

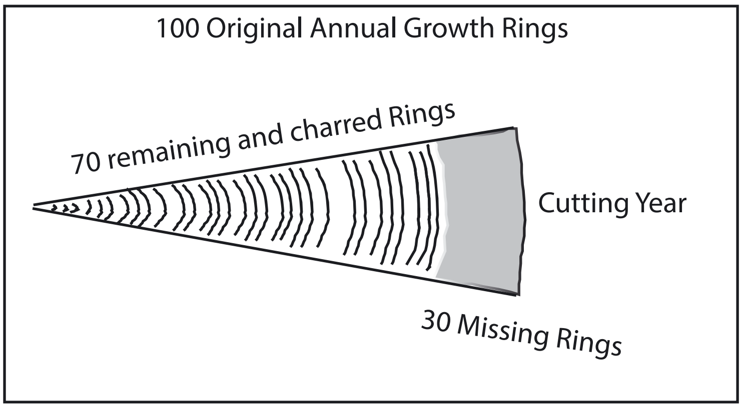


Fig. 4 Troy standard tree.

event will most likely (indeed quite inevitably) have occurred at the very end of the life-span of the building under study. These arguments put together, given that a specific charcoal sample is *known* to derive from the burning of a large building, we may therefore expect the larger 'old-wood' effect to represent the life-span of the building. For example, if the house under study had a life-span of, say, 50 years, and conservatively assuming the house had been built using wooden beams from relatively small trees (e.g. 100 rings), then the combined age offset (30 + 50 = 80 yrs) will inevitably have its larger component not in the 'inner ring' effect (in this case 100 rings × 30% = 30 yrs), but rather in the much longer time lapse of 50 yrs between the cutting year of the tree and its later burning. Unfortunately, the dating error associated with this combination of biological and of life-span properties of charcoal samples is not only large, but – worse – highly asymmetric.

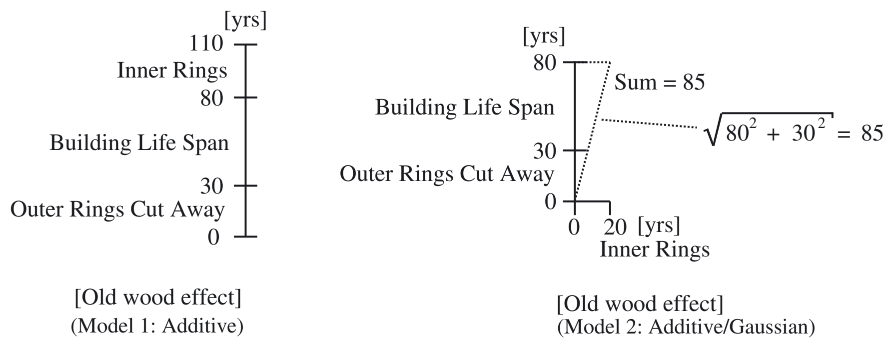
At this point in the discussion we now recognise that the Gaussian error model implemented in GMWCM, as described above, is quite incapable of describing the real-world sampling situation at Troy. Due to the strong bias of the Troy-EBA database on charcoal, the Gaussian error model is dangerously incomplete. Put differently, if we nevertheless (and despite these known restrictions) do actually use the GMCWM method in the present paper, we must at least develop some kind of strategy to make allowance for the age-offsets to be expected for the 'old-wood' effect. As an illustration of the 'old-wood' effect, we now introduce the notion that the dated charcoals derive from what we call a 'Troy Standard Tree' (Fig. 4).

For illustration purposes this picture of a 100-year old tree (Fig. 4) is included in the legend in many of the ^{14}C-graphs. Although we could have used the same picture to emphasise that some quite specific date looks very much as if it were measured on a truly (very) 'old-wood' sample, we have avoided attaching this icon to any of the individual ^{14}C-data bars. Otherwise the ^{14}C-graphs would have been be smothered by the many 'Standard Tree' labels.

Quantitative Error Analysis

As mentioned above, due to the strong bias of the present Troy ^{14}C-database towards charcoal samples, it is not possible to construct a useful *prior* (or any other kind of age-model) that can adequately mirror, simultaneously, all of the many different types of 'old-wood' effect. What would be clearly necessary would be a detailed dendrochronological analysis of all dated charcoals, in combination with estimates of the time-spans of all the different buildings. But for that the available data is quite insufficient. Hence the question arises, how to account for the 'old-wood' effect in quantitative terms? To begin, it is not even clear how to recognise which of the ^{14}C-ages are really affected, and by what amount, by the 'old-wood' . Perhaps the correction factor is different for each sample, for different phases, or even systematically for the different periods? Further, how can we possibly differentiate between 'old-wood' samples on the one hand, and the statisti-

Error Mechanism	Depth-Error [cm]	Context [different Units]	Systematic [yrs]	Gaussian [yrs]
Daily Nivellement	± 1 cm	---	---	± 1 yr
Square Nivellement	± 1 cm	---	---	± 1 yr
Phase-Internal	---	± 0.5 phase	---	± 10 yrs
Wood Outer Rings Cut Away	---	+ 30 rings	+ 30 yrs and/or	± 20 yrs
Building Life Span	---	+ 50 yrs	+ 50 yrs and/or	± 20 yrs
Wood Inner Rings	---	+ 30 rings	+ 30 yrs and/or	± 20 yrs
Terracing Operations	+ 40 cm	+ 60 yrs	+ 60 yrs	?
Not-Flat Stratigraphy	± 30 cm	---	---	± 30yrs



Tab. 1 Quantitative estimates of modelling errors.

cally quite normal (or extreme) spread of the ^{14}C-ages, on the other? To illustrate this problem, in Tab. 1 we have assembled a number of error-estimates for the different mechanisms to be allowed for in statistical modelling.

As indicated in Tab. 1, the (unknown) building life-span is likely to be the largest of all 'old-wood errors', but only in combination with the equally (if not larger) impact of the *a priori* also largely unknown terracing operations. Such terracing, indeed any kind of stratigraphic sample reworking, will have a potentially devastating impact on the integrity of any ^{14}C-based age-model. In face of this problem, what we finally decided to do is to take out of the ^{14}C-analysis the (really) obvious outliers (of course following their documentation) and simply fit the remaining charcoal-dates to the calibration curve. This decision opens the path for testing by comparison.

Multiple Testing Programme

In running this case-control program what we have basically done is to apply the GMCWM-method under different study conditions and then compare the results. For all data sub-sets (Fig. 1) it is possible to apply (Test 1) a uniform (architectural) phase-model. If only applicable to the Troy II–III data, as an alternative approach it is possible (Test 2) to assume a linear increase in the height of the tell, i.e. a uniform (stratigraphic) age-depth model. This double test was unfortunately not applicable to the Troy I sequence, due to its strongly sloping stratigraphy in the central and northern parts of Schliemann's north–south trench. Such linearity test would require projection of the recorded depths of the Troy I samples onto a vertical line through the relevant layers, which was beyond the scope of the present paper. Hence, to avoid being blinded by untested GMWCM-results, for Troy I we have compared (Test 3) the results obtained from the analysis of the sequence of all phases (Ia–Ij) with the age obtained independently for phase Id by dendro-wiggle matching of the beam (Behälter D5.365). In a next step (Tests 4/5), only applicable to the Troy II–III data subset, we have compared the results of two different age-models (age-depth and age-phase). Finally (Test 5), the results obtained in Tests 4/5 were critically evaluated by comparison with the results obtained from single-age calibration of the short-lived sample from phase IIIa (Hd-20174: 3797 ± 25 BP, 2230 ± calBC). As it turned out (see below), the critical point prior to the final combination of results achieved for Troy I and for Troy II–II was the – clearly – unrealistic overlap (by some 50 yrs) of both chronologies. Nevertheless, and allowing both for this overlap and for other (partly terminological) problems that only became apparent during the testing exercise, the results were altogether acceptable. In statistical terms, the ^{14}C-chronology has a precision in the order of ± 30 yrs (68% confidence).

Naturally, even after all the number-crunching necessary in modelling, the resulting ^{14}C-chronology will still be charcoal-based. But then, at least, we will have at our disposal an archaeologically criticised and statistically optimised impression of what we call the *best position* of each ^{14}C-dated charcoal sample on the calibration curve. Allowing for the final 'old-wood' correction, for convenience chosen as 50 yrs, we estimate that the overall dating precision (Troy I–III) is in the order of ± 30 yrs (68% confidence).

Unfortunately, we cannot immediately start off with ^{14}C-age modelling, say by plonking the dates into an algorithm and seeing what comes out. As stated above, such is the increasingly widespread misuse of the otherwise highly advanced and useful method of Bayesian Sequencing. The use of BS would have been nice, but the data under study here are not. Similar to wild animals in a circus, they first require some fair amount of taming. In support of this maybe curious judgement, we may cite the excavator of the Pinnacle, who states quite frankly that he cannot make sense of the ^{14}C-ages obtained for the Pinnacle E4/5, except that they are *clearly* wrong, at any rate unacceptably old.[34] Well, we think we can make sense of them, but that remains to be demonstrated. In historical perspective, it is interesting to observe that similar statements were made about the acceptability of ^{14}C-ages, the moment the very first stratified ^{14}C-ages became available for the southeast European tell-sites, and that is some 40 years ago. At that time the dates were criticised for not *clearly* following the archaeological stratigraphy. The solution, as we now know, is that ^{14}C-dates should indeed follow the stratigraphy, but simultaneously the wiggles of the ^{14}C-age calibration curve, as well as a variety of taphonomic processes.

Today, and *prior* to the ^{14}C-analysis in the sense of an analytical *conditio sine qua non*, what is first required is to establish that the architectural stratigraphy of EBA-Troy does not contain temporal breaks (what we call 'gaps'), at least to any extent beyond the visibility of the ^{14}C-data to be analysed. With this specific question in mind, we now turn to the pottery analysis. The overall aim of the following studies is to quantify the size of potential gaps in the stratigraphic sequence at Troy. As already discussed, the existence of such gaps would *not* necessarily inhibit the envisaged ^{14}C-modelling studies; this depends on their temporal extent (and visibility cf. below), which must be quantified.

Pottery Seriation and Stratigraphic Analysis

In a previous study, a database that covers the 'complete' Cincinnati pottery shape inventory of Troy I–V was established.[35] That database contains a total of 14,917 reconstructed pots, all clas-

34 Mansfeld 2001, 203.
35 Weninger 2002.

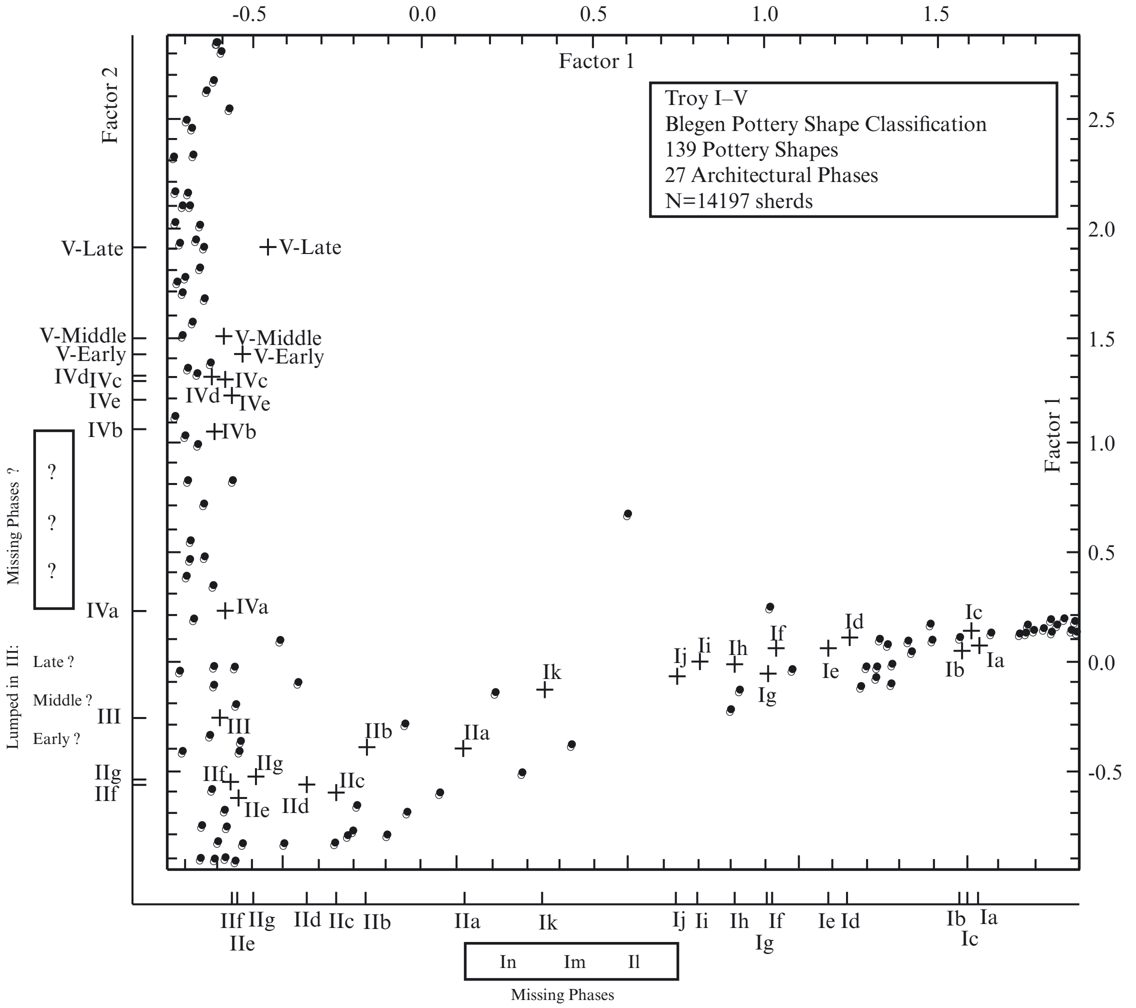


Fig. 5 Correspondence analysis applied to pottery shapes for Troy (periods I–V), classified according to Blegen et al. (1950; 1951; 1953). Graph based on data assembled in Weninger (1995). CA-scores for Blegen phases (shown as crosses) are projected onto Factor 1 (Troy I–II) or onto Factor 2 (Troy III–V). Small dots show CA-scores (i.e. central values) for pottery shapes. There are indications for a gap with three missing phases between Ij and IIa (shown on Factor 1) and for another gap with missing phases between III and IV (shown on Factor 2).

sified according to the Cincinnati pottery shape system.[36] Using Correspondence Analysis (CA) as seriation method, it was shown possible to use the Blegen pottery inventory assemblages to reconstruct the EBA architectural stratigraphy, albeit with a quantifiable dating precision. The dating precision achieved by CA for Blegen's material is of the order ± 1 settlement phase, which translates to a dating error of ± 50 yrs (68% confidence). Previously, we had no satisfactory explanation either for the conspicuous bend in the CA-diagram around the time of Troy IIg/III, nor did we understand the cause of the rather void region in the seriation between Troy III and Troy IV (Fig. 5). The central topic of the following section is a re-interpretation of this seriation, which we have undertaken to incorporate the new excavation results achieved by Manfred Korfmann and his team.

Next to the generally acknowledged existence of a terminological error in Blegen's periodization, there is another interesting observation by Easton,[37] namely, that there appear to be

[36] Blegen et al. 1950; Blegen et al. 1951.

[37] Easton 1976, tab. 1.

some phases missing (he proposed two) in the transition from Late Troy I to Early Troy II (i.e. in between Troy Ij and Troy IIa). At this very position, practically the same number of phases (three) were later identified by excavation.[38] The existence of these phases was also forecasted by pottery seriation. In Fig. 5, we have redrawn the original CA-diagram (dated to Sep. 1986) on which this forecasting was based. As noted by Weninger,[39] the CA-results clearly pointed to the existence of a substantial number (3–5) of new architectural phases between Late Troy I and Early Troy II, which were unknown to the Cincinnati team. In combination with Easton's forecasting, and now that Korfmann has identified by excavation the forecasted number of phases, we are presently confident that the CA-results are confluent, for Troy I–II. This is useful to know, since we can now confidently analyse the ^{14}C-dates from Troy I–II, for which a gap-free linear interpolation is necessary.

As can also be taken from Fig. 5, however, not only is there a gap in the CA-diagram between Ij and IIa, but quite apparently again between III and IVa. Then follows the largest of all gaps, that is between IVa and IVb. The next following phases of Troy IV and V fall nicely into sequence.

Before proceeding, we must add a cautionary note. To be sure, independently, the CA-method cannot prove the existence of settlement gaps. This is only possible by excavation. Gaps of any type are caused by lack of data. We can, of course, classify them, just as we classify pottery. The most elementary classification is to differentiate between two fundamentally different and logically exclusive types of gap. All gaps of what we call 'Type 1' are caused by lack of excavation of existing deposits. All gaps of 'Type 2' are due to non-existing deposits. Despite their clear and distinct definition, in any given case (and in particular for disturbed deposits), it is actually not at all easy to decide whether a gap exists, or not. Obviously, it is impossible to excavate non-existing *deposits*. A more demanding (structural) question is to decide whether it is possible, or not, to excavate non-existing *phases.* This is because we find deposits, but define phases. Although maybe curious, this is the very problem we must address, in order to understand the cause of the CA-gap between Troy III and Troy IV.

Sometimes a historical perspective can be useful in scientific discourse. Above we noted that the CA-seriation shown in Fig. 5 was established in 1986, that is some 16 years before its publication.[40] Back in 1986, the relevant author (B. Weninger) had not yet visited the site of Troy and, indeed, the CA-analysis of the Blegen material was initially not even directed at obtaining a pottery-based chronology for the EBA at Troy. Instead, my intention was to critically test the proposal put forward by Peter Stehli and Andreas Zimmermann (at that time my teachers at the Institute of Prehistory, University of Frankfurt/M.) that the CA-method was capable of producing a high-resolution pottery chronology for the early Neolithic Linearbandkeramik (LBK) culture. Quite simply, *a priori*, I did not believe them. Obviously, the underlying method needed testing. Now, for empirical testing and hence under realistic conditions, it is necessary to find a pottery database which has an independent time-scale. Further, the independent (non-pottery) time-scale to be used in the CA-test should be as long and as precise as possible. And, of course, the test had to be interesting. Now, back in 1986, the controversies between the followers of the traditional chronology of the European Neolithic and Bronze Age and the new calibrated ^{14}C-chronology were at a climax. A central site within this discussion was Troy. So, I went to the library, took out the Blegen volumes, sat down for some months to produce a pottery database for the EBA, ran a CA-seriation, and concluded my teachers were correct. At Troy, the dating resolution of the CA-method is ± 1 phase and this applies, as far as I could judge at that time, to all phases of Troy I–V. Apparently, the precision of pottery dating was indeed sufficient to help solve the dating

38 Korfmann 1999, fig. 6; Korfmann 2000, fig. 6.
39 Weninger 2002, 1051.
40 Weninger, 2002.

controversy, that amounted to a difference of ~1000 years between the conflicting high- and low chronologies for the European Neolithic.[41]

However, there is one important condition. With life-spans of many hundreds of years for typical vessel shapes, the condition is that pottery dating must be based on statistical procedures, not on single vessel comparisons. The next thing I did was to test the seemingly natural hope that a refined pottery classification will automatically lead to an increase in the precision of pottery dating. For this I made use of the refined (i.e. carefully re-classified) EBA-Troy pottery classification that Podzuweit[42] had developed, also based on Blegen's publications. For the re-classified Blegen material of Troy I, the expected (enhanced) chronological sensitivity is confirmed by CA. But for Troy II–V the opposite is the case. In both cases, moreover, since the refinement of the classification could only be achieved based on the relatively few pictures that Blegen had been able to publish, following re-classification there is very little remaining data. This may be useful for long-distance comparisons. But the refined classification is definitely quite insufficient for site-internal synchronization. Finally, following these studies, I gave up trying to prove the validity *either* of the low (pottery-based) *or* of the high ^{14}C-chronology. For me, the highest dating resolution could quite obviously be achieved only by combining the different types of dating methods (CA and ^{14}C), not by putting them in contra-position.

What had not occurred to me in these earlier papers, and even up to recently, was that under certain conditions the achieved 'highly precise' CA dating at Troy can actually be highly misleading. At Troy, and acknowledging that other sites may be different, the exact methodological fix-point for the results to become misleading is when the dating is transferred from the (ordinal) architectural scale to the (metric) calendric time-scale. This transfer process, that makes phases into years (e.g. ± 1 CA-phase ~ ± 50 yrs), is only valid for a gap-free sequence.

What Makes a Gap?

Now, a gap is not simply a Gap, and in a tell-site such as Troy there are sure to be many gaps, and probably an infinite number, depending on how close we look. Fortunately, looking at all the many gaps, there is a natural limit to the number we can sensibly talk about. As in ^{14}C-analysis, the only gaps worth talking about are the ones with a length beyond the established statistical dating limits. At Troy, these limits are in the range of ± 1 architectural phase. Using the CA-method, we could be able to discern temporal gaps, but significantly only if their length is longer than 3 standard deviations (i.e. three phases or more). In other words, assuming that the gap under study is shorter than ~ 150 years (i.e. 3σ), it will be difficult if not impossible to recognize its existence. If longer than ~ 150 years? Well, then, we may have a chance to see it. Ultimately, what we can recognise as a gap depends on how realistic the corresponding error-analysis is.

With these limitations in mind, let us now take a closer look at the structure of the CA-diagram (Fig. 5). When projected onto Factor 1, we observe that the CA-scores are in correct stratigraphic order for the large majority of phases of Troy I and Troy II. One particular concern is Troy IIe, for which the seriation provides a seemingly wrong date between IIg and IIf (on Factor 1), but which is also very close to III (on both Factors). However, making allowance for the limited amount of material available from IIe, this dating is quite acceptable. First, the architectural structures (buildings IIM and IIN) assigned to IIe (Ünlüsoy: IIc3) are indeed likely to be at least broadly contemporary with Megarons IIA and IIB. This was concluded both by Easton and by Unlüsöy.[43]

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41 E.g. Renfrew, 1971.

42 Podzuweit 1979.

43 Easton 2002, 307; Unlüsöy 2011, plan 12; Easton 2014, note 540.

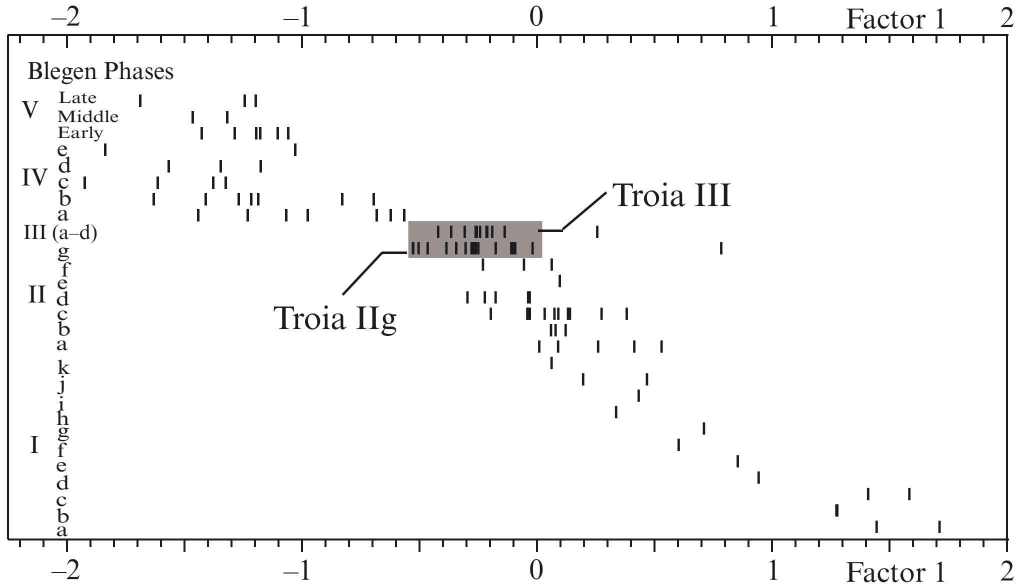

Fig. 6 Zoom into Fig. 5 (above) with rotation of the CA-diagram by 45º to illustrate that Blegen pottery shapes from IIg and III are virtually indistinguishable, using only statistical procedures.

Second, not only does the available pottery from IIe derive from a quite small (3 m^2) section, but the CA-dating of this phase is based on a mere 35 sherds (from 5 vessel shapes).[44]

At this point it is worth emphasising how satisfactory the CA-results are, despite such material limitations. The real question to ponder, therefore, is not the cause of the seemingly wrong pottery dating of IIe (which is statistically correct). Instead, we may wonder how can it be possible that the CA-method is capable of such reliable dates, even when based on a handful of default-type Troy II sherds? The answer is that the CA-method analyses the complete pottery assemblage, simultaneously for the entire site, to reconstruct the overall pottery sequence, but only from the specific perspective of what is found together. The alternative dating method would be to take every single pottery find, analyse all the finds, but only one after another. Whichever of these two approaches we favour, both have their advantages and disadvantages, depending on application. From the dating perspective, however, the problem of applying single-vessel procedures is very similar to that of analysing radiocarbon dates. If based on graphically stacking the separate calendar-age intervals, one above the other for each single measurement, all that essentially happens is that we reinforce the already known calendric interval, over and over again. Now, since every now and then an outlier will occur, inevitably, the targeted interval will get wider and wider, the more dates that are entered. This seemingly contra-intuitive property of archaeological ^{14}C-dates was first described by James Ottaway, who concluded that he would not allow application of any such method to any kind of data for which he was responsible.[45] The solution, and which does not only apply to archaeological ^{14}C-dates, is that we can only obtain access to the information otherwise hidden in the increasingly large database by changing the analytical method (today we use the method of archaeological wiggle-matching). Interestingly, a similar restriction applies to pottery dating. Again, the solution is not (only) to add more data but to change the dating method. Otherwise, the larger the set of individual pottery synchronisms, the more outliers will appear, and the more difficult a conclusion becomes. What we may conclude, now that we are using the CA-method for pottery-based chronological analysis, is that the given (Blegen-classified) CA-

[44] Blegen et al. 1950, 301; Weninger 2002, 1049, Appendix II.

[45] Ottaway 1983.

sequence is essentially 'gap-free' (within the 3σ limits of observability defined above), all the way from the beginning of Troy I to the end of Troy III, but not necessarily beyond.

To further address the question what causes the CA-gap between Troy III and IV, let us now rotate the CA-diagram and zoom into the relevant section (Fig. 6). The reason for this may not be immediately clear. By rotating the diagram, we achieve a reconstruction of the overall sequence of architectural phases for Troy I–V. Unfortunately, the advantage of this approach is immediately counteracted by a loss of dating precision for certain periods. By CA-rotation, we may optimise the dating precision either for phases on Factor 1 (periods Troy I–III), or else for phases on Factor 2 (periods Troy III–V), but not simultaneously for all phases of all periods. Having tried out all possible rotations, with the aim of identifying that one specific rotation which optimizes the phase-sequence in the vicinity of Late Troy II/III, we come to the following conclusion. Whatever rotation is selected, the result is always the same: the material from these phases appears to be identical (at any rate in statistical terms). This interesting property of the CA-diagram is illustrated in Fig. 6. If only demonstrated here for one specific rotation, (and hopefully the reader will nevertheless accept the following argument), the almost complete overlap of Blegen's pottery assemblages for phases IIg and III can be observed for all possible rotations of the CA coordinate system.

Indeed, this is no new result. As is known from detailed CA-studies by Frirdich[46] it is very difficult to differentiate between the pottery inventories of Late Troy II and Troy III, not only using the Blegen pottery classification but also by fabric analysis. One of her most important results[47] is that basically only Troy II and III are represented on the Pinnacle E4/5, and not the entire Troy II–V-sequence as was later proposed by the excavator.[48] Her results were confirmed by Pavúk,[49] who undertook a detailled reconstruction of the height of the different pinnacles along the NS-section of EBA-Troy. Apparently, Mansfeld[50] had not taken into account the existence of a major terminological discrepancy between Dörpfeld's and Blegen's periodizations, such that Blegen's Troy III is Dörpfeld's Troy IV, and Blegen's Troy IV+V are Dörpfeld's Troy V.[51] To this the complementary information can be added, namely, that it is impossible to close the CA-gap between III and IV, simply by rotating the CA-diagram.

To this last point we return to the autobiographical section (cf. above). In contrast to all other phases of Troy I–V, back in 1986, when first constructing the Blegen pottery-shape database, we had found it impossible to separate into different phases (Troy IIIa–d) the material that Blegen had excavated from Troy III, simply by reading the text.[52] Namely, in contrast to all other EBA-periods, the pottery finds from Troy III are catalogued according to rooms and houses, but not by phases.[53] In consequence, what is called 'Troy III' in the CA-diagram in actual fact represents the material from altogether four phases, but which is lumped together. Based on previous efforts to better resolve the pottery dating in the region of the CA-bend (i.e. between II and III), we also know that the change from Factor 1 to Factor 2 is not due to the properties of the Troy IV/V-material, as might be expected. What we observe is that the switch from Factor 1 to Factor 2 is a fundamental property of the total pottery assemblage, such that the switch occurs immediately, the moment the database contains even only one excavation unit that follows stratigraphically upon Troy III.[54] Put differently, if we accept the general consensus that Troy V dates to the Middle Bronze Age (e.g. due to the occurrence of red-cross bowls), due to the strong clustering of the respective CA-scores, (Fig. 5), then this must surely also apply culturally, if not chronologically, to Troy IV.

46 Frirdich 1997.
47 Frirdich 1997, figs. 9–10.
48 Mansfeld 2001.
49 Pavúk 2010, fig. 11.
50 Mansfeld 2001.
51 I.e. the so-called Easton's Law: Blegen=Dörpfeld-1: Easton 2000, 78–79; Jablonka 2000, 103.
52 Blegen et al. 1951, 37–97.
53 Blegen et al. 1951, 37–97.
54 Weninger 2002.

Putting all this information together, we come to the following conclusions. First, the CA-gap between Troy III and Troy IVa is probably due to the lumping together of the material from altogether four Troy III Blegen phases into 'Troy III'. As indicated in Fig. 5, by interpolation we may therefore fill the III–IVa CA-gap by allowing for the (known) existence not of one, but of four Troy III phases. This first gap-component is purely artificial. It is an artefact of the manner in which we initially constructed the pottery database for Troy III. Allowing for this, what remains to be explained is why the CA-seriation places the material from IVa so close to that of Troy III. The same question, but formulated the other way around, is, why does the seriation produce such a strong separation between the material of Troy IVa and that of the following Troy IV phases? The solution we propose is that there exists a real settlement break between Troy III and Troy IV, which amounts to some (at least) three phases. The CA-score for Troy IVa is being pulled so strongly towards Troy III, we propose, because some large amounts of the IVa pottery finds actually do derive from Troy III, but were re-deposited during the very first rebuilding activities following an abandonment of the site at the end of Troy III. Interestingly, the ^{14}C-dates assigned to Troy IV show very much the same properties. As can be taken from the ^{14}C-diagrams published by Kromer et al.[55] and which were further studied by Blum,[56] essentially all ^{14}C-ages assigned to Troy IV have calibrated ages that overlap (indeed entirely) with available (and altogether satisfactory) dates for Troy III. From these same diagrams, it further appears that the ^{14}C-dates assigned to Troy V are separated by some 100–200 years from Troy IV. Even allowing for the 'old-wood' effect, the dates from Troy IV and V do point in the same direction.

But how long could the III–IV gap be, supposing it exists? As *Gedankenexperiment*, we may calibrate its (unknown) length by reference to the (known) length of the I–II gap in the CA-diagram (Fig. 5). As it appears, between Troy periods III and IV there are some 3–4 missing architectural phases. Hence, we conclude, the gap has a length in the order of 100–200 years. This estimate agrees well with a chronological gap shown by the ^{14}C-data.[57] Although we judge that the coincidence of missing phases and of obviously strongly reworked ^{14}C-samples is indeed telling, this alone does not resolve the problem whether there exists a real settlement break at Troy, or not. Namely, in terms of the gap-classification introduced above, the III–IV gap could either be of Type 1 (lack of excavation) or else of Type 2 (settlement break).

Not least Wilhelm Dörpfeld supplies arguments that *could* be interpreted in the same manner. Looking back at his excavations 1870–1894, partly undertaken together with Heinrich Schliemann (up to 1890), he writes:

> "Die Zerstörung der III. Ansiedlung ist bei weitem nicht so gründlich gewesen, wie die der II. Burg. Sicherlich war es keine grosse allgemeine Feuersbrunst, die das Dorf vernichtete. Zwar sind in manchen Häusern deutliche Brandspuren gefunden worden, sie waren aber nicht allgemein wie bei der II. Schicht. Da die Hausmauern trotz ihrer geringen Stärke bei der Ausgrabung meist noch 1–1,5m hoch aufrecht standen, so möchte man am liebsten vermuten, dass das Dorf aus irgendeinem Grund von seinen Bewohnern verlassen wurde und dann allmählich verfiel. Die Dächer und Oberteile der Wände stürzten zusammen, füllten die Zimmer bis zu einer gewissen Höhe an und schützten so die stehengebliebenen Unterteile der Mauern vor gänzlichem Verfall. Einige Zeit später wurde ein neues Dorf errichtet, die IV. Schicht. Von den Häusern der älteren Ansiedelung kann damals nichts mehr sichtbar gewesen sein, weil sonst die zerstörten Mauern wieder reparirt oder als Fundament für die neuen Häuser benutzt worden wären."[58]

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55 Kromer et al. 2003, fig. 5.
56 Blum 2012, fig.107.
57 Kromer et al. 2003, fig. 5; Blum 2012 fig.107.
58 Dörpfeld 1902, 102.

Unfortunately these observations are not relevant to the present Gap question. For when Dörpfeld talks about the end of his '*III. Ansiedlung*' we must understand him to mean the end of Blegen's Troy II (i.e. Blegen IIg) – although, since there was some irregularity across the mound, at least some of what Dörpfeld calls '*Schicht III*' may have been a part of what Blegen later calls 'period III'. Perhaps more clearly formulated, most of what Dörpfeld calls '*Schicht IV*' later became Troy III.[59] Hence, we cannot use Dörpfeld's observations, however intriguing they may appear, as independent (eye-witness) testimony that the postulated III/IV gap in the Blegen-referenced CA-diagram (Fig. 5) really does indicate a temporal break in the architectural sequence.

Concluding this chapter, Fig. 7 illustrates that the gap-question cannot either be resolved by analysis of the *amounts* of pottery excavated by Blegen for the different periods. What this diagram does demonstrate is that, closely corresponding to the phase-wise strongly varying number of excavated sherds, Blegen was able to define a higher (or lower) number of different pottery shapes. But that is not unexpected. Neither is it of particular help to know that Blegen excavated a comparatively large amount of material (both sherds and shapes) from Troy III. This is an artefact of our lumping of the material from four phases into one. More important is what the diagram does not show: there is no indication for any lack of material from any of the Troy IV phases, nor for that matter from Troy V. Hence, we conclude (and this is not trivial), there is enough material evidence to demonstrate the existence of all five periods (I–V) at Troy. But, as with the non-existence of a major gap in the sequence, and in particular between III and IV, this can neither be proven nor discounted by simply counting sherds and shapes. Whatever is correct, even the possibility that 'the Gap' exists, immediately enforces a truncation of the ^{14}C-analysis using the GMWCM-method, at the end of Blegen Troy III.

Seriation of Pottery Data Derived from Schliemann's Records (1870–1873 Seasons)

To further address the cause of the III–IV gap, we have undertaken complementary CA-studies, based on pottery data reconstructed from the Schliemann material by Easton.[60] As is well-known, the relevant layers were largely removed from the mound by Heinrich Schliemann already during his highly destructive excavations 1870–1873, and for which only limited documentation is available. The idea is to see how far the pottery distribution proposed for the spread of Schliemann 'Units' across the periods I–V may (or may not) be consistent with the expectations derived from the Blegen excavations. The pottery contents of the Schliemann 'Units' are given in Appendix, Tab. B. This database contains altogether 63 'Units' that were derived from Schliemann's notebooks and publications.[61] In this study, the units were first dated according to the reconstructed stratigraphic depths, as described by Easton.[62] The material was already 'Blegenized', i.e. shape-classified according to Blegen's pottery shape system, and has been entered into the Blegen-seriation. The pottery database takes into account not just presence and absence of the different types, but also frequency of occurrence. It is important to note that, *qua method*, it is only possible to include in the joint seriation the Schliemann material for which the same shapes were noted by Blegen.

Not unexpectedly, a number of Schliemann units immediately turned out to be outliers, and we have removed these from the seriation. This applies in particular to shape C30 which introduces a large distortion of the CA-diagram. As shown in Fig. 8, the Schliemann units spread across the same span as the Blegen units.

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59 Easton 2014, 297.

60 Easton 2002.

61 1870 to 1873 seasons – the sources are detailed in Easton 2002.

62 Easton 2002.

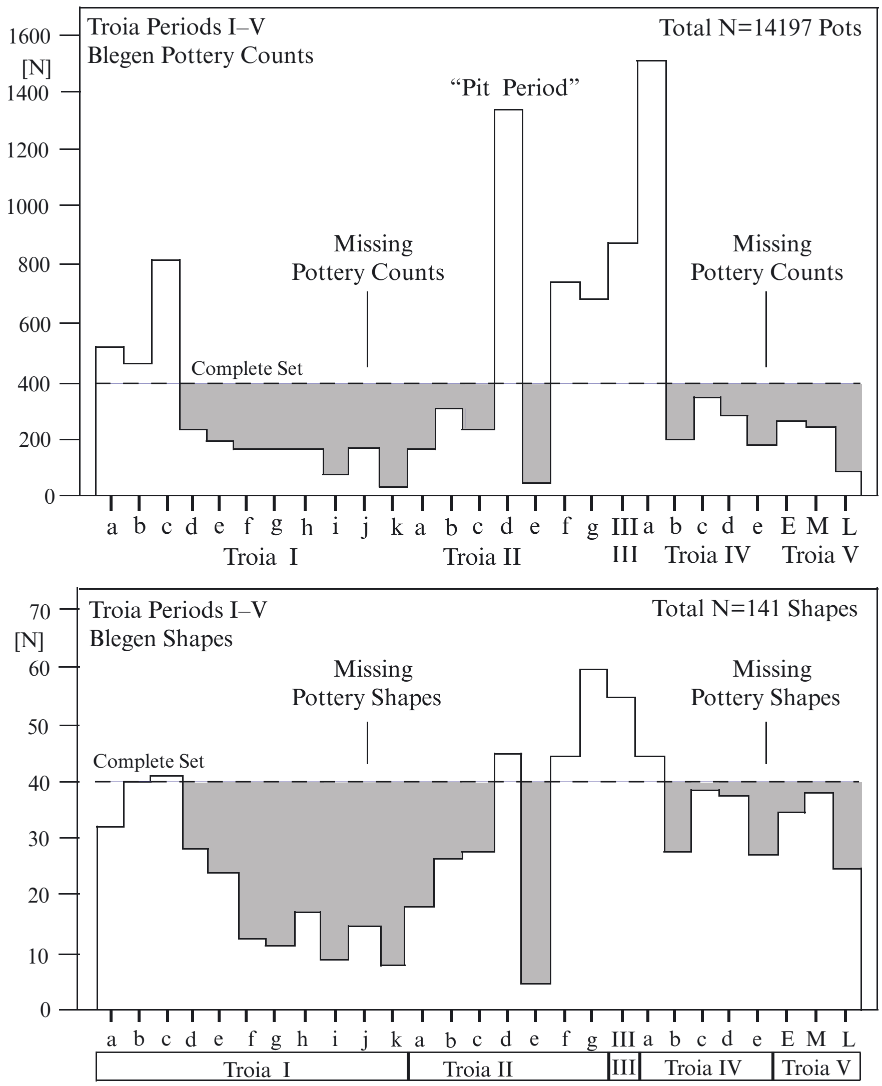

Fig. 7 Quantities of pottery for Troy periods I–V reconstructed from Blegen et al. (1950; 1951). Upper: pottery (sherd-based) counts referenced to Blegen phases. Lower: pottery (shape-based) counts referenced to Blegen phase. Data: Weninger (1995).

Naturally, due to their lower stratigraphic integrity, the Schliemann units show much less distinction between Troy IIg/III and Troy IV/V than was previously apparent in Blegen's units (Fig. 4). A sceptic might take this wider spread of the Schliemann deposits as confirmation of his hopeless unreliability as an excavator. But other explanations are available. As it appears, the Schliemann material succeeds in bridging the conspicuous gap between III and IV which exists in the CA-chart of the Blegen material (Fig. 4). This bridging of the gap is no doubt due to the much greater extent of Schliemann's excavations in the strata of II, III and IV and especially in his 'Burnt City'. However, we must be cautious in all details of this interpretation, since we do not yet know how precise the CA-dating of the Schliemann material actually is. In particular, we cannot yet exclude the possibility of a settlement hiatus between III and IV, which Schliemann himself would surely not have recognised.

To answer this question, let us take a closer look at the data. It contains a large number (N=14) of units (i.e. 14/63 = 22%) that consist of only two shapes. For such limited amounts of material we cannot expect a particularly precise dating. Further units were demonstrably affected by the presence of pottery shapes occurring either earlier, or later, than was observed by Blegen. Such younger/older CA-readings are, of course, not necessarily wrong. But this does probably account

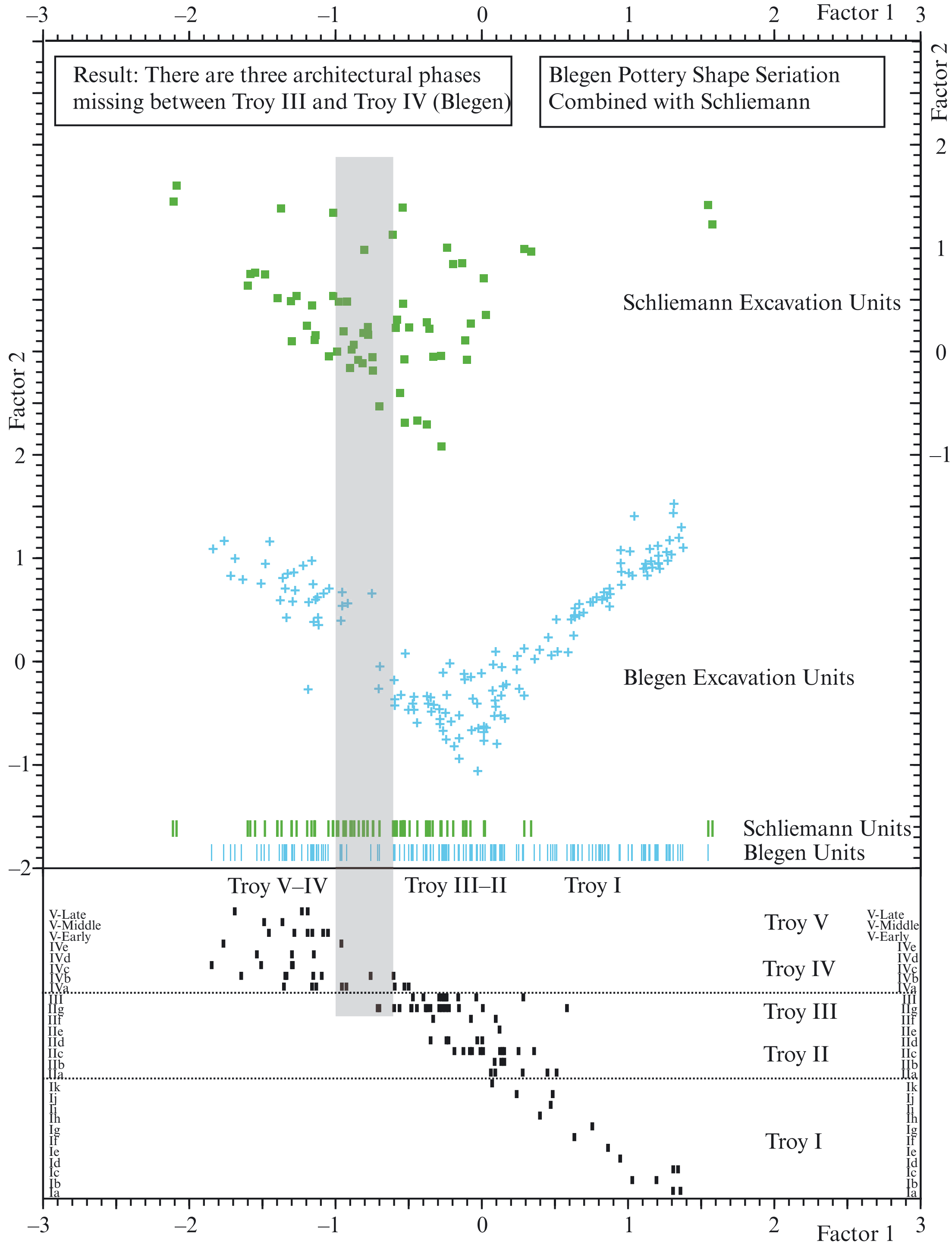

Fig. 8 Correspondence analysis applied to the joint Blegen and Schliemann pottery shape database for Troy periods I–V. CA-rotation by 45º. The graph (upper) shows CA-scores for Blegen and Schliemann excavation units. The graph (lower) shows the CA-scores for Blegen's phase-certified excavation units. At first look the Schliemann units appear to fill the gap between III and IV. Their position in the CA-graph is consistent with their stratigraphic position, but the quality of the Schliemann excavations and the small size of the units may make them less reliable than Blegen's (see text).

for the extreme position of Units 120 and 20 which appear to date 'younger than Troy V' (i.e. beyond the limits of the CA). The point here is that, since the Blegen data used in CA replicate the chronological distributions which Blegen observed, we had no choice but to judge the Schliemann data against those same distributions. Further inspection of the relevant units shows that Unit 20 belongs to period IV, which is acceptable (allowing for finite CA-dating errors). Curiously, Unit 120 was expected to date to Troy II, such that the CA-dating to Troy IV or V is unacceptable, despite the fact that Unit 120 contains quite a large number of shapes (N=8) and pots (N=11). This specific dating discrepancy is probably explained, however, by the fact that the unit includes a theriomorphic vase (classified as D29) and a beak-spouted jug (classified as B20) both of which shapes have exclusively late distributions in Blegen.

Although the exercise to some degree yielded a positive verdict on the proposed distribution of the Schliemann material, its value is obviously limited, in two respects. First, Schliemann did not systematically quantify his finds as Blegen generally did. Thus a comparison based simply on presence and absence, not on relative frequency, might have been deemed more preferable. Although we have tested the combined seriation for such effects – which do not appear to significantly impact the results – we must nevertheless acknowledge that at many points the Schliemann corpus extends the chronological distribution of pottery shapes beyond that defined by Blegen. In conclusion, although promising for further studies, for the moment we must regard the Schliemann data as neutral and inconclusive in regards to the Gap question.

Radiocarbon Age Modelling

Troy Ia, Single-Phase Model (Appendix, Tab. C)

Turning now to the ^{14}C-studies, we begin by calculating an up-dated age estimate for Troy Ia. The new results are shown in Fig. 9. They are based on the hypothesis that, since the six available Troy Ia ^{14}C-ages are all assigned to the same phase, it is quite likely they will have approximately the same age. Of course, as mentioned above, we must allow for the fact that their exact position within phase Ia remains unknown, just as the dated charcoals all have an unknown number of inner growth rings. In the Monte Carlo modelling process, consequently, we have applied a random shuffling error of ± 30 yrs (i.e. ± 30 rings) to all samples. This error should be sufficient to cover both effects (i.e. phase-internal age differences and inner rings), but it does require further testing. Unfortunately, as can be taken from Fig. 9, the probability distribution of the 'best-fitting' GMWCM-model shows the existence of two alternative dates, namely at ~ 2880 calBC (with the highest probability) and at ~ 2760 calBC (with only slightly lower probability).

Actually, it would be possible to force a decision between these two alternative dates, simply by choosing an error smaller than ± 30 yrs for the Gaussian random sample shuffling. For example, by selecting ± 10 yrs, the relative probability for the older reading increases significantly. Quite apparently, the younger readings are due to the shape to the calibration curve, which shows an upwards directed wiggle for calendric ages ~ 2780 calBC. This wiggle catches the younger ^{14}C-ages all the more, the wider the random shuffling is chosen. Nevertheless, before deciding on which of these two dates is to be preferred, let us have a look at the results obtained for the extended Troy I sequence.

Troy Ia–Ij, Multiple-Phase Model (Appendix, Tab. D)

Whereas for Troy Ia all samples derive from the same phase, when extending the age-model to cover the total number of ten Troy I phases (Ia–Ij), the error-model must now allow for the finite (but unknown) time-span of the different phases. Hence, in contrast to the single-phase model, it is not possible to reduce the random shuffling error (below, say ± 30 yrs), even for explorative purposes. Fig. 10 shows the results obtained under the assumption that all Troy I phases have an equal length. Although the best-fitting positions achieved for samples assigned, in particular, to the younger phases Ie to Ii are not all entirely satisfactory, what does appear to be significant is that the Troy Ia dating to ~ 2880 calBC is confirmed. Quite apparently, when combined with the sequence of younger samples, *qua method* a unique reading is obtained for the Troy Ia samples.

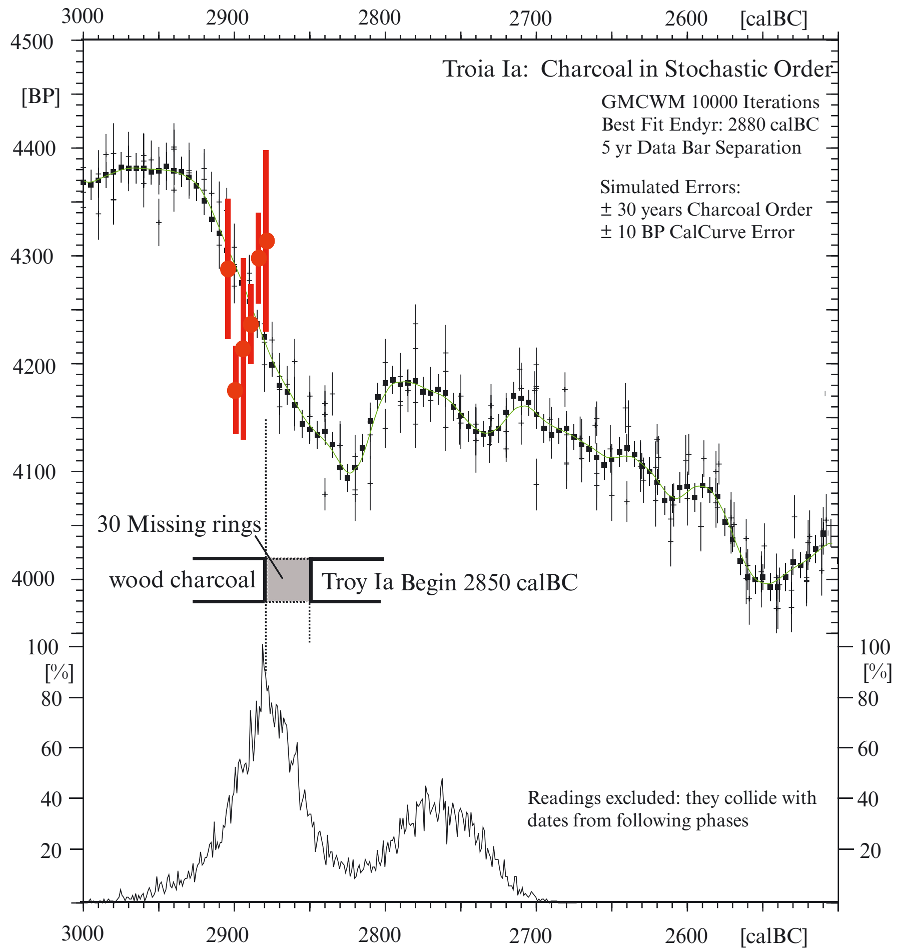

Fig. 9 Troy Ia. Results of GMWCM using Single phase model (Age-model: Tab. C, Appendix).

As such, we gain confidence that the older reading for Troy Ia is indeed correct. However, this does not necessarily imply that the assumed equal phase-length model is equally valid for the following phases.

Looking at the younger end of the Troy I sequence, it is interesting that the two samples (No. 40 and 41: Hd-16810, Hd-16832) from phase Ij do actually appear to derive from the wiggle around 2510 calBC. Both ^{14}C-measurements, although positioned at some (unacceptable) distance *above* the INTCAL13-calibration curve, have ^{14}C-ages that are closer to the limits we may expect if the amplitude of the INTCAL13-curve around 2520 calBC could be set, say, some ~50 BP higher. But, as can be judged from the spread of the laboratory raw-data in this region of the calibration curve, this appears unlikely. Anyway, taken at face value, both of these samples could just as well represent 'old-wood' that is ~ 100 years (or more) older. Less understandable, in statistical terms, are the positions *beneath* the calibration curve obtained for samples Nos. 45 and 47 (Hd-13862, Hd-13848), which could either be due to stratigraphic misalignment or else due to extreme ^{14}C-values.

Model Testing: Troy Id, Beam (Appendix, Tab. E)

Having confirmed the modelled date of ~ 2880 calBC for Troy Ia, let us now test the results of the uniform multiple-phase model itself. If this model is correct, we may expect a date between 2800 and 2760 calBC (i.e. ~ 2780 calBC) for phase Id (Fig. 10). The following test is based on a series of 10 high-precision ^{14}C-measurements obtained by the Heidelberg laboratory on a large charred beam (Beh.D5.365) that was found, apparently in-situ, in Square D5, at the eastern edge

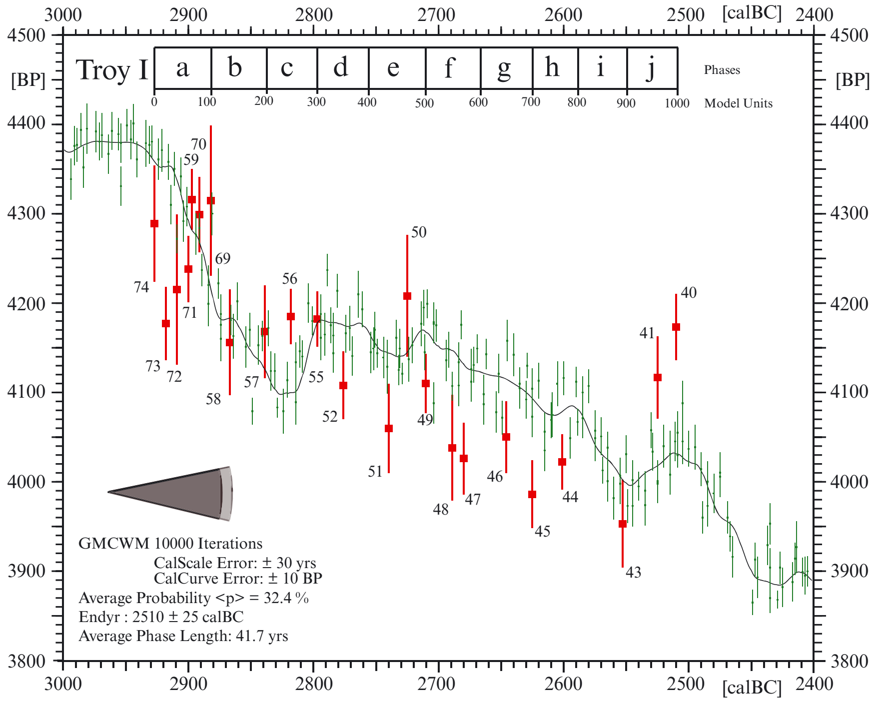

Fig. 10 Troy Ia-Ij. GMWCM-results for multiple-phase model (Age-model: Tab. D, Appendix).

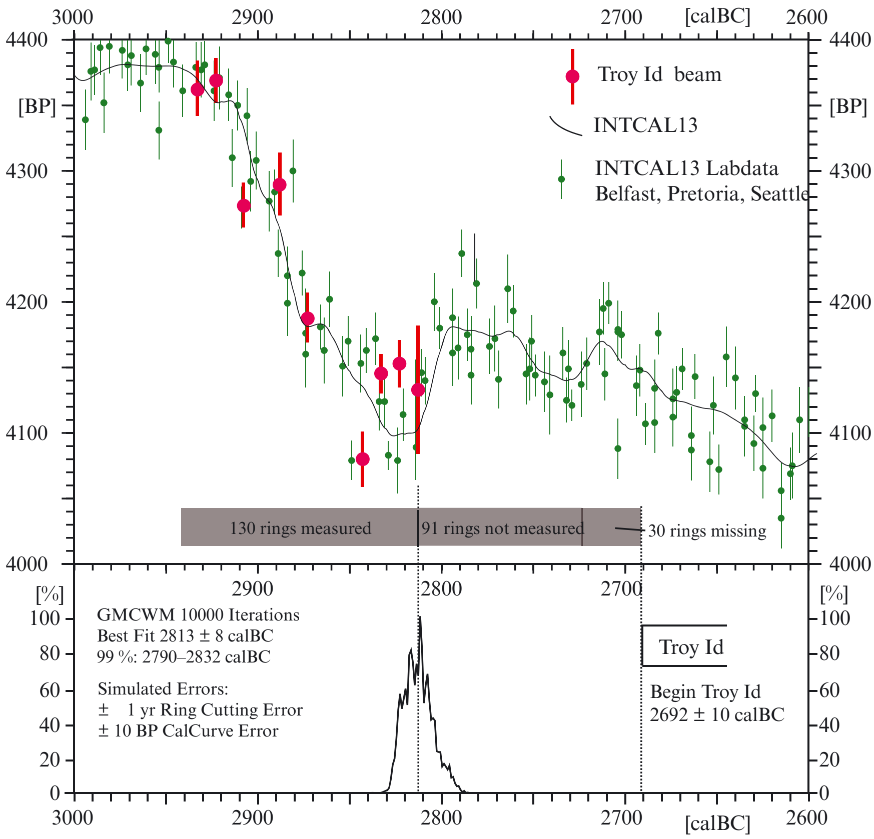

Fig. 11 Troy Id beam. Results of dendrochronological wiggle matching (Data: Korfmann – Kromer 1993, 155) (Age-model: Tab. E, Appendix).

of the Schliemann Graben. Originally, this beam was assigned to Troy I b/c,[63] but its stratigraphic position is more likely to be Troy Id or even later in Troy I.[64] The following discussion is based on the assumption that Troy Id is the correct assignment for the beam.

As shown by dendrochronological analysis, the beam had 226 growth rings, of which only 130 rings were large enough for ^{14}C-measurement. According to the communication from Peter Kuniholm to Manfred Korfmann (dated 18.08.1990) and which is cited by Korfmann and Kromer,[65] the "badly deteriorated condition of the exterior rings made them unsuitable for radiocarbon analysis". Kuniholm writes further: "Thus the final date for the felling of the tree will be the wiggle-matched date plus 91 plus ?? missing rings". As to these question marks, Kuniholm proposes that ~ 30 yrs should be allowed for to account for the missing bark and/or sapwood (German *Splintholz*). Hence, in Fig. 11, having achieved a dendrochronology-based wiggle-match best fit of 2813 ± 8 calBC (rounded: 2813 ± 10 calBC) for the youngest measured sample, we have adjusted the date for the deposition of the beam in Middle or Late Troy I to 2813 minus (91+30 yrs) = 2692 ± 10 calBC. This result is in near-perfect agreement with the result 2699 ± 15 calBC obtained by Korfmann and Kromer.[66]

Looking back at the ^{14}C-results for Troy I (Fig. 10), and comparing the phase-modelled age of Troy Id (2800 ± 30 calBC) with the surely more precise dendrochronological wiggle-matching age (2692 ± 10 calBC) (Fig. 11), it immediately becomes apparent that the phase-modelled results are more-or-less exactly 100 years too old. This age-difference, although obviously large and at any rate not covered by the combined error, is disappointing but not unexpected. It makes us aware, once again, of the many dangers involved in construction of archaeological age-models that are based on the uncritical analysis of charcoal samples. Despite all cautionary measures, perhaps we are still underestimating the impact of the 'old-wood' effect? Notwithstanding this is a real possibility, on the one hand, the offset can *itself* hardly be explained by the exceptional size of the Troy Id beam which has 226 (measured) growth rings. This is because we have corrected the dendro-wiggle-matched date for the 'old-wood' effect, in order to get as close as possible to the actual cutting year of the beam. Hence, this age is *qua method* not dependent on the size of the tree. On the other hand, we cannot exclude that the beam is indeed *double* exceptional, in comparison to the other Troy Ia–Ij charcoals. Beyond its unusual size, it may well represent one of the rare cases where the outer growth rings are conserved. Ultimately, it is impossible to decide which of the two dates is correct. Indeed, perhaps both are correct (or wrong). The only remaining question is, then, how to combine the different dating results? Obviously, we should not simply use the offset of 100 yrs as a correction factor, to be applied to all phases. It may be an extreme value. Instead, but this is looking ahead, in the combined ^{14}C-chronology (Fig. 16) we finally applied a 50-yr 'old-wood' correction to the entire sequence (Troy I–III).

To the same question, it is informative to take a brief look at previously obtained results. According to Weninger (1995), based on an assumed uniform 50-yr phase model for Troy I, the beginning of Troy Ia was dated to 2920 calBC. The end of Troy I (defined as Ii) was dated to 2420 calBC. Similar results were obtained by Manning.[67] In comparison, the present studies indicate that the average Troy I phase length is likely to be somewhat shorter (43 yrs) than was previously established (50 yrs). The difference, although seemingly small (~ 14%), does add up to some 70 yrs at the end of Troy, due to its many phases.

Before taking a closer look at the ^{14}C-dates that are available for the transition from Troy I to Troy II, it is informative to hear what Manfred Korfmann thinks about this question. He comments on the continuity problem as follows: "Several further building phases in the area of Late Troy I to

63 Korfmann – Kromer 1993, 155.
64 Easton – Weninger in preparation.
65 Korfmann – Kromer 1993, 155.
66 Korfmann – Kromer 1993, 155.
67 Manning 1997.

Troy IIc were revealed in addition to those known to Blegen. This jumble of countless walls and parts of walls was extremely difficult to untangle".[68] As it turns out, since the dating results are better than expected (under such prospects), it appears that the necessary untangling of walls, and definition of phases, was altogether quite successful. Plans of the different phases are provided by Unlüsöy.[69] The results of modelling the Troy II–III dates are described in the following.

Troy II–III, Multiple-Phase Model (Appendix, Tab. F)

Similar to the approach taken in modelling the ^{14}C-ages for Troy Ia–Ij, for the next younger data set (Troy II–III) we first apply a uniform phase model. In addition, and which was not possible for Troy I (due to the strongly sloping stratigraphy), it was possible to test the Troy II–III phase model using an age-depth model (see below). For purposes of comparison, the results of the two models are shown together in Fig. 12. Both models are in good agreement concerning both the *beginning of Troy* II (with phase IIa1 dated to ~2550 calBC) as well as the *end of Troy III* (with the youngest Troy III Pinnacle Schicht S6 dated to ~2200 calBC).

Due to its importance for the ^{14}C-analysis, in Fig. 13 we provide a stratigraphic section through the Pinnacle, onto which the ^{14}C-dates for Schichten S13, S12, S9, S7, S6, and S3 are projected.[70] Note that we use here the phasing terminology of Frirdich.[71] Based in particular on studies by Pavúk,[72] we may be reasonably confident that the Pinnacle contains layers mainly of Troy II–III. As indicated (Fig. 13, top), Troy IV is also represented in the Pinnacle, but only in the uppermost layers (S1–S5). These layers, for which ^{14}C-ages are not available, have an extremely small area (< 1m²). More important is that the Pinnacle provides a more-or-less continuous sequence of stratified ^{14}C-ages, documented under conditions that could have been termed ideal if only short-lived samples (e.g. animal bones) had been dated. Even for the given charcoal dates, however, the Pinnacle provides us with some welcome control over the modelling results, both in stratigraphic terms and in terms of periodization/phasing.

Moving from lower to higher in Fig. 13, the heavily burnt Schicht S12 at the lowest levels of the Pinnacle represents the destruction by fire of Megarons IIA and IIB. Both buildings were constructed in Blegen IIc/Ünlüsoy IIc1. The stratigraphically lowest ^{14}C-ages are from burnt wooden beams either from the roof construction of Megaron IIA (Hd-14561) or from the Parastade of Megaron IIB (Hd-14572, Hd-14573, Hd-14008).[73] There is no special need to clarify the ^{14}C-results for Hd-14573, Hd-14008, Hd-14561), since it is obvious these measurements are indicative of the 'old-wood' effect, in all its glory.

The next higher level in the Pinnacle (Schicht S11), and which is also heavily burnt, corresponds to Blegen's IIg. Since the two destruction layers S11 and S12 are difficult to separate elsewhere on the site, many researchers, including Blegen, did not recognise the existence of these two consecutive fire destruction episodes (S12 and S11). Moving again higher, Blegen's Troy III is represented in S10–S3 (^{14}C-ages are available for Schichten S9, S7, S6). Finally, at the very top of the Pinnacle, Blegen's Troy IV is represented in Schichten S1–S5 (^{14}C-age Hd-12099 is available for S3).

Mansfeld correctly shows Blegen's Troy IId and IIe as subphases within his lowest bundle of deposits, Pinnacle S12.[74] In our judgement, they are best interpreted as representing subphases of IIc, during which the large central Megarons continued to exist, although with many alterations to

[68] Korfmann 2000, 5–7, fig. 5.
[69] Unlüsöy 2010, vol. II.
[70] Cf. Tab. 4, Tab. G, Appendix.
[71] Frirdich 1997.
[72] Pavúk 2010.
[73] Mansfeld, 2001, Appendix III, 266.
[74] Mansfeld 2001, figs. 12–13; cf. figs. 1, 51.

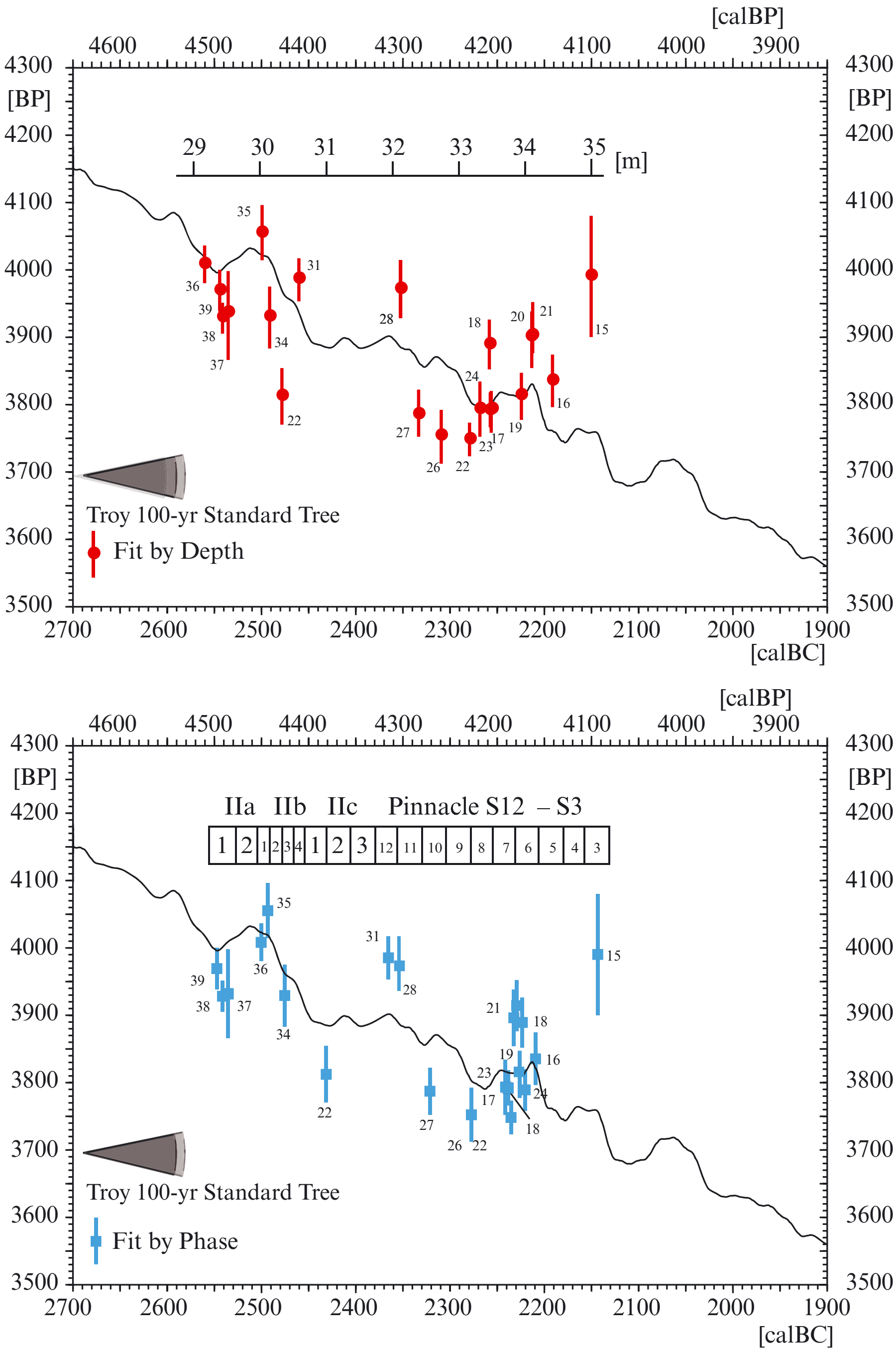

Fig. 12 Comparison of modelling results for Troy II–III, using a linear age-depth model (Upper. Model: Tab. G, Appendix) in comparison to a uniform phase-model (Lower: Model: Tab. F, Appendix). For convenience in ^{14}C-phase-modelling, Phases IIc1–c3 are taken as consecutive, despite the fact that elements of these phases are known to be parallel (cf. text).

the buildings around them.[75] This same phase (Blegen IIc, Ünlüsoy IIc1) witnessed not only the construction of the two central buildings (Megaron IIA and IIB), but also the strengthening and an expansion of the fortifications (Dörpfeld's fortification IIb), the construction of large gates (Gate FM with ramp, Gate FO with superstructure), and the construction of the Temenos with Gate IIC.

[75] Ünlüsoy 2010.

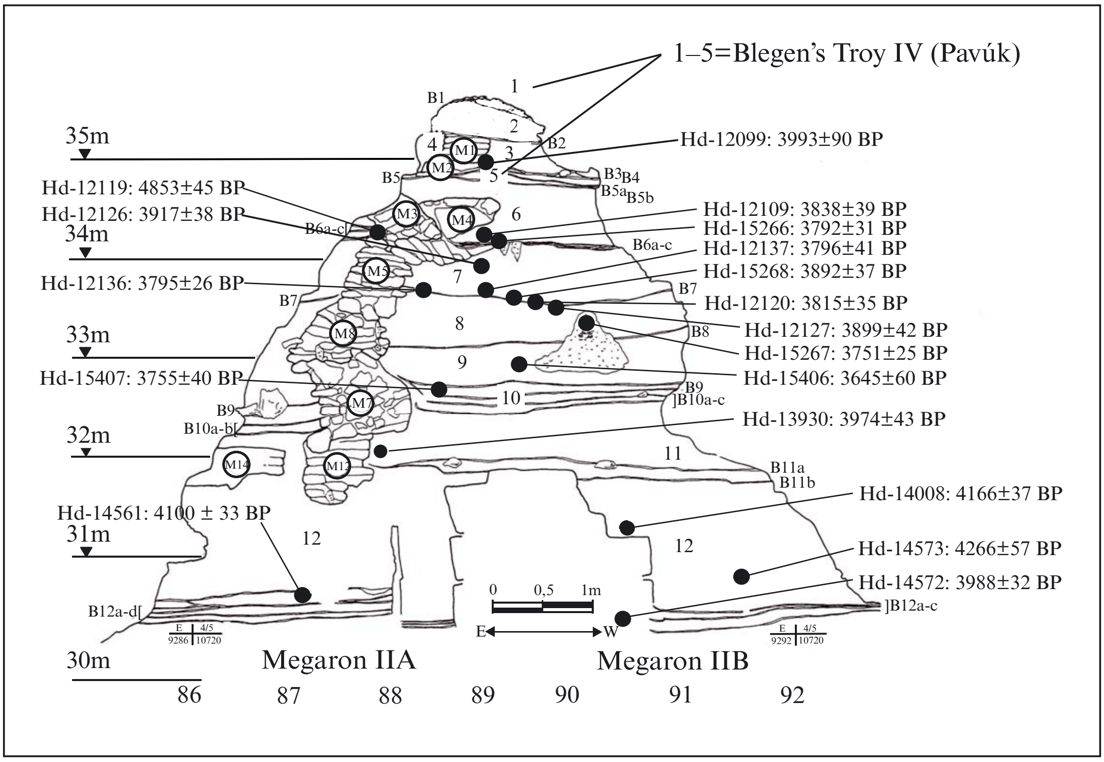

Fig. 13 Pinnacle E4/5 (E–W Profile) excavated by Mansfeld (2001), with projection of ^{14}C-ages (Tab. A, Nos.15–26) according to site coordinates provided by Korfmann – Kromer, 1993). The phases are named here *Schichten* (S12–S1) according to the terminology of Frirdich (1997). As indicated, the highest Schichten (S1–S5) most likely correspond to Blegen's Troy IV (Pavúk 2010). According to archaeozoological analysis by Hans-Peter Uerpmann (referenced in Mansfeld 2001, 162) the hyena den dug into Schichten S8 and S9 (shown with dotted outline) is indicative for a settlement abandonment of unknown length. The B=Boden numbers follow those in Mansfeld's section drawing, but recoded according to the terminology of Frirdich (1997).

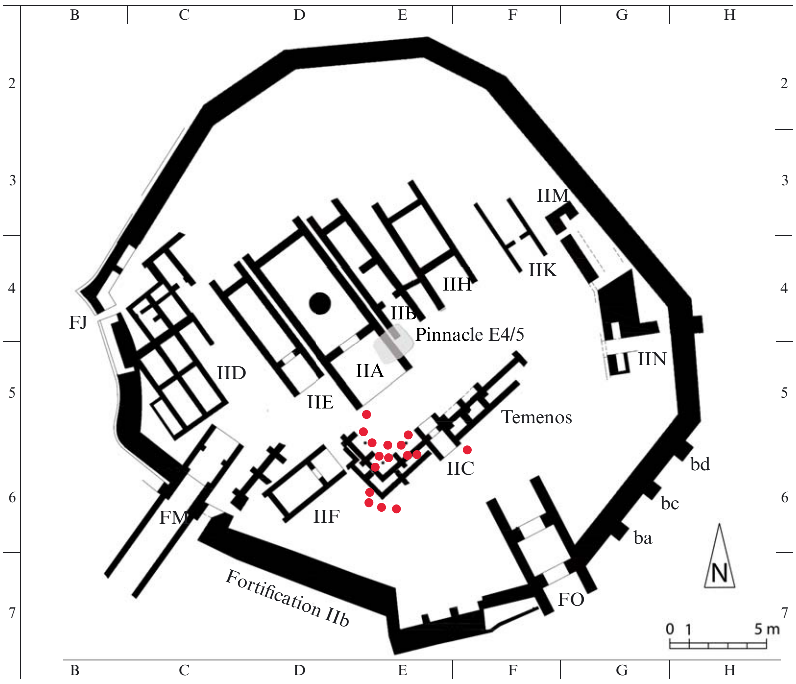

Fig. 14 Plan of Troy Phase IIc (redrawn from Ünlüsoy 2010, 12), with location of major architectural units, including Pinnacle E4/5 (shaded outline) and the position of pits from Phase IId ('Pit Period': Blegen et al. 1950, pt. 2, pl. 457).

With all these major components put together, the plan of IIc (Fig. 14) provides a vivid impression of architectural monumentality and economic wealth at Troy, during this period. Indeed, to the present day the central Megaron IIA at Troy remains the largest building in the EBA of western and central Anatolia.[76]

Of special importance in ^{14}C-age modelling, contrary to Blegen's conclusion the evidence now attests that Megaron IIA was in continued use during Blegen IIc–d–e (Ünlüsoy, IIc1–c3), but was burnt at the same time as the colonnade and courtyard.[77]

Consequently, in ^{14}C-age modelling it is necessary to allow for the extended lifespan of the central architectural complex. As a pragmatic solution, instead of correctly placing phases IIc1–c3 (partly) parallel to each other in time, for convenience we have allowed for their additive timespan by assuming they are consecutive and of equal timespan. This decision opens the path for numerical ^{14}C-age processing.

As stated above, for the Troy II–III sequence we obtain essentially identical *corner* dates for the beginning of Troy II and for the end of Troy III, for both age-models (Fig. 12). What remains to be studied is the statistical stability of intermediate dates.

Troy II–III, Age-Depth Model (Appendix, Tab. G)

To maintain control over the Troy II–III age-depth model (Fig. 12, upper), let us have a closer look at the underlying assumptions. In comparison to the phase-model, which is based on an ordinal scale (i.e. one phase after the other), the age-depth model is based on a metric scale. The specific assumption we wish to check is, how precisely does each centimetre of stratigraphic growth represent one and the same time-span? This time-span is initially unknown. The task we therefore present to the GMWCM-algorithm is to find the best-fitting position of the ^{14}C-ages on the calibration curve, in relation to their stratigraphic depth. Using the GMWCM-method, this task is achieved by stepwise expansion of the sequence, until an optimal growth value [cm/yr] is achieved. In archaeological terms the assumption is that, within error limits to be established, the overall stratigraphy of Troy II in any one phase is horizontal, with gradual but always upward directed growth due to the accumulation of deposits. Obviously, prior already to the ^{14}C-analysis, the validity of this assumption needs to checked. It is not that we *believe* in the validity of this assumption, or not. Much simpler, the aim of checking is to quantify the numeric errors to be entered into the GMWCM-algorithm.

As can be taken from Fig. 15, the central stratigraphy of the site has corner values of ~ 29.5m for Troy IIa1, at the lower end, and of ~ 35.0m for the end of Troy III (Pinnacle Schicht S3) at the higher end of the graph. The growth rate between these two ends is indeed to some extent linear, as required for age-depth modelling. However, the graph shows two quite conspicuous steps, the first and largest of which (> 1.5m) dates to Pinnacle Schicht S12, the second dates to Pinnacle Schicht S7. The first step at c. 31–32m reflects the large accumulation of burnt debris that is associated with the collapse of Megaron IIA and Megaron IIB at the end of the IIc–d–e sequence (in Blegen's terms). This was a very severe conflagration and a major incident in the site's history. The step at c. 33.20–34.20 does coincide with another severe burning in the course of Troy III (Pinnacle S7). However, both the two lowest as well as some of the higher samples in this step come from pits dug down from the next younger Schicht S6a into these deposits. Hence, if only for this second step, the vertical spread of sample heights is not only caused by fire-destruction. As in the case with the linear growth model, it is also interesting to observe that, for essentially all the many (!) phases in between these steps, the site does appear to be gradually developing upwards. A quick estimate would be that it takes some 500 years for Troy to grow some 5m. This value (i.e. 1cm/yr) is no way unusual. Similar values (± 30%) can be obtained

[76] Bachhuber 2009, 7.
[77] Easton 2000, 78–79.

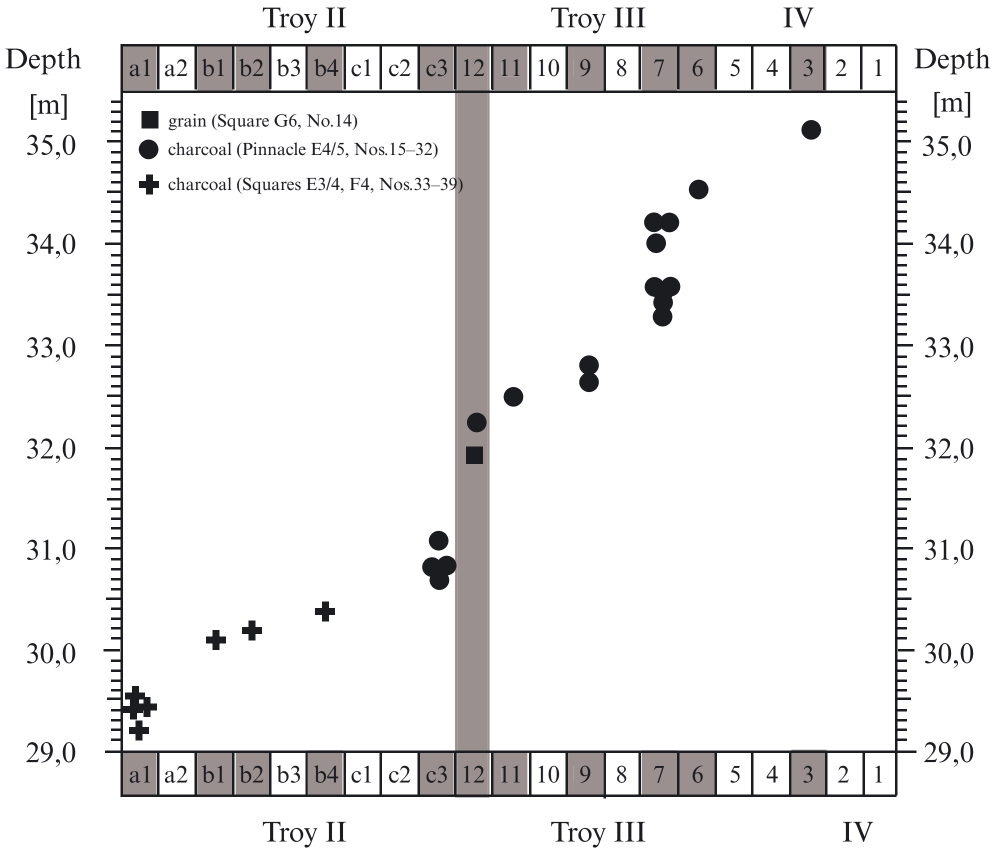

Fig. 15 Phase-depth relation for ^{14}C-dated samples from Troy II–III.

for tell-sites all over the Near East and southeast Europe and, as it appears, the range of values is only a minor function of construction material (stone and/or clay). These notions remain to be documented. What is important, for present purposes, is that the growth-rate error, to be entered into the GMCWM-algorithm is in the order of ± 30cm (see Fig. 15). When translated to calendric ages, the resulting error of ± 30 yrs coincides perfectly with the value we have been using all the time in phase-modelling (above), but which was up to now not well-established.

We are now in a position to critically compare the results achieved for Troy II–III by the two different methods (Fig. 12). As already mentioned above, essentially identical ages are achieved for the *corner ages* of the sequences (i.e. for the beginning of II and the end of III). But what about the ages for the intermediate samples? For these samples, the maximal deviation is for date No. 31, for which an age-model difference of 97 yrs is achieved [2464 calBC (*phase*) minus 2367 calBC (*depth*)]. Otherwise, the results of the two models are quite similar. The main difference is that, in the phase model (Fig. 12, lower), the sample positions are slightly (by a few decades) closer together than in the depth model (Fig. 12, upper). From a statistical viewpoint, this is acceptable. To maintain compatibility with the phase-modelling for Troy I, in the final combined chronology (Fig. 16) we decided also to base the Troy II–III component on the phase model.

Model Testing: Hd-20174: Final Test

Purposely, we have not included Hd-20174: 3797 ± 25 BP (2230 ±50 calBC) in any of the models. Hd-20174 is quite singular in that the ^{14}C-measurement was performed on the only short-lived (grain) sample in the entire data-set. Consequently, it is possible to use this date for final control purposes. Hd-20174 was taken from the inside of a burnt wooden construction found standing on the floor of Megaron 1 (Square G6, Beh. G6.1056). Photographic documentation of Megaron 1 is provided by Sazcı and Ünlüsoy.[78] According to Sazcı,[79] the sample can be attributed to Blegen IIIa (i.e. the earliest phase of Blegen's period III, if only in the sense that the sample represents the burning of Megaron 1 at some – unknown – time following its construction). When transferred to the Pinnacle, therefore, we may expect Hd-20174 to have a calendric age that is compatible with the end of Schicht S10. For this comparison to be valid, however, due allowance is to be made for the 'old-wood' effect.

Combined ^{14}C-Chronology

All that is now necessary is to combine the age-models achieved for the different floating data sub-sets, that is for Troy Ia–Ij (Fig. 10), the Beam Id (Fig. 11), and for Troy II–III (Fig. 12, lower). The combined ^{14}C-chronology is shown in Fig. 16 (upper).

Remembering that all these components were obtained for charcoals, Fig. 16 (lower) shows the chronology as it would appear when a systematic shift of 50 yrs (younger) is applied to all phases. This shift is necessary to allow for the (estimated) 'old-wood' effect. In the corrected ^{14}C-chronology, due allowance is also made for the three Late I–Early II phases (Il, Im, and In). These three phases are not covered by the age-models. We show this corrected chronology in Fig. 16 (lower), despite all necessary phase-interpolations. It is the chronology to be preferred for synchronisms with other Anatolian EBA-sites, and in particular when long-distance synchronisms between Troy and sites with historical dates (e.g. in Mesopotamia) are requested.

Purposely *not* shown in the Final Age Model (Fig. 16, lower) is the chronological position of Hd-20174, which is the only presently available ^{14}C-age that was measured on a short-lived

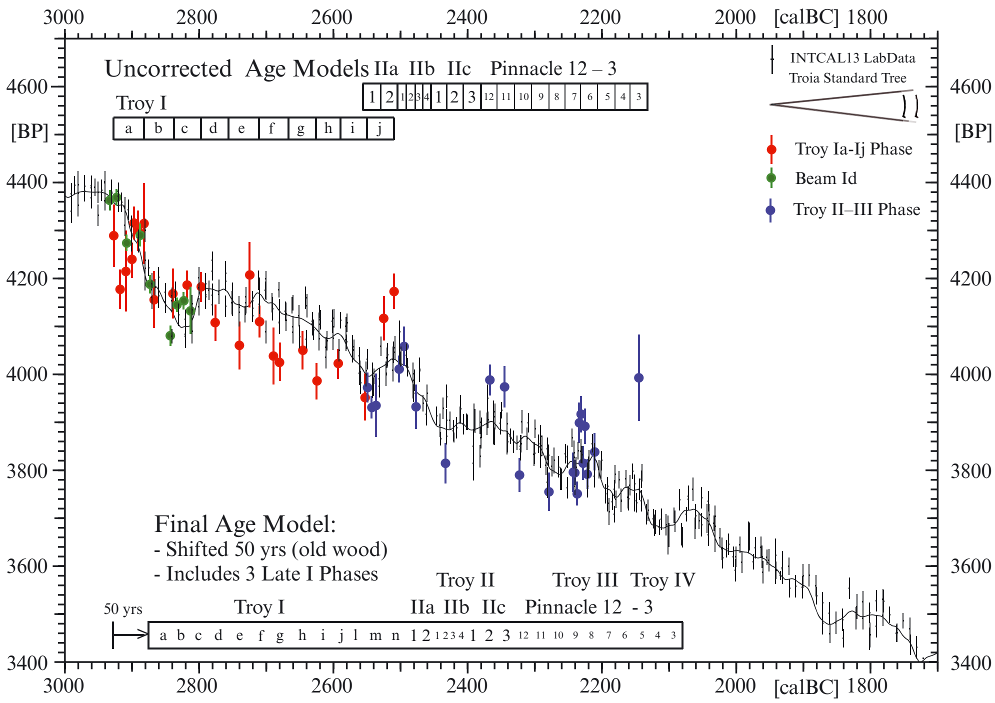

Fig. 16 Combined stratigraphic succession of ^{14}C-ages (Data: Tab. A, Appendix) for Early Bronze Age Troy (periods I–III). The figure combines the ^{14}C-age sequence according to different age models for initially floating ^{14}C-data subsets (Fig. 1).

[78] Sazcı 2001; Ünlüsoy 2010.

[79] Sazcı 2001, 384.

sample. According to the forecasting (in the previous section), the age obtained for Hd-20174 (3797 ± 25 BP: 2230 ± 50 calBC) by single-date-analysis should (hopefully) be synchronous with the age obtained for the end of Pinnacle Schicht S10. As can be taken from Fig. 16 (lower), and when inserting a date of 2230 ± 30 calBC for Pinnacle Schicht S10, this is indeed the case.

Conclusions

To summarise, we have developed a stratigraphic age model for EBA-Troy (periods I–III) that incorporates N=76 published ^{14}C-ages (Appendix, Tab. A). The main results of our studies are shown in Fig. 16. We provide here two variants of the same ^{14}C-based chronology, that is (1) a chronology that is uncorrected for the 'old-wood' effect (Fig. 16 upper) and (2), the same chronology but which is systematically shifted by 50 yrs to the younger, and which incorporates three ^{14}C-undated architectural phases between Late Troy I and Early Troy II (Fig. 16 lower). It is to be emphasised that, in the construction of both chronologies, we found it impossible to attribute any of the ^{14}C-dated charcoal samples to the calendric time-scale, more precisely than with a (minimum) error of ± 30 yrs (68% confidence). A further (and significant) reduction in dating errors should be possible, we judge, if in the future a more extensive series of radiocarbon ages on short-lived samples (e.g. animal bone, shell, charred grain) becomes available.

In our judgement, the following three observations are of particular interest: 1. the chronological results shown in Fig. 16, although derived from complex modelling, are in good agreement with the results for Troy II–III obtained from critical single-date analysis by Ünlüsoy;[80] 2. the chronological results shown in Fig. 16, although obtained on such complex entities as are archaeological charcoals, finally required leaving away *only* six ^{14}C-measurements as *outliers* (Hd-14008, Hd-14573, Hd-13633, Hd-14561, Hd-13619, Hd-13931 cf. Appendix Tab. A); 3. as discussed in detail here, there are indications for the existence of a gap (in the sense of a real settlement hiatus) of 100–200 yrs in length between the end of Troy III and the beginning of Troy IV. This possibility (Fig. 5), although presently not confirmed by the combined Blegen and Schliemann pottery seriation (Fig. 8), requires further attention.

Acknowledgements: We gratefully acknowledge the support by Peter Jablonka (Tübingen) during many excavation campaigns at Troy and thank him for his thoughtful and constructive review of the present paper. Remaining errors are of course ours, to be quantified.

80 Ünlüsoy 2010, 172–178, pl. 120.

Appendix Tab. A

No.	LabCode		Phase	Material	*Behälter Nr.*	^{14}C-Age [BP]	Height [m]	Y	X	Model Age calBC (68%)
1	Hd-13823		nd	charcoal	D7.33	3829 ± 33	31.32	78.50	67.50	nd
2	Hd-14022		nd	charcoal	D7.146	3890 ± 33	27.91	78.20	72.30	nd
3	KN-131		III ?	charcoal	---	3750 ± 95	nd	nd	nd	*2038 ± 40*
4	Bln-1235		--	short	Inv.No.9493	3665 ± 60	nd	nd	nd	*2062 ± 40*
5	Bln-1234		--	pees	Inv.No.9483	3635 ± 60	nd	nd	nd	*2086 ± 40*
6	Bln-1239		III ?	charcoal	Inv.No.9482	3845 ± 70	nd	nd	nd	*2110 ± 40*
7	Bln-1237		--	pees	Inv.No.9481	3730 ±100	nd	nd	nd	*2134 ± 40*
8	Bln-1238		--	charcoal	Inv.No.9480	3710 ± 80	nd	nd	nd	*2158 ± 40*
9	Bln-1106		III	seeds	Inv.No.9479	3900 ± 90	nd	nd	nd	*2182 ± 40*
10	Bln-1310		--	charcoal	Inv.No.9475	3760 ± 60	nd	nd	nd	2206 ± 40
11	Bln-1236		--	charcoal	Inv.No.9475	3700 ±100	nd	nd	nd	*2230 ± 40*
12	Bln-1129		IIg ?	peas	Inv.No.9474	3800 ± 60	nd	nd	nd	*2254 ± 40*
13	Bln-1132		IIg ?	peas	Inv.No.9474	3735 ± 60	nd	nd	nd	*2278 ± 40*
14	Hd-20174		IIIa	seeds	*G6.1056*	*3797 ± 25*	*31.94*	*93.30*	*94.80*	*2230 ± 50*
15	Hd-12099	S-3	IV	charcoal	E4/5.17+20	3993 ± 90	35.03	88.60	19.80	2145 ± 30
16	Hd-12109	S-6	III	charcoal	E4/5.31	3838 ± 39	34.44	88.89	20.35	2211 ± 30
17	Hd-15266	S-7	III	charcoal	E4/5.122	3792 ± 31	33.50	88.95	18.90	2222 ± 30
18	Hd-15268	S-7	III	charcoal	E4/5.112	3892 ± 37	33.50	88.95	18.90	2225 ± 30
19	Hd-12120	S-7	III	charcoal	E4/5.67	3815 ± 35	33.97	89.25	20.30	2228 ± 30
20	Hd-12126	S-7	III	charcoal	E4/5.68	3917 ± 38	34.14	89.25	20.30	2231 ± 30
21	Hd-12127	S-7	III	charcoal	E4/5.71	3899 ± 42	34.13	90.35	19.97	2234 ± 30
22	Hd-15267	S-7	III	charcoal	E4/5.178	3751 ± 25	33.19	88.09	19.92	2237 ± 30
23	Hd-12136	S-7	III	charcoal	E4/5.92	3795 ± 26	33.50	88.20	20.00	2240 ± 30
24	Hd-12137	S-7	III	charcoal	E4/5.93	3796 ± 41	33.55	89.30	19.70	2243 ± 30
25	Hd-15406	S-9	III	charcoal	E4/5.140	3645 ± 60	32.58	89.70	22.10	2030 ± 90
26	Hd-15407	S-9	III	charcoal	E4/5.162	3755 ± 40	32.76	88.45	20.67	2279 ± 30
27	Hd-15408	S-11		charcoal	E4/5.170	3790 ± 35	32.42	87.77	21.70	2323 ± 30
28	Hd-13930	S-12		charcoal	E4/5.307	3974 ± 43	32.15	87.50	21.50	2345 ± 30
29	Hd-14008	S-12		charcoal	E4/5.393	4166 ± 37	31.00	90.50	20.00	outlier
30	Hd-14573	S-12		charcoal	E4/5.580	4266 ± 57	30.75	91.55	19.90	outlier
31	Hd-14572	S-12		charcoal	E4/5.584	3988 ± 32	30.62	90.27	20.04	2367 ± 30
32	Hd-14561	S-12		charcoal	E4/5.551	4100 ± 33	30.79	86.75	19.20	outlier
33	Hd-16733		IIb4?	charcoal	E4.660	3815 ± 42	30.37	86.00	36.00	2433 ± 30
34	Hd-16734		IIb2	charcoal	E4.701	3932 ± 46	30.18	88.00	36.50	2477 ± 30
35	Hd-16735		IIb1	charcoal	E4.639	4058 ± 41	30.07	85.00	31.00	2495 ± 30
36	Hd-17664		IIb1	charcoal	E3.39	4011 ± 28	29.19	87.50	49.00	2502 ± 30
37	Hd-19823		**IIa1**	charcoal	F4.67	**3935 ± 66**	29.55	07.00	29.20	2537 ± 30
38	Hd-19822		**IIa1**	charcoal	F4.68	3931 ± 23	29.46	07.50	29.20	2543 ± 30
39	Hd-20040		**IIa1**	charcoal	F4.69	3972 ± 31	29.42	08.00	29.40	2549 ± 30
40	Hd-16810		Ij	charcoal	D3.278	4173 ± 37	24.30	74.00	47.50	2510 ± 30
41	Hd-16832		Ij	charcoal	D3.266	4117 ± 46	24.13	75.50	48.30	2525 ± 30
42	Hd-13633		Ii	charcoal	D2.82	4228 ± 45	24.44	79.50	61.25	outlier
43	Hd-13813		Ii	charcoal	D2.275	3954 ± 49	23.90	74.50	63.80	2553 ± 30

No.	LabCode	Phase	Material	*Behälter Nr.*	^{14}C-Age [BP]	Height [m]	Y	X	Model Age calBC (68%)
44	Hd-13812	Igh	charcoal	D2.236	4022 ± 31	24.27	66.75	62.45	2600 ± 30
45	Hd-13862	Igh	charcoal	D2.196	3986 ± 38	22.92	73.70	68.70	2625 ± 30
46	Hd-13850	Ig	charcoal	D3.190	4050 ± 40	24.00	71.45	58.75	2646 ± 30
47	Hd-13848	If	charcoal	D3.105	4026 ± 40	23.77	69.00	59.00	2680 ± 30
48	Hd-13801	If	charcoal	D3.105	4038 ± 59	23.77	69.00	59.00	2689 ± 30
49	Hd-13384	Ief	charcoal	C3.164	4110 ± 33	24.25	55.35	58.25	2710 ± 30
50	Hd-13852	Ie	charcoal	D3.138	4208 ± 68	23.51	68.50	58.50	2725 ± 30
51	Hd-13851	Ie	charcoal	D3.167	4060 ± 50	23.47	68.30	58.20	2740 ± 30
52	Hd-13618	Icd	charcoal	C3.223	4108 ± 38	23.50	54.50	57.65	2776 ± 30
53	Hd-13619	Icd	charcoal	C3.223	4288 ± 37	23.50	54.50	57.65	outlier
54	Hd-13931	Icd	charcoal	D4.215	3786 ± 55	28.32	77.12	24.22	outlier
55	Hd-13751	Icd	charcoal	C3.201	4182 ± 31	23.87	55.10	57.00	2797 ± 30
56	Hd-13929	Icd	charcoal	D4.379	4185 ± 31	28.38	77.60	23.72	2818 ± 30
57	Hd-11906	Ibc	charcoal	D4.14	4168 ± 52	26.46	74.40	31.00	2839 ± 30
58	Hd-12059	Iab	charcoal	D4.118	4156 ± 59	26.50	60.75	24.25	2867 ± 30
59	Hd-11935	Iab	charcoal	D4.38	4316 ± 34	26.30	75.45	24.20	2897 ± 30
Beam (*pinus brutia,* 226 rings), Beh.D5.365. 'Id' means: *Begin Id (or younger), with ~121 not-dated outer rings.*									
60	Hd-14706	'Id'	charcoal	1051-1060	4133 ± 49	27.47	78.0	18.0	2813 ± 10
61	Hd-14614	--	charcoal	1041-1050	4153 ± 18	27.47	78.0	18.0	2823 ± 10
62	Hd-15023	--	charcoal	1031-1040	4145 ± 15	27.47	78.0	18.0	2833 ± 10
63	Hd-14698	--	charcoal	1021-1030	4080 ± 21	27.47	78.0	18.0	2843 ± 10
64	Hd-14686	--	charcoal	991-1010	4188 ± 19	27.47	78.0	18.0	2873 ± 10
65	Hd-14937	--	charcoal	976-985	4290 ± 24	27.47	78.0	18.0	2888 ± 10
66	Hd-14672	--	charcoal	956-965	4274 ± 17	27.47	78.0	18.0	2908 ± 10
67	Hd-15095	--	charcoal	941-950	4369 ± 17	27.47	78.0	18.0	2923 ± 10
68	Hd-14615	--	charcoal	931-940	4363 ± 21	27.47	78.0	18.0	2933 ± 10
69	Hd-11945	Ia	charcoal	D4.46	4315 ± 84	26.00	75.30	24.12	2882 ± 30
70	Hd-11917	Ia	charcoal	D4.35	4299 ± 42	25.58	74.10	32.45	2891 ± 30
71	Hd-11944	Ia	charcoal	D4.50	4238 ± 37	25.62	75.20	24.20	2900 ± 30
72	Hd-12058	Ia	charcoal	D3.43	4215 ± 84	24.53	61.00	40.60	2909 ± 30
73	Hd-12061	Ia	charcoal	D4.136	4177 ± 41	25.93	60.60	24.30	2918 ± 30
74	Hd-12060	Ia	charcoal	D4.129	4289 ± 65	26.02	60.65	24.30	2927 ± 30
75	Hd-14223	Pre-I	charcoal	D5.457	4271 ± 45	25.49	75.75	9.50	--
76	Hd-14222	Pre-I	charcoal	D5.443	4568 ± 47	25.52	74.30	9.30	--

Appendix Tab. A Early Bronze Age ^{14}C-Dates (Troy I–III). ^{14}C-data from Korfmann – Kromer (1993), Sazcı (2001) and Ünlüsoy (2010). Calendric ages in the far right column are based on architectural-phase modelling (Tabs. C–F), see text. These ages do not account for the age-distorting impact of the 'old-wood' effect. Ages provided for Hd-20174 and Hd-15406 – set *italic* – were derived from single-age calibration. They were used for model testing. For methodological reasons it is not possible to derive weighted averages from calibrated ^{14}C-ages with '±' notation (Chapter 3).

Abbreviations: (1) LabCodes: Hd (Heidelberg), Bln(Berlin), KN(Köln). (2) nd: not defined) (3). S-1 to S-12: Pinnacle notation by *Schichten*, according to Frirdich (1997).

Appendix Tab. B

Unit Nr	Text Unit	Text Page	Troy Period	Blegenized Pottery Inventory															
UNIT 5	NE.v.4–5	p97	II–III	NoTypes	NoPots	%-Tot	C10	D14											
				2	2	0.01	1	1											
UNIT 7	NP.i.10	p110	II	NoTypes	NoPots	%-Tot	B3	C34	C39	D33									
				4	4	0.03	1	1	1	1									
UNIT 9	NP.ii.4	p115	V	NoTypes	NoPots	%-Tot	A33	C28	D13										
				3	3	0.02	1	1	1										
UNIT 11	NP.ii.6	p115f	III	NoTypes	NoPots	%-Tot	B15	C35	D13										
				3	3	0.02	1	1	1										
UNIT 12	NP.ii.7	p116	II	NoTypes	NoPots	%-Tot	A39	A41	B8	B17	C28	C34	C35	C39	D29				
				9	9	0.06	1	1	1	1	1	1	1	1	1				
UNIT 13	NP.ii.9	p117	I–II	NoTypes	NoPots	%-Tot	B1	B20	D1										
				3	3	0.02	1	1	1										
UNIT 16	NP.iv.2	p121	III	NoTypes	NoPots	%-Tot	A12	B20	B24	C32	D8	D24							
				6	6	0.04	1	1	1	1	1	1							
UNIT 17	NP.iv.3	p122f	II	NoTypes	NoPots	%-Tot	B3	B15	C28	C35	D13	D15	D31						
				7	7	0.05	1	1	1	1	1	1	1						
UNIT 18	NP.iv.4	p125	I–II	NoTypes	NoPots	%-Tot	B15	C1	C35	D3									
				4	4	0.03	1	1	1	1									
UNIT 20	NP.v.2	p127	IV	NoTypes	NoPots	%-Tot	A8	B3	B24										
				3	3	0.02	1	1	1										
UNIT 22	NP.v.4a	p128f	II	NoTypes	NoPots	%-Tot	C28	C34	D30										
				3	3	0.02	1	1	1										
UNIT 23	NP.v.4b	p128f	II	NoTypes	NoPots	%-Tot	B13	C28											
				2	2	0.01	1	1											
UNIT 25	NP.vii.6a	p131	III	NoTypes	NoPots	%-Tot	B3	C5	C39	D34									
				4	5	0.03	2	1	1	1									
UNIT 27	NP.vii.7a	p132	II	NoTypes	NoPots	%-Tot	A	C28	D7	D33									
				4	4	0.03	1	1	1	1									
UNIT 28	NP.vii.7b	p132	II	NoTypes	NoPots	%-Tot	B5	C34											
				2	2	0.01	1	1											
UNIT 31	NP.viii.2	p135f	V	NoTypes	NoPots	%-Tot	B21	B22	C5										
				3	3	0.02	1	1	1										
UNIT 38	NS/n.ii.5	p145f	III–IV	NoTypes	NoPots	%-Tot	A45	B20	B21	C32	C35	C39	D3	D7	D8	D13			
				10	10	0.06	1	1	1	1	1	1	1	1	1	1			
UNIT 39	NS/n.ii.6	p147	II	NoTypes	NoPots	%-Tot	A45	B24	C28	C32	C39	D7	D8						
				7	8	0.05	2	1	1	1	1	1	1						
UNIT 44	NS/n.iii.7	p153f	IV	NoTypes	NoPots	%-Tot	B13	C28	D26										
				3	3	0.02	1	1	1										
UNIT 45	NS/n.iii.10	p155	III	NoTypes	NoPots	%-Tot	A2	A33	A43	B3	B17	C28	D13	D33					
				8	8	0.05	1	1	1	1	1	1	1	1					
UNIT 46	NS/n.iii.11	p156	II	NoTypes	NoPots	%-Tot	A39	A45	B3	B6	B17	C5	C28	D3	D13	D29			
				10	15	0.10	1	3	2	1	1	1	3	1	1	1			
UNIT 48	NS/n.iii.11	p157	II	NoTypes	NoPots	%-Tot	A2	B3	B18	C27	C28	D1	D13						
				7	9	0.06	1	1	1	1	2	1	2						
UNIT 49	NS/n.iii.12	p160	II	NoTypes	NoPots	%-Tot	A39	B3	B17	C10	C27	C28	C39						
				7	12	0.08	1	1	1	1	1	1	6						
UNIT 50	NS/n.iii.15	p163	I–II	NoTypes	NoPots	%-Tot	A12	A26	C28	C35	D8	D15							
				6	6	0.04	1	1	1	1	1	1							
UNIT 51	NS/n.iii.17	p164	I	NoTypes	NoPots	%-Tot	A7	D24											
				2	2	0.01	1	1											
UNIT 53	NS/n.v.4a	p168f	IV	NoTypes	NoPots	%-Tot	B3	C7	C28	D30									
				4	4	0.03	1	1	1	1									
UNIT 54	NS/n.v.4b	p169	IV	NoTypes	NoPots	%-Tot	A33	A39	A43	B5	B15	C35							
				6	6	0.04	1	1	1	1	1	1							
UNIT 55	NS/n.v.5	p170	III	NoTypes	NoPots	%-Tot	A45	B3											
				2	3	0.02	2	1											
UNIT 56	NS/n.v.6a	p171	II	NoTypes	NoPots	%-Tot	A33	A43	A45	B3	C10	C19	D3						
				7	8	0.05	1	1	1	2	1	1	1						
UNIT 57	NS/n.v.6b	p171f	II	NoTypes	NoPots	%-Tot	A2	C28	D33										
				3	3	0.02	1	1	1										
UNIT 58	NS/n.v.7	p173	I	NoTypes	NoPots	%-Tot	A31	D11											
				2	2	0.01	1	1											
UNIT 66	NS/s.iii.9	p187f	IV	NoTypes	NoPots	%-Tot	A2	A33	A45	B3	B17	C25	C29	C35	C36	D1	D3	D8	D13
				13	21	0.14	1	5	3	1	1	1	1	2	1	1	1	1	2
UNIT 67	NS/c.i.5	p194f	V	NoTypes	NoPots	%-Tot	A33	A45	C8	D13	D31								
				5	7	0.05	2	2	1	1	1								

Unit Nr	**Text Unit**	**Text Page**	**Troy Period**	**Blegenized Pottery Inventory**			
UNIT 68	NS/c.i.6	p195f	IV	NoTypes 8	NoPots 15	%-Tot 0.10	A33 A39 A45 B9 C19 C28 D13 D14 2 1 4 1 1 4 1 1
UNIT 69	NS/c.i.7	p198f	III	NoTypes 9	NoPots 10	%-Tot 0.06	B3 B6 B20 C22 C28 C39 D7 D29 D33 2 1 1 1 1 1 1 1 1
UNIT 70	NS/c.i.8	p201f	II	NoTypes 10	NoPots 11	%-Tot 0.07	A2 A39 B6 B18 C6 C10 C11 C21 C25 C35 1 2 1 1 1 1 1 1 1 1
UNIT 71	NS/c.11a	p204	II	NoTypes 3	NoPots 3	%-Tot 0.02	A2 C25 C28 1 1 1
UNIT 72	NS/c.i.11b	p205	II	NoTypes 5	NoPots 5	%-Tot 0.03	A1 A39 A45 C25 D29 1 1 1 1 1
UNIT 73	NS/c.i.14	p207	I	NoTypes 4	NoPots 4	%-Tot 0.03	A12 B1 C25 C28 1 1 1 1
UNIT 75	NS/c.ii.6	p209	IV	NoTypes 2	NoPots 2	%-Tot 0.01	A39 D33 1 1
UNIT 76	NS/c.ii.7	p209	III	NoTypes 2	NoPots 2	%-Tot 0.01	A45 D7 1 1
UNIT 77	NS/c.ii.8	p210f	II	NoTypes 6	NoPots 6	%-Tot 0.04	A2 A39 B15 C1 C27 D29 1 1 1 1 1 1
UNIT 86	EW.ii.5	p229	IV–V	NoTypes 4	NoPots 5	%-Tot 0.03	A44 B24 C35 D15 1 1 1 2
UNIT 87	EW.iii.3	p233	III	NoTypes 9	NoPots 11	%-Tot 0.07	A16 B3 B4 B5 B20 C10 C35 D2 D7 2 1 1 1 1 1 2 1 1
UNIT 88	EW.iii.4	p234f	II	NoTypes 7	NoPots 12	%-Tot 0.08	A2 A30 A45 B3 B18 C7 C11 6 1 1 1 1 1 1
UNIT 89	EW.iv	p236f	II	NoTypes 11	NoPots 12	%-Tot 0.08	A43 B4 B8 B9 C1 C7 C13 C19 D7 D13 D31 1 2 1 1 1 1 1 1 1 1 1
UNIT 94	EW.v.9	p242ff	II 20	NoTypes 29	NoPots 0.19	%-Tot 6	A2 A37 A39 A45 B3 B4 B18 C1 C5 C10 C13 C28 C32 C34 C35 D2 1 2 1 2 1 1 1 1 2 1 2 1 1 1 1 D13 D14 D24 D33 1 1 1 1
UNIT 97	NW.iii.6	p259	II	NoTypes 2	NoPots 2	%-Tot 0.01	A45 D29 1 1
UNIT 100	WA.iii.6	p272	IV–V	NoTypes 2	NoPots 2	%-Tot 0.01	A20 C21 1 1
UNIT 103	WA.iv.7a	p276	IV	NoTypes 2	NoPots 2	%-Tot 0.01	C28 D1 1 1
UNIT 105	WA.iv.7c	p276	IV	NoTypes 2	NoPots 2	%-Tot 0.01	B20 C13 1 1
UNIT 106	WA.iv.8	p278	III	NoTypes 4	NoPots 6	%-Tot 0.04	A16 A39 A45 C27 2 1 2 1
UNIT 107	WA.iv.9a	p279	II	NoTypes 2	NoPots 2	%-Tot 0.01	D13 D34 1 1
UNIT 108	WA.iv.9b	p279f	II	NoTypes 5	NoPots 5	%-Tot 0.03	A16 B5 B17 C10 C27 1 1 1 1 1
UNIT 110	WA.iv.9d	p280	II	NoTypes 2	NoPots 2	%-Tot 0.01	A2 C35 1 1
UNIT 113	WA.v.3	p284	IV	NoTypes 3	NoPots 3	%-Tot 0.02	B7 C32 D13 1 1 1
UNIT 114	WA.v.4	p285f	III	NoTypes 8	NoPots 12	%-Tot 0.08	A7 B3 B4 C5 C6 C19 C28 C35 1 1 1 2 1 1 3 2
UNIT 115	WA.v.7a	p288f	II	NoTypes 6	NoPots 9	%-Tot 0.06	B9 B15 B24 C25 C32 D13 1 1 1 1 2 3
UNIT 116	WA.v.7b	p288f	II	NoTypes 3	NoPots 6	%-Tot 0.04	C5 C7 C28 3 1 2
UNIT 117	WA.v.7c	p288f	II	NoTypes 2	NoPots 2	%-Tot 0.01	B13 C10 1 1
UNIT 118	WA.vi.4	p294	IV	NoTypes 3	NoPots 3	%-Tot 0.02	B9 B17 C12 1 1 1
UNIT 119	WA.vi.5	p295	III	NoTypes 8	NoPots 8	%-Tot 0.05	A39 B1 B13 B15 C32 D15 D31 D32 1 1 1 1 1 1 1 1
UNIT 120	WA.vi.8	p301ff	II	NoTypes 8	NoPots 11	%-Tot 0.07	B6 B20 C5 C32 D8 D26 D28 D29 1 1 2 1 2 2 1 1

Appendix Tab. B Blegenised pottery data from Schliemann (seasons of 1870–1873). Early Bronze Age pottery finds reconstructed from figures recorded by Schliemann in notebooks and publications (sources detailed in Easton 2002), and referenced to the pottery shape classification system of Blegen et al. (1950; 1951). The database contains 62 text units (named UNIT 5 ... UNIT 120). For each unit we provide the most probable *stratigraphic dating* (e.g. *I–II*=Troy I–II) as reconstructed by Easton (2002).The table includes all units for which at least two pot shapes can be referenced to Blegen et al. (1950; 1951).

Appendix Tab. C

No.	Lab Code	Phase	^{14}C-Age [BP]	Model Input [yrs]	Model Output [calBC]
69	Hd-11945	Ia	4315 ± 84 BP	0 ± 30	2880 ± 30
70	Hd-11917	Ia	4299 ± 42 BP	5 ± 30	2885 ± 30
71	Hd-11944	Ia	4238 ± 37 BP	10 ± 30	2890 ± 30
72	Hd-12058	Ia	4215 ± 84 BP	15 ± 30	2895 ± 30
73	Hd-12061	Ia	4177 ± 41 BP	20 ± 30	2900 ± 30
74	Hd-12060	Ia	4289 ± 65 BP	25 ± 30	2905 ± 30

Tab. C Troy Ia. Single Phase Age Model (Fig. 9)

Appendix Tab. D

No.	Lab Code	Phase	^{14}C-Age [BP]	Model Input Units [rel]	Model Output [calBC]
40	Hd-16810	Ij	4173 ± 37 BP	967	2510
41	Hd-16832	Ij	4117 ± 46 BP	933	2525
43	Hd-13813	Ii	3953 ± 49 BP	867	2553
44	Hd-13812	Igh	4022 ± 31 BP	775	2593
45	Hd-13862	Igh	3986 ± 38 BP	700	2625
46	Hd-13850	Ig	4050 ± 40 BP	650	2646
47	Hd-13848	If	4026 ± 40 BP	570	2680
48	Hd-13801	If	4038 ± 59 BP	550	2689
49	Hd-13384	Ief	4110 ± 33 BP	500	2710
50	Hd-13852	Ie	4208 ± 68 BP	467	2725
51	Hd-13851	Ie	4060 ± 50 BP	433	2740
52	Hd-13618	Icd	4108 ± 38 BP	350	2776
55	Hd-13751	Icd	4182 ± 31 BP	300	2797
56	Hd-13929	Icd	4185 ± 31 BP	250	2818
57	Hd-11906	Ibc	4168 ± 52 BP	200	2839
58	Hd-12059	Iab	4156 ± 59 BP	134	2867
69	Hd-11945	Ia	4315 ± 84 BP	100	2882
70	Hd-11917	Ia	4299 ± 42 BP	80	2891
59	Hd-11935	Iab	4316 ± 34 BP	66	2897
71	Hd-11944	Ia	4238 ± 37 BP	60	2900
72	Hd-12058	Ia	4215 ± 84 BP	40	2909
73	Hd-12061	Ia	4177 ± 41 BP	20	2918
74	Hd-12060	Ia	4289 ± 65 BP	0	2927

Tab. D Troy Ia–Ij. Uniform Phase Model (Fig. 10)

Appendix Tab. E

No.	Lab.Code	^{14}C-Age [BP]	RingNo. Center	RingNo. (10 rings)	Model Output [calBC]
60	Hd-14706	4133 ± 49	1055	1051–1060	2813 ± 10
61	Hd-14614	4153 ± 18	1045	1041–1050	2823 ± 10
62	Hd-15023	4145 ± 15	1035	1031–1040	2833 ± 10
63	Hd-14698	4080 ± 21	1025	1021–1030	2843 ± 10
64	Hd-14686	4188 ± 19	995	991–1000	2873 ± 10
65	Hd-14937	4290 ± 24	980	976–985	2888 ± 10
66	Hd-14672	4274 ± 17	960	956– 965	2908 ± 10
67	Hd-15095	4369 ± 17	945	941– 950	2923 ± 10
68	Hd-14615	4363 ± 21	935	931– 940	2933 ± 10

Tab. E Troy Id or later, Beam. Dendrochronological Wiggle Matching (Fig. 11)

Appendix Tab. F

No.	Lab Code	Phase	^{14}C-Age [BP]	Model Input Units [rel]	Model Output [calBC]
15	Hd-12099	S-3	3993 ± 90 BP	3150	2145
16	Hd-12109	S-6	3838 ± 39 BP	2850	2211
17	Hd-15266	S-7	3792 ± 31 BP	2800	2222
18	Hd-15268	S-7	3892 ± 37 BP	2787	2225
19	Hd-12120	S-7	3815 ± 35 BP	2775	2228
20	Hd-12126	S-7	3917 ± 38 BP	2762	2231
21	Hd-12127	S-7	3899 ± 42 BP	2750	2234
22	Hd-15267	S-7	3751 ± 25 BP	2737	2237
23	Hd-12136	S-7	3795 ± 26 BP	2725	2240
24	Hd-12137	S-7	3796 ± 41 BP	2712	2243
26	Hd-15407	S-9	3755 ± 40 BP	2550	2279
27	Hd-15408	S-12	3790 ± 35 BP	2350	2323
28	Hd-13930	S-12	3974 ± 43 BP	2250	2345
31	Hd-14572	IIc3	3988 ± 32 BP	2150	2367
33	Hd-16733	IIb4	3815 ± 42 BP	1850	2433
34	Hd-16734	IIb2	3932 ± 46 BP	1650	2477
35	Hd-16735	IIb1	4058 ± 41 BP	1567	2495
36	Hd-17664	IIb1	4011 ± 28 BP	1533	2502
37	Hd-19823	IIa1	3935 ± 66 BP	1375	2537
38	Hd-19822	IIa1	3931 ± 23 BP	1350	2543
39	Hd-20040	IIa1	3972 ± 31 BP	1325	2549

Tab. F Troy II–III, Uniform Phase Model (Fig. 12, Lower)

Appendix Tab. G

No.	Lab Code	Phase	^{14}C-Age [BP]	Model Input [m]	Model Output [calBC]
15	Hd-12099	S-3	3993 ± 90 BP	35.03	2150
16	Hd-12109	S-6	3838 ± 39 BP	34.44	2192
20	Hd-12126	S-7	3917 ± 38 BP	34.14	2213
21	Hd-12127	S-7	3899 ± 42 BP	34.13	2214
19	Hd-12120	S-7	3815 ± 35 BP	33.97	2225
17	Hd-15266	S-7	3792 ± 31 BP	33.51	2258
23	Hd-12136	S-7	3795 ± 26 BP	33.50	2259
18	Hd-15268	S-7	3892 ± 37 BP	33.49	2260
24	Hd-12137	S-7	3796 ± 41 BP	33.35	2270
22	Hd-15267	S-9	3751 ± 25 BP	33.19	2281
26	Hd-15407	S-9	3755 ± 40 BP	32.76	2312
27	Hd-15408	S-12	3790 ± 35 BP	32.42	2336
28	Hd-13930	S-12	3974 ± 43 BP	32.15	2355
31	Hd-14572	IIb4?	3988 ± 32 BP	30.62	2464
22	Hd-16733	IIb2	3815 ± 42 BP	30.37	2482
34	Hd-16734	IIb1	3932 ± 46 BP	30.18	2495
35	Hd-16735	IIa1	4058 ± 41 BP	30.07	2503
37	Hd-19823	IIa1	3935 ± 66 BP	29.55	2540
38	Hd-19822	IIa1	3931 ± 23 BP	29.46	2546
39	Hd-20040	IIa1	3972 ± 31 BP	29.42	2549
36	Hd-17664	IIb1	4011 ± 28 BP	29.19	2565

Tab. G Troy II–III. Linear Age-Depth Model (Fig. 12, Upper)

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The Balkans, the Marmara Region and Greece

In Quest of a Missing Era in Eastern Thrace – Dilemma of the 4th Millennium

Mehmet Özdoğan[1]

Abstract: Our knowledge of the prehistory of northwestern Turkey has considerably increased over the last two decades. Today it is possible to define a more or less reliable cultural sequence running from the late 7th to the mid-5th millennia BC. Following a peculiar hiatus lasting from 4700/4500 to 3400/3200 BC, developments of the 3rd millennium BC are evidenced at a number of sites. However, despite extensive survey activities in eastern Thrace little data has emerged concerning this hiatus. Evidently the reasons for such a long and widespread hiatus have to be sought on a macro sphere. To the east, in Syro-Mesopotamia – including southeastern Turkey – an uninterrupted progression in the archaeological record spanning from the 5th to the 3rd millennia BC occurs. In particular, the 4th millennium stands out as dynamic and innovative era during which social and technological changes, the development of towns and the formation of states take place. In the eastern Balkans on the other hand, by mid-5th millennium BC, a significant core conventionally known as the Gumelniţa-Cucuteni group emerged with modalities notably distinct from that of the east. Extensive mound sites of this culture, revealing a rich variety of status objects of high-level technology are present, nearly all over the northeastern parts of the Balkans. It is also evident from the sites of Karanovo (VI period) that the sphere of this culture extended to the southern parts of the Balkan Mountains, becoming considerably inconspicuous in eastern Thrace. Although one could surmise that the region around the Sea of Marmara remained a dormant buffer zone insulated from core areas, this scenario is not without problems; certain parallelisms such as technologies based on arsenic copper, certain figurine and amulet types, graphite decoration on pottery, the presence of 'fruit-stands' had been noted between Gumelniţa-Varna-İkiztepe-Arslantepe assemblages, possibly having some contact through the Black Sea coast bypassing Thrace. If there had not been the difference of over a thousand years among the absolute dates from either side of this vast territory, the above-mentioned equalisation would have been good a working hypothesis. The paper presents an overview on the above-mentioned issues, however, without proposing a solution.

Keywords: Thrace, northwestern Turkey, Sea of Marmara region, 4th millennium gap, chronology, Helvacı Şaban Ware, Kocatepe Ware

Defining the Problem

On a supra-regional level, the 4th millennium BC – the time period of concern here – stands as one of the most critical turning points in the cultural history of a vast area extending from the Near East to Anatolia and to the Balkans. It is within this period that social and technological changes leading to the development of towns and to the formation of states transpire. Although overarching trends characterise the 4th millennium, the developments in the eastern, western and northern parts of this macro region considerably vary from each other. In the eastern part, Syro-Mesopotamia – including southeastern Turkey – the 4th millennium stands as dynamic and innovative era during which the introduction of incipient markers of the 'urban revolution' begin taking shape. Consequently, these social and economic processes are as significant as the incipient stages of neolithisation. In this respect, it is worth restating that Syro-Mesopotamia is the only region within this vast area with an uninterrupted progression in the archaeological record that spans from the 5th to the 3rd millennia BC. This is in strong contrast with the other areas where cultural succession from the Neolithic period to the Bronze Age is interrupted in the mid-5th millennium or later. More

[1] University of Istanbul, Turkey; email: c.mozdo@gmail.com. All illustrations used in this paper: courtesy of the Eastern Thrace Project Archive of the Istanbul University with the copy right of the author of the paper.

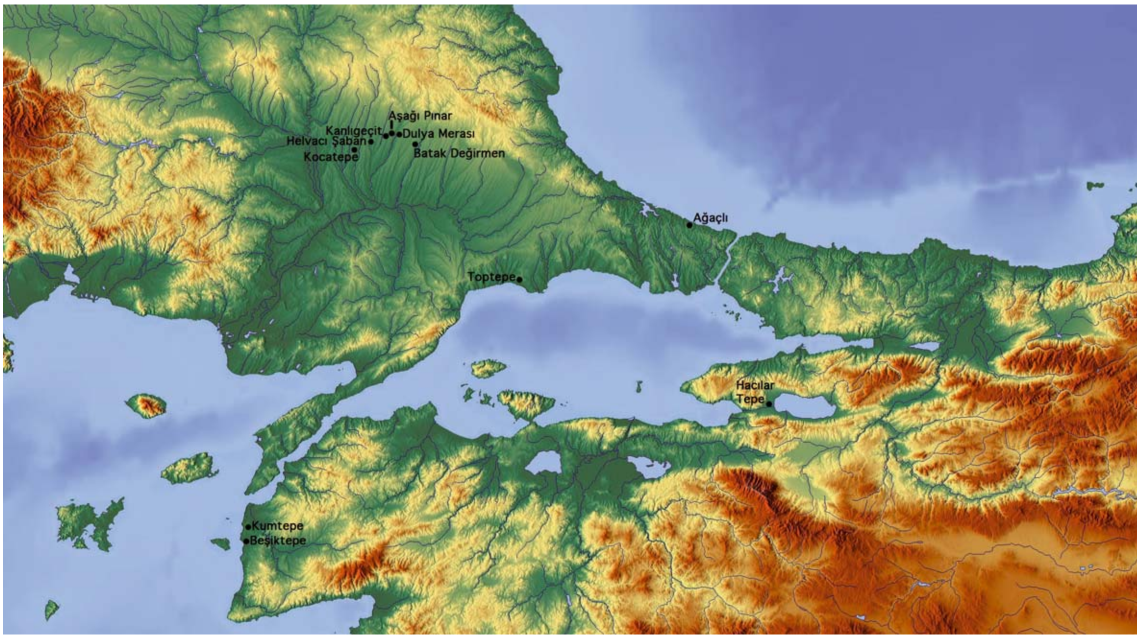

Fig. 1 Sites mentioned in the text.

specifically, only in the Syro-Mesopotamian region a cultural accumulation that has its roots in Neolithic forms constitutes the ancestral backdrop of the Bronze Age cultures.

In other regions, particularly in the Balkans and the Aegean and to a lesser degree in western Anatolia, cultural succession of the Neolithic substratum comes to an end seemingly giving way to an indefinable hiatus. Notably, through the 4th millennium the socio-economic and possibly also political system of Syro-Mesopotamia, evidenced by recent excavations at Güvercinkayası and Yumuktepe, was expanding its sphere of influence towards the west. The rather sudden appearance of relatively substantial Early Bronze Age urban centres, such as Hacılar Büyüktepe[2] and Seyitömer,[3] on the southern parts of the central Anatolian plateau, indicate the presence of a much more complex 4th millennium substratum than previously envisaged.[4] Evidently, lack of archaeological research in the southern parts of central Anatolia, the Konya Plain and its surroundings, stands as the major obstacle in correlating the east with the west. The Konya Plain and its environs, a most critical area for correlating the east to the west, provide relatively abundant data concerning the time period from the Early Neolithic to the end of the Early Chalcolithic.[5] By the Middle Chalcolithic the region becomes rather indistinct, and then fades away almost completely by the late stages of the Early Bronze Age. It is only during the very end of the Early Bronze Age that subtle archaeological evidence from the region can be detected again.

As briefly noted above, the 4th millennium in the east, in Syro-Mesopotamia, is the time when components of urban and state formation, such as bureaucracy, metallurgy, mass production, new forms of labour, military installations, organised trade, procurement of exotic materials, etc. began to take form. Conversely, on the other end of this macro region, mainly in the northern parts of the Balkans, cultural sequences developed on a different trajectory; there, a cultural peak occurred during the earlier part of the 5th millennium, with the so-called Karanovo VI-Gumelniţa-Cucuteni horizon. Some of the markers of this cultural horizon, such as metallurgy, large populated settle-

2 Umurtak 2013; Umurtak – Duru 2013.
3 Bilgen 2011.
4 Özdoğan 2007.
5 Schoop 2005.

ments, and prestige objects, are somewhat comparable to those of the eastern group. Nevertheless, it is clear that the governing social structures of the two regions are not comparable. It was only in the later stages of the Bronze Age that elements of the Syro-Mesopotamian system become archaeologically visible in the western parts of Anatolia and the Aegean as delayed and modified reflections originating in the east.[6] Nevertheless, this does not shed light on the problematic period preceding the 3rd millennium. Further in the northern part of the area of the flourishing Karanovo VI-Gumelniţa culture, it is not clear when and how exactly this cultural stage came to an end. Moreover, its interface with the Varna stage is a highly controversial issue that cannot be dealt with here. Nevertheless, recent, but subtle evidence for the terminal date of this cultural stage places it to around 4400 BC;[7] thus, the gap or unstable period preceding the Ezero-Bronze Age cultures – previously surmised to be only a few hundred years – can be expanded to almost one and a half millennia. With the current chronological placement of the Varna phase, synchronisation of the northern Balkans with the Aegean and Anatolian cultures – already problematic for a long time – is now even more difficult to resolve.[8]

The region around the Sea of Marmara connecting Anatolia, the Aegean and the Balkans due to its critical location seemed to be the optimal place to finds answers for these problems on a supra-regional level.[9] It is highly regretful that in spite of the accelerated research in this region the archaeological evidence continues to remain mute for this particular time range. Here, this paper attempts to draw a picture of what might be correctly named as the missing era; however, interpretations mostly rely on piecemeal evidence.

Picturing the Region around the Sea of Marmara

Knowledge of the prehistoric cultures of northwestern Turkey has considerably increased during the last two decades, making it possible to relatively define a more or less reliable cultural sequence running from the late 7th to mid-5th millennia. Likewise, developments of the 3rd millennium BC, previously solely dependent on Troy, are now attested at a number of other sites, e.g. Kanlıgeçit in eastern Thrace being the most prolific.[10] Most peculiar is the lacuna in between these two periods, from 4700/4500 to 3400/3200 BC.

Settlement history of all excavated sites, located either on the Asian or the European side of the Sea of Marmara, evidently stops by the first quarter of the 5th millennium BC. Furthermore, evidence indicating that the location of settlements had shifted to another location remains absent. In eastern Thrace, there are six excavated sites that could be relevant to the time period under investigation: Hoca Çeşme, Aşağı Pınar, Alpullu, Toptepe, Yarımburgaz and Yenikapı. In all of these sites, the uppermost cultural layer is disturbed, negating the possibility to view how the settlement came to an end. However, at Aşağı Pınar, the northernmost of these sites, the latest definable archaeological material is of the Toptepe culture, a culture widespread in the southern parts of eastern Thrace during the Karanovo IV middle to late period of Bulgaria. The latest phase at Aşağı Pınar, layers 2 and 1, have yielded material of the so-called Maritsa type and can be no later than early Karanovo V (Fig. 2).

The chronological position of the Maritsa pottery type is well attested in Bulgaria and gradually developed into the more flamboyant cultural stages of Karanovo V and VI, better known as the Koca Dermen-Gumelniţa horizon. In the surface survey of eastern Thrace, this type of pottery was restricted to the northern parts of eastern Thrace, becoming notably more intensive near

6 Özdoğan 2007; Özdoğan 2011.
7 Johnson 1999; Chapman et al. 2006; Higham et al. 2007.
8 Özdoğan 1991; Özdoğan 2007; Özdoğan 2011.
9 Özdoğan 1991; Özdoğan 2004; Özdoğan 2007.
10 Özdoğan – Parzinger 2012; Özdoğan et al. 2013.

Fig. 2 Maritsa type of vessels, Aşağı Pınar phase 2.

the present-day Bulgarian border, but totally absent in areas near the Sea of Marmara. As noted above, neither excavated sites nor surface surveys yielded material that could be the immediate successor of Toptepe group, strongly suggesting that the abandonment of sites took place earlier in the southern parts of eastern Thrace then its northern extensions. The evidence from the sites on the Anatolian side, such as Ilıpınar and Aktopraklık, indicates that the cultural breakdown took place even a few centuries earlier. Thus, it is possible to surmise that whatever phenomenon led to the abandonment of settlements, it had its origins in the south and gradually moved into the northern areas. It is also evident that the Istranca Mountains, the present day boundary between Turkey and Bulgaria, limited this event. In the Bulgarian part of Thrace, north of the Istranca range, besides having no break in cultural sequence, Karanovo V and VI horizons represent a cultural climax with a marked increase in the number of settlements and sophistication of the socio-cultural organisation. The Karanovo VI period – the north of the Istranca range – is the time of 'mound-building' in the eastern Balkans; settlement mounds of that time period are characterised by several meters of accumulation. The Karanovo VI period not only exhibits an increase in population, but it also stands as one of the most innovative periods in the Balkans, exemplified by the achievements attained in metallurgy. It is of interest to note that this remarkable period is not traceable in eastern Thrace. Nevertheless, much can be missed in surface surveys, and future research may reveal some flat sites overlooked in our surveys; however, if mound sites similar in height to those documented in the Bulgarian part of Thrace were present, they would have been easy to detect in a flat terrain such as Thrace.

In light of the present state of knowledge, there seems to be a 1500 year 'blank' period of time in eastern Thrace that is rather difficult to conceive. This gap commences from the mid-5th millennium up to the beginning of the 3rd. There are two distinct pottery assemblages, Helvacı Şaban and Kocatepe, securely attributable to this long and austere period. These ware groups are named after their site types. The pottery sherds of both ware groups were easily distinguishable in the survey due to their characteristic features, Helvacı Şaban with its distinct shapes, decoration and paste, and Kocatepe with a fine quality surface treatment. Surface surveys covering most of Eastern Thrace revealed numerous sites with Helvacı Şaban pottery, however, those with Kocatepe were less common. As will be noted below in some detail, chronologically these wares clearly belong to an uncertain time period between the end of Aşağı Pınar and the beginning of Early Bronze Age, Helvacı Şaban preceding Kocatepe. A more precise date is not possible though we surmise that they must be contemporary with the early stages of Karanovo VI period.

The Helvacı Şaban Ware[11]

During the surface survey, the presence of a previously undefined group became evident; sherds of this group, characterised by its paste, surface treatment, shape and decoration, were easily distinguishable at a number of sites, particularly on the northern parts of eastern Thrace. This ware was predominate at Helvacı Şaban and subsequently named after the site. It was the most prolific site yielding this type of pottery, but also a single component site lacking other pottery types, facilitating its definition. The site of Helvacı Şaban, coded as Site No. B 5/28 during the survey, located on the terrace, at the left bank of the Tekederesi stream, ca. 15km southwest of the town of Kırklareli and 2km north of Dokuzhöyük village. Helvacı Şaban, as all other sites yielding this pottery type, is a flat site with no detectable artificial rise, and a surface scatter of about 150x100m. The pottery occurs clustered in patches, ca. 5 to 10m apart, as if resurfacing from eroded pits or pit-dwellings. Besides Helvacı Şaban and Kocatepe, Dulya Mevkii and Batak Değirmen, two other sites documented during the last years, east of Kırklareli, have also revealed

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[11] In earlier reports this ware was noted as Kocatepe ware after the site of its discovery, located further west along the Süloğlu Stream in Edirne province (Özdoğan 1991; Özdoğan 2004); however, due to the predominant presence of the latter ware group at Kocatepe, it is addressed as Helvacı Şaban ware, to save further confusion.

a rich assemblage of this ware group. At present Vize plain constitutes the eastern limit of this ware group.

The Helvacı Şaban pottery type is characterised by its fine sandy, micaceous paste; the fabric is exclusively hard, compact and well fired. Light to dark greyish surfaces are common, but occasionally they take on a blackish or buff colour. Most, surfaces are well smoothed, but unburnished, however, some vessels are either buffed or slightly burnished. Additionally, their sandy paste gives a sandpaper effect. Vessel forms, decoration, techniques and designs are extremely characteristic (Fig. 3–5). A tall cylindrical pot stand, with an upper part that is flattened by inverted sides, forming a small opening at the top, is the most common shape. All such vessels are highly decorated; decorative techniques include excision, incision, impression, grooving and stamping. The designs are also extremely varied: spirals, mixed arrangements of parallel lines, cross-hatchings. In addition to these pot-stands, there are also deep bowls with inverted rims, usually with small knob-like pierced lugs.

This pottery type is not known either from northwestern Turkey, Greece or Bulgaria, therefore, assigning a date to this group was not possible. The closest parallels, in terms of shape and decoration, have been documented within the so called Pre-Cucuteni or Aldeni group from much further north in the Danube basin, relatively contemporary with Karanovo V–VI.[12] In this respect, the recovery of Helvacı Şaban type of pottery in a number of pits at Kanlıgeçit, made it possible to tentatively date this group to a period earlier than Kocatepe.[13] For example, in sounding 35N a huge Helvacı Şaban pit, cut by a later pit of Kocatepe type, made it possible to attain a relative date for this culture.

In all the explored sites, there is a marked abundance of decorated cylindrical pot stands, highly suggesting that these might actually be cult centres and not settlement sites. Then of course, where the settlements are located, or whether these sites belonged to mobile pastoral communities continues to remain a question unanswered. It is also of interest to note that while several sites in the northern part of eastern Thrace have revealed Helvacı Şaban pottery type until recently no such pottery had ever been recorded in Bulgaria. It is only after a preliminary publication of such vessels, that Derviş Ocak a site near the Turkish border in the Maritsa valley revealed identical material.[14] Among the decorated sherds from Bereketska in western Thrace, Maritsa type of Karanovo V material were predominate, but some sherds that may represent a transitional type between Maritsa and Helvacı Şaban were present.[15] Thus, further suggesting that Helvacı Şaban group may be contemporary with late Karanovo V.

The Kocatepe Ware

The Kocatepe, designated as Site No. B 4/40 in the surface survey, is located approximately 28km east of Edirne on the right bank of Süloğlu stream. This site, like all other sites of this horizon is flat with no detectable elevation, covering an area of about 50x100m. Sites yielding Kocatepe type pottery are less common than those of Helvacı Şaban, and partially overlapping in spatial distribution. In the northern parts of eastern Thrace, mainly along the southern foothills of the Istranca Mountains, both Kocatepe and Helvacı Şaban pottery, occur in the same sites, while there are some sites that exclusively contain Helvacı Şaban material. However, further to the south, past the Ergene valley no sites yielding Helvacı Şaban pottery have been recovered, while, at Toptepe on the coastal strip of the Sea of Marmara, sites of Kocatepe culture are present but extremely random. Among the sites of Kocatepe horizon, Batak Değirmen nearby Kaynarca, is worth mentioning as it is the only site which seems to have a detectable mound formation; nevertheless, the

12 Marinescu-Bilcu 1974, figs. 41–42, 69.
13 Özdoğan – Parzinger 2012, 46–48.
14 Leshtakov 1997.
15 Kalchev 2004.

Fig. 3 Helvacı Şaban type of pottery from various sites in eastern Thrace.

Fig. 4 Helvacı Şaban type of pottery from various sites in eastern Thrace.

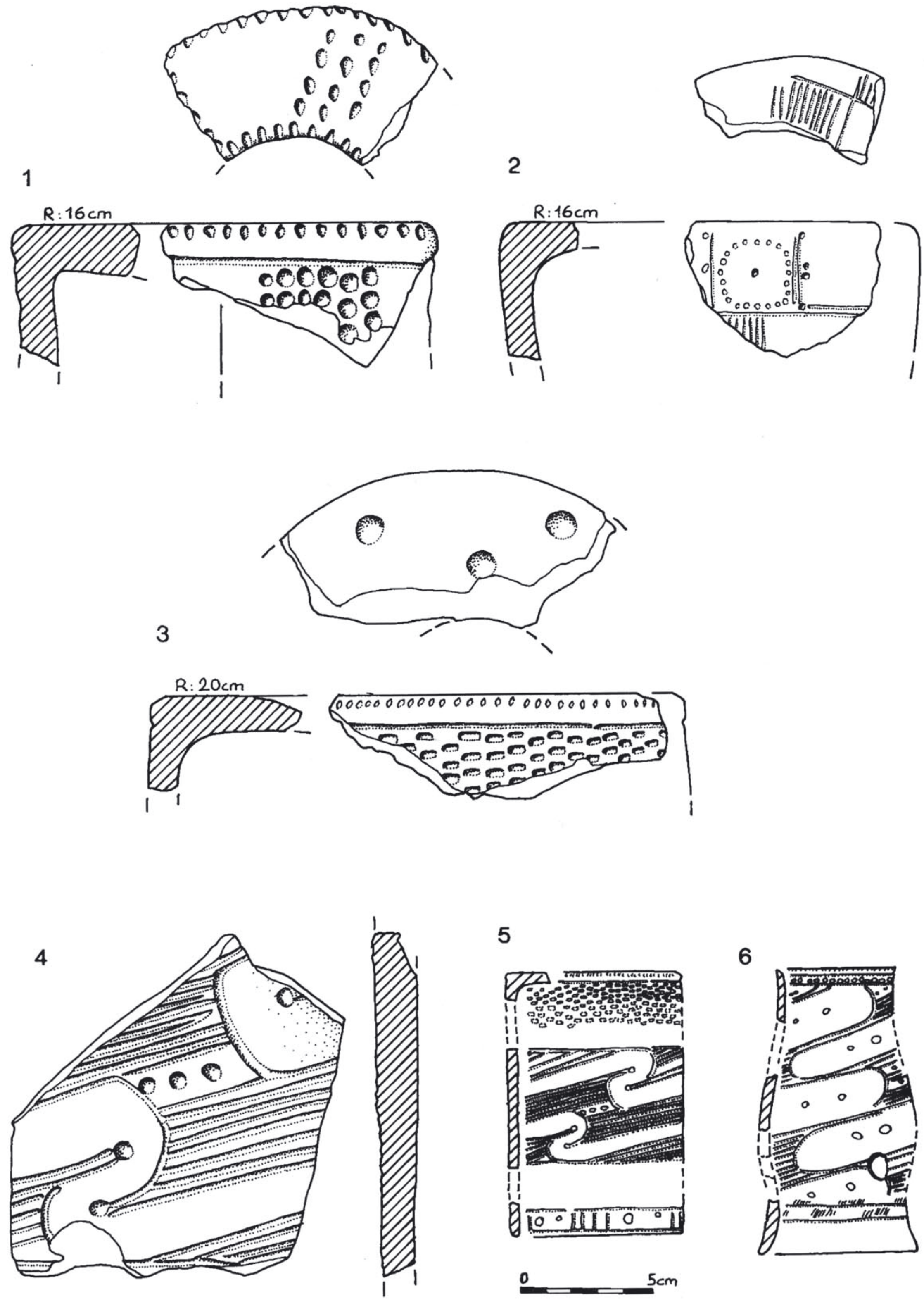

Fig. 5 Helvacı Şaban type of pot stands.

presence of sherds from other periods made it difficult to determine whether or not the mound formation belonged to the Kocatepe period.

The pottery of Kocatepe is finer than that of Helvacı Şaban; it is easily recognisable with its fine burnished surfaces, mostly with a metallic lustre. The fabric is exclusively of fine levigated paste with some mica, and compact and hard firing technique; surfaces are smoothed and highly burnished, and take on light buff to orange tones. There are a few sherds with linear graphite decoration (Fig. 6) and a single sherd has been found with bichrome black and red paint. Most characteristic vessel forms are open bowls with incurved rims (Fig. 7); they are occasionally carinated having a rather limited repertoire; nevertheless, there is an apparent resemblance to those of Karanovo VI-Gumelniţa wares.

The chronological position of Kocatepe ware was first identified at Toptepe, where a pit containing exclusively Kocatepe material was found at the surface of the 1989 trench, evidently well below Early Bronze Age, cutting into Toptepe deposits.[16] Subsequently, at Kanlıgeçit, other pits containing similar material were observed stratified below Early

Fig. 6 Graphite decorated Kocatepe sherd from Kanlıgeçit phase 5b.

Fig. 7 Kocatepe type of bowls from Kanlıgeçit phase 5b.

[16] Özdoğan 1991.

Fig. 8 Pattern burnished sherds from Hoca Çeşme, inner surfaces.

Fig. 9 Pattern burnished sherds from Hoca Çeşme, exterior surfaces.

Bronze Age deposits, one of them intersects into a pit with Helvacı Şaban material.[17] Accordingly, with some justification we can consider Kocatepe to be contemporary with the early Karanovo VI period.

Concluding Remarks

Our team has been working in eastern Thrace since 1980 carrying out surface surveys and conducting excavations in various parts of the region; despite all of our research efforts it is not possible to provide more robust evidence for this critical region during the 4th millennium BC at this point. As has been summarised above, the chronologically significant material remains associated with this time span, are restricted to a few pits with pottery sherds of Helvacı Şaban and Kocatepe type, seemingly analogous to Pre-Cucuteni and Gumelniţa cultures respectively. Therefore, they are not at all sufficient to fill this lengthy lacuna. As previously noted, the gap is not only restricted to the 4th millennium, but extends well into the second half of the 5th millennium, in the southern parts of the region, a considerably longer span. Consequently, it is useful to note that pattern burnished wares of the so called Beşiktepe type, were initially placed within this blank period; however, their extensive presence both at Hoca Çeşme and Aşağı Pınar together with Karanovo IV assemblage (Fig. 8–9) clearly indicated that they must be of an earlier date, the late Karanovo IV period.

It also seems clear that the reasons behind such a long and widespread hiatus cannot be explained by solely looking at the evidence from the region under investigation. This is a complex research problem that has to be explored on a macro regional scale. By mid 5th millennium BC in the eastern Balkans, a significant core, conventionally known as the Karanovo VI-Kocadermen-Gumelniţa-Cucuteni group emerged with modalities notably distinct from that of the east. Extensive mound sites revealed a rich variety of status objects indicative of high level technology. Even though the core of this culture is in the northeastern parts of the Balkans, related cultural formations have been discerned from a much wider area, extending into western and northwestern Balkans. It is also evident from the presence of Karanovo VI sites in western Thrace that the Balkan Mountains did not constitute the southern border of this cultural formation. Although the Istranca Mountains seem to mark southern limits of this culture, the presence of Kocatepe material suggests that this culture extended further to the south, but considerably inconspicuous in eastern Thrace. It also seems evident that Kocatepe material represents the earlier part of Karanovo VI period with no archaeologically detectable evidence either in late Karanovo VI or subsequent periods. On the other hand, it seems possible that the Helvacı Şaban group might be the immediate predecessor of Kocatepe, though neither the exact date nor the cultural affiliation of Helvacı Şaban group has been clarified; nevertheless, it is certainly earlier than Kocatepe with some affiliations to the northern Balkans. It is thus possible to surmise that, by mid 5th millennium, mobile groups penetrated eastern Thrace filling in the vacant space after settlements were abandoned. At this point, the reasons for this abandonment can only be conjectured. However, because this break took place earlier on the Anatolian side of the Sea of Marmara than in Thrace, it is clear that these groups were not the cause, but the result of this turbulent period.

In a broader sense, the region around the Sea of Marmara is positioned between two major cultural formation zones, a very dynamic one in the east and a less stable one in the Balkans. While, the latter was interrupted by the second half of the 5th millennium, there is an unbroken continuum in the former. The region around the Sea of Marmara must have developed and persisted as a dormant buffer zone between the two. Evidently, this scenario is not without problems; certain parallelisms such as technologies based on arsenic copper, certain type of figurines and amulets, graphite decoration on pottery, the presence of 'fruit-stands' have been noted between Gumelniţa-

[17] Özdoğan – Parzinger 2012, 46–47.

Varna in the Balkans and İkiztepe-Arslantepe assemblages in Anatolia. Such similarities highly suggest that some sort of contact occurred among them. As neither of these assemblages has been recovered on either side of the Sea of Marmara, we might postulate a maritime connection between central Anatolia and the northern Balkans through the Black Sea, bypassing the Marmara region;

The difference of over a thousand years in the absolute dates from both sides of this vast territory, invalidate the above mentioned equalisation as a good working hypothesis. The problem stems from the absolute dates of similar elements on either side of this geographical sphere. For example, Varna dates to the mid 5th millennium, while Arslantepe with close ties to the Uruk culture of Syro-Mesopotamia, remains at the end of the 4th millenium. At this point, we have no answer to this critical question. Without proposing a solution, this paper tries to present an overview that is primarily based on negative evidence.

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The Wealth of the Tells: Complex Settlement Patterns and Specialisations in the West Pontic Area between 4600 and 4250 calBC

Agathe Reingruber[1]

Abstract: The tells in the west Pontic region have been under investigation for almost a century now, yet our knowledge concerning the social organisation of Copper Age communities is still insufficient. Prior to the discovery of the cemetery near Varna, studies on the social complexity of communities living on tells were rare. However, since the discovery of the Varna necropolis in 1972 the enormous wealth displayed in merely a few graves led to the implicit interpretation of tell-sites as proto-cities and urban centres characterised by 'palaces', 'sanctuaries' and 'military fortifications'. Caution is advisable here since apart from two recent excavations in Pietrele and Provadia the surroundings of the numerous tell-sites have not been systematically investigated, and the settlement plans are virtually incomplete. Not a single tell-site has provided enough support to interpret houses as special buildings of a central authority. It is, therefore, impossible to match the outstanding graves in Varna with any corresponding buildings on the mounds. Unlike the wealth in graves in Varna and Durankulak, the wealth of tells is far more evenly dispersed throughout the houses. Still, the complex layout of settlements with houses in rows, separated only by narrow lanes, and with a flat area surrounding the monumental tells, point to a complex social organisation that was present centuries before urban centres appeared in the Near East and Anatolia. Craft specialisation, the application of innovative technologies and intensified communication between regions were the basis for the social transformations of the 5th millennium BC.

Keywords: West Pontic region, 5th millennium BC, tells, settlement patterns, specialised crafts, raw material exchange, production centres

The Chronological and Geographical Setting

The west Pontic settlement mounds north and south of the lower Danube area belong to the youngest group of tell-sites throughout southeast Europe. Other than the tell-settlements south of the Balkan Mountains that were founded around or shortly after 6000 calBC (e.g. Tell Karanovo and Tell Azmak), the ones near the west Pontic river plains do not predate the 5th millennium BC. To our best knowledge some of the tells south of the Danube River were founded at around 4900 calBC (e.g. Goljamo Delčevo or Ovčarovo)[2], whereas those north of the river probably developed only after 4750 calBC (e.g. Căscioarele).[3] Most of the sites are concentrated along river valleys, the highest tells being situated near the northern banks of the Danube River (Fig. 1). Other concentrations are along its tributaries and smaller rivers flowing into the Black Sea near the bays of Varna and Burgas. As shown elsewhere,[4] at around 4600 calBC on both sides of the Danube important social and cultural transformations appear, probably caused by innovations related to metallurgy as pointed out already half a century ago by V. G. Childe.[5] In the second half of the 5th millennium BC a better command of firing techniques, a more industrious extraction of raw material resources (e.g. ores, minerals, salt), better construction techniques (erection of two-storey buildings) can be observed together with optimised storage modalities (e.g. in *pithoi*), as well as

[1] Eurasia Department of the German Archaeological Institute, Berlin, Germany; email: agathe.reingruber@dainst.de.
[2] Görsdorf – Boyadziev 1996.
[3] Dumitrescu 1974.
[4] Reingruber, in print.
[5] Childe 1944; Childe 1958.

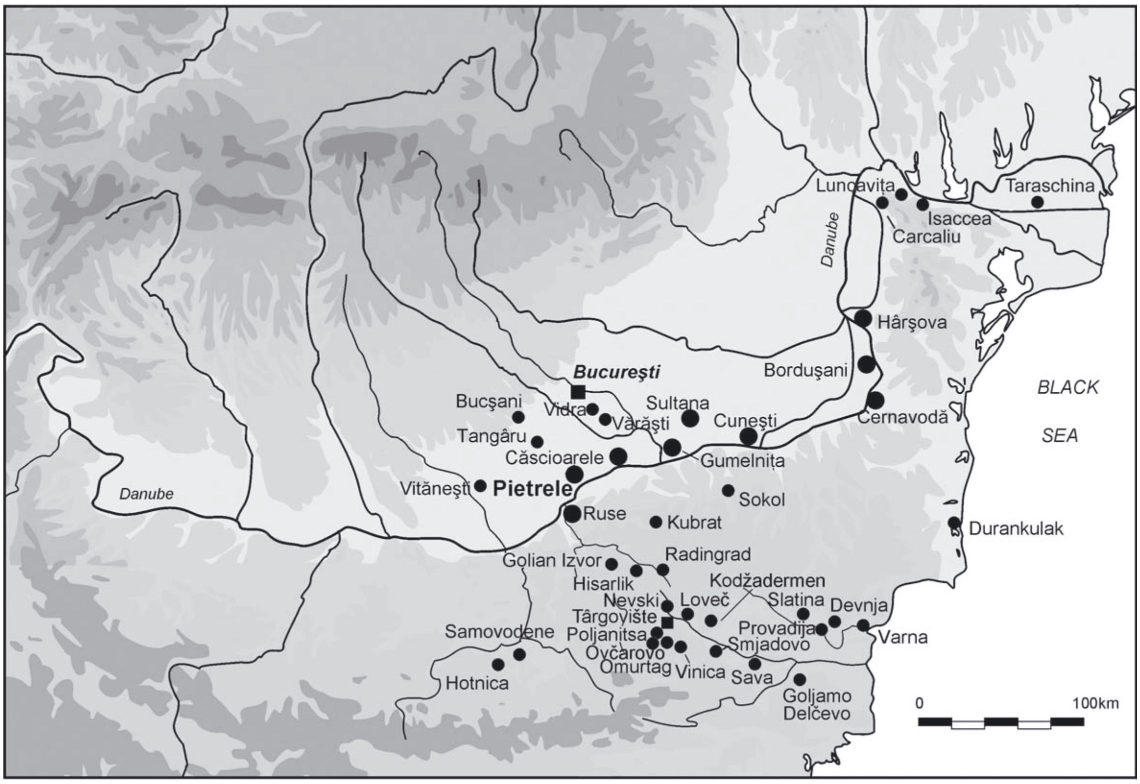

Fig. 1 Map of the lower Danube area (W. Rust – A. Reingruber).

new manufacturing techniques and innovative technologies (e.g. lever technique for blade production). Around c. 4250 calBC, these progressive traits, elude the archaeological record in the entire area of the eastern Balkans. The simultaneousness of their disappearance is one of the most intriguing and still unsolved problems in Balkan prehistory, each generation of archaeologists putting forward its own explanations deriving from the respective *zeitgeist*: after World War II invasions and conflicts were proposed by M. Gimbutas, during the 1980s climatic catastrophes were invoked by H. Todorova, after the fall of the Iron Curtain cultural transformations were put forward by Th. Link.[6] More recently, combinations of different factors are advanced, for example, social conflict and economic problems, and/or climatic and cultural deterioration.[7]

Nonetheless, between 4600 and 4250 calBC, the length of 350 years at least, indications are strong for a well organised society, not merely horizontally but also vertically structured. Complex settlement systems, the wide distribution of raw materials and the circulation of prestige goods circumscribe a vast area of highly interactive communities that surpasses the confinements of the map published by Jan Lichardus.[8] When focussing on two of the most important innovations of the 5th millennium, early metallurgy and a better control of firing techniques, especially the firing of graphite painted pottery, similar traits can be broadly observed from as far as the Strymon- and Axios/Vardar valleys in the southwest and the Morava Valley in the northwest, to the Black Sea coast in the east. On the other hand, in the area of Lichardus' Kodžadermen-Gumelniţa-Karanovo VI (KGK-VI)-complex, sites are not evenly dispersed, but rather form clusters according to their geographical positions. North of the lower Danube valley tells are located at equal distances of 20–30km. On today's maps, generated after the drainage of the Danube meadow in the 1960s,

6 Gimbutas 1977; Todorova 1989; Link 2006.
7 Weninger et al. 2009; Windler et al. 2012.
8 Lichardus 1988, 85, fig. 43.

these sites appear to be isolated settlements. Yet in prehistory they were all connected by a vast palaeo-lake fed by the Danube and its northern tributaries, the Argeş and the Mostiştea.[9] Farther upstream, also in a lake-rich region, sites attributed to the Bolgrad-variant of the KGK-VI-complex cluster north and south of the river bend shortly before the Danube delta.

Another cluster of sites forms along the Kamčija and Provadia rivers as well as near the bays of Varna and Burgas. In the latter region investigations recently commenced in Akladi Cheiri under the direction of Petar Leshtakov and at Kozareva Mogila guided by Petya Georgieva.[10] These sites will add important information to the broader picture, especially since they are in the vicinity of copper mines in the Burgas-Strandža area. Located close to the freshwater lake and the inlet near the modern city of Varna is the famous homonymous cemetery; however, no settlements can be directly connected to it, since they are all submerged in the waters of Lake Varna.[11] Thus, it is indeed noteworthy that most of the sites previously thought of as favouring riverside locations now should be reconsidered as potential lakeside settlements, some probably comparable to those of Ezerovo IV in Lake Varna.[12]

Case Studies: Settlement Layouts and Specialised Working Areas

Prior to 1972, studies investigating the organisation of Eneolithic society in the 5th millennium in the Balkans seemed superfluous since village communities were regarded as relatively egalitarian and/or an offshoot of the more elaborate societies in the Aegean. However, as early as 1969, Sir Colin Renfrew reflected on the supremacy of metal production in the Balkans,[13] preparing the grounds for the 'Ex Balcanae Lux'-model.[14] Three years later the spectacular finds from the cemetery near Varna thoroughly changed the comprehension of Eneolithic communities. Some of its 307 graves were furnished with a multitude of artefacts made of gold and copper. The majority of these artifacts derive from cenotaphs whereas graves with skeletons only held a smaller fraction. Also striking was the different placement of the bodies of males and females: the former were buried in an extended supine position, while the latter were placed in *hocker* position.[15]

The surplus wealth in some of the graves overshadows the 'quotidian' wealth that could be expected in the dwellings. Therefore, one aspect in this contribution will be the analysis of the stratigraphically and chronologically well-defined prestige objects from tell-sites, which allow us to explore the social organisation of the communities – whether they are labelled 'proto-cities'[16] or even 'urban centres'.[17]

How a settlement belonging to such a sophisticated sepulchral society was organised can only be answered – for lack of sites in the immediate neighbourhood of Varna – with comparisons with more distant but coeval sites. Therefore, the following three sites will be discussed below: Poljanica near the Kamčija River, Pietrele near the Danube River and Provadia near the Black Sea coast.

9 Benecke et al. 2013, figs. 1, 3.
10 Georgieva 2003; Leshtakov 2010; Leshtakov – Klasnakov 2010.
11 Angelova, forthcoming; Filipova-Marinova 2011.
12 Todorova – Tončeva 1975, 30–46.
13 Renfrew 1969, 12–47; Renfrew 1971, 275–282.
14 Todorova 1978, 1.
15 Slavchev 2010, 200.
16 Todorova 1978, 55; contra: Chapman 2010, 78.
17 Nikolov 2012.

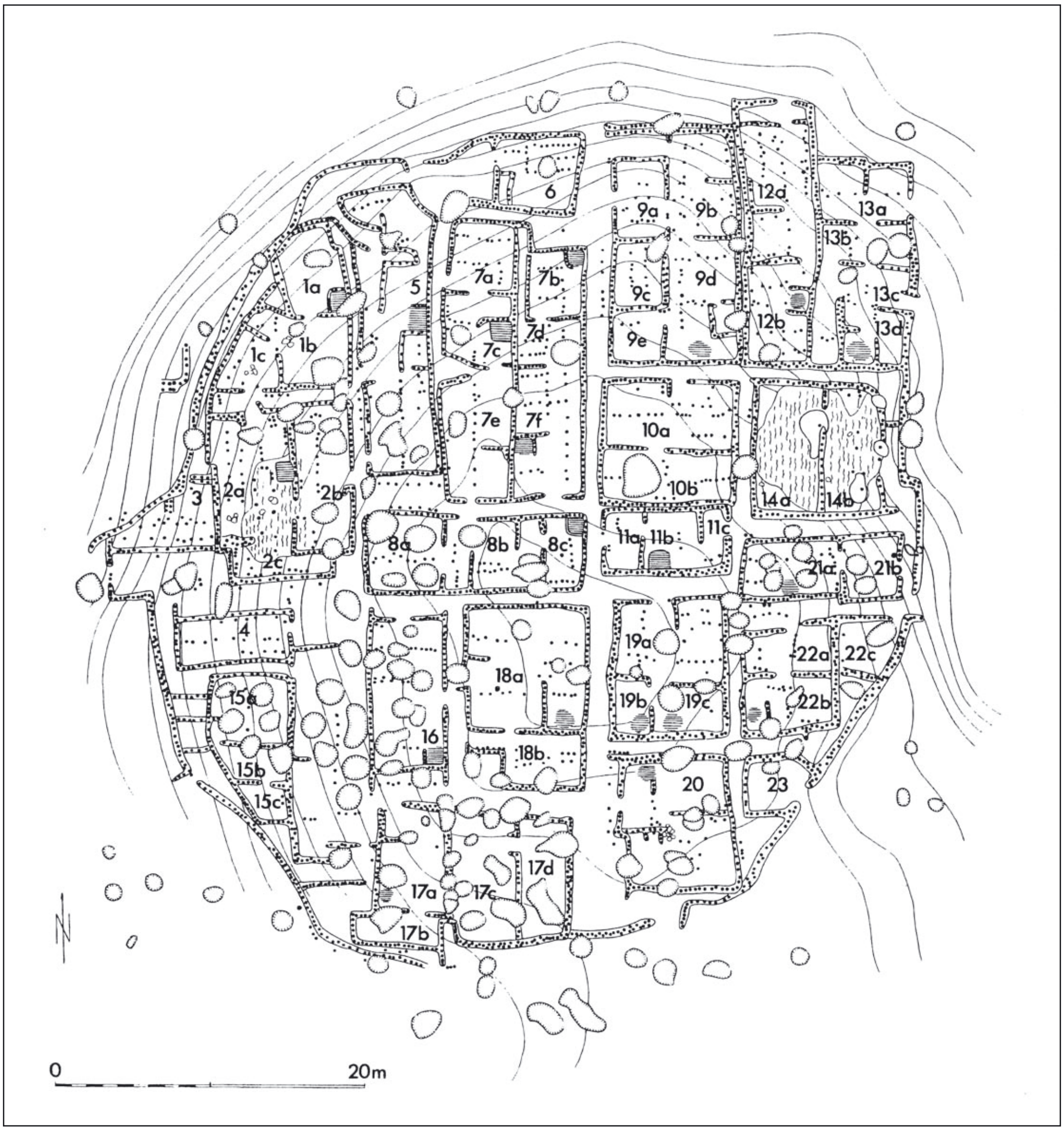

Fig. 2 Poljanica level VIII (after Todorova 1982, fig. 173).

Poljanica[18]

Only few sites north of the Danube River valley have been entirely exposed: not only are the mounds on the northern banks much higher and larger than those in the Kamčija River basin, their excavation requires enormous effort and energy. Excavation methods differed as well, since the emphasis of archaeologists in Romania was on establishing a relative chronology with the help of small and deep soundings (Gumelniţa) or by 1–2m narrow but up to 20m long sections (Sultana). Only the upper horizon of Căscioarele has been thoroughly investigated,[19] but unfortunately never published.

The first extensive knowledge of the spatial organisation of tells was provided by H. Todorova in Poljanica between 1973–1975. The only 3m high tell was entirely excavated. Seven of the

[18] Todorova 1982, 144–165.
[19] Dumitrescu 1965.

eight habitation levels belong to the first half of the 5th millennium, level VIII to the beginning of the KGK-VI complex (Fig. 2).[20] The carefully planned settlement of Poljanica is surrounded in different phases by trenches with palisades. The rectangular layout of the site allows for narrow lanes, keeping free spaces between houses to a minimum. The houses were arranged in clusters, each 1–2 room house contained ovens. Houses did not notably differ from one another, neither by construction techniques nor by facilities or finds. J. Chapman pointed out the spatial and also social complexity, '[…] based upon the differentiation of house space, with larger families more carefully controlling access to rooms and developing specialised uses for them – as sites for hospitality, domestic ritual, food preparation, food storage, tool making, and sleeping'.[21]

According to the calculations proposed by Todorova for tells like Poljanica and also for the nearby tell Ovčarovo, each settlement was inhabited by some 60 to 100 persons.[22] In her view these sites were of 'standard size' in the Eneolithic.[23] Nonetheless, it is difficult to conceive such small communities as the bearers of the complex and stratified social system as it appeared in the rich cemetery of Varna.

Pietrele[24]

Thanks to modern prospection methods it is now known from the site of Pietrele in Romania that the tell itself represented only the prominent part of the residential area: Măgura Gorgana, the mound, is surrounded by a vast flat settlement (Fig. 3).[25] Both to the west and to the northeast of Măgura Gorgana several burnt and unburnt houses were discovered that are coeval with the building horizons on the tell itself. However, some of the structures are much older.[26] Thus, the tell is only part of a far more complex settlement layout. The exact dimensions of the whole settlement have yet to bee fully determined; to date 8.2ha have been investigated geomagnetically. Nonetheless, it is clear that this discovery enormously amplifies our estimation of the sites' inhabitants. The previously established figure of only some 60 people living and producing 'stuff'[27] has to be recalculated and multiplied. In only ten excavation campaigns 13.5 tons of pottery including 485,000 sherds and 1640 vessels were counted, weighed and processed. Furthermore, the flint stone collection of 12,000 is huge, and prominent among the other c. 8000 small finds are objects made of stone and bone as well as copper and *Spondylus*.[28] Such an outstanding wealth of objects, even if divided into the six settlement phases excavated until 2013, certainly surpasses both the potential and the needs of only some 60 people living per phase.

Through large excavated areas on the tell Măgura Gorgana, it can now be established that not all of the houses were used for the same activities and that not all of them contained the same inventories: houses from the northern row are characterised by grinding, milling and cooking areas (Fig. 4),[29] and loom installations;[30] they also served as depositories for flint provisions.[31] The houses on the southern row, on the other hand, yielded most of the fishing and hunting equipment.[32] Knowledge of Eneolithic societies will be significantly enriched once comparisons between inventories from the tell and those from the flat settlement around it are fully analysed.

[20] Todorova 1982, 145.
[21] Chapman 2010, 80.
[22] Todorova 1978, 55; Todorova 1982, 65.
[23] Todorova 1982, 54.
[24] Hansen et al. 2004–2012.
[25] Hansen et al. 2005, 342–346; Reingruber et al. 2011a, 117–129.
[26] Hansen, in print, with recommended literature.
[27] Miller 2009.
[28] Hansen, in print.
[29] Reingruber 2010, 157–174.
[30] Hansen et al. 2008, figs. 15–16.
[31] Hansen et al. 2007, 59–69.
[32] Hansen, in print.

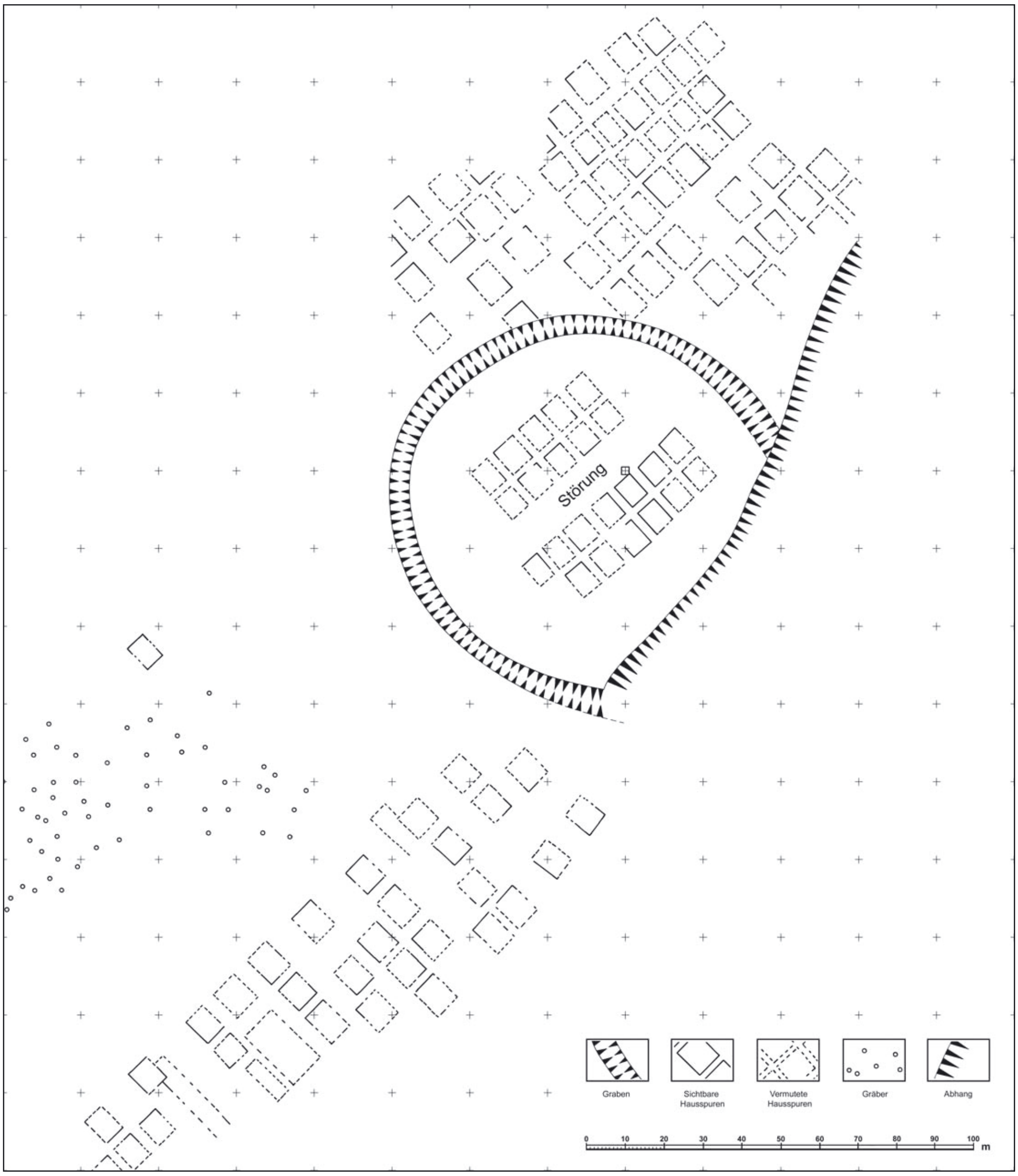

Fig. 3 Pietrele: Interpretative plan based on the geomagnetic investigations (after B. Song in Hansen et al. 2006, fig. 7).

Initial insights point to an uneven distribution of prestige goods like copper objects and *Spondylus* ornaments. Also, access to certain raw materials (flint, graphite bars) seems to have been restricted to the inhabitants of the tell. Therefore, not only on the tell itself can differences between houses be ascertained, but even more pronounced differences emerge when comparing households from the tell with those in its flat surroundings.[33]

In Pietrele indications are strong for a heterogeneous Eneolithic society, organised in equitable groups that were further structured into specialised crafts that required special skills and training. Among these crafts, pottery production – especially the firing of vessels with graphite paint in re-oxidizing atmospheres – is only one example of the specialised activities that were carried out

33 Reingruber 2012, 139–151.

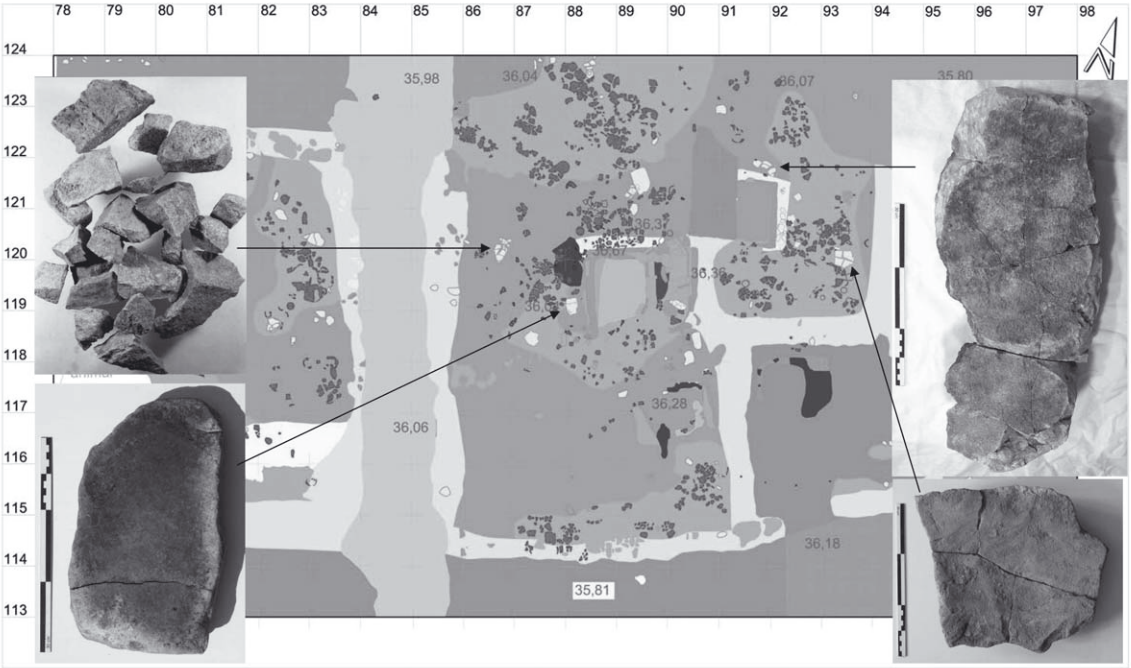

Fig. 4 Pietrele: Northern row of burnt houses in trench B with buildings separated by a lane, containing clay installations, millstones and a total of 321 vessels (digital plan: U. Koprivc, photos: S. Hansen).

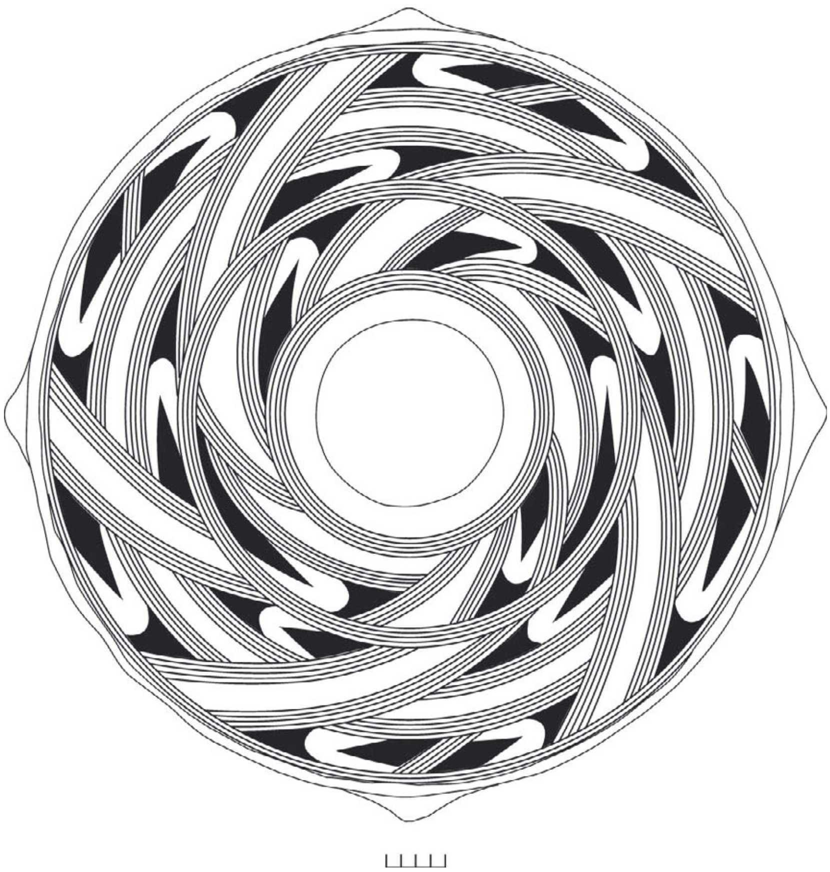

Fig. 5 Pietrele: Graphite painted bowl from trench S (digital drawing: W. Rust – A. Reingruber).

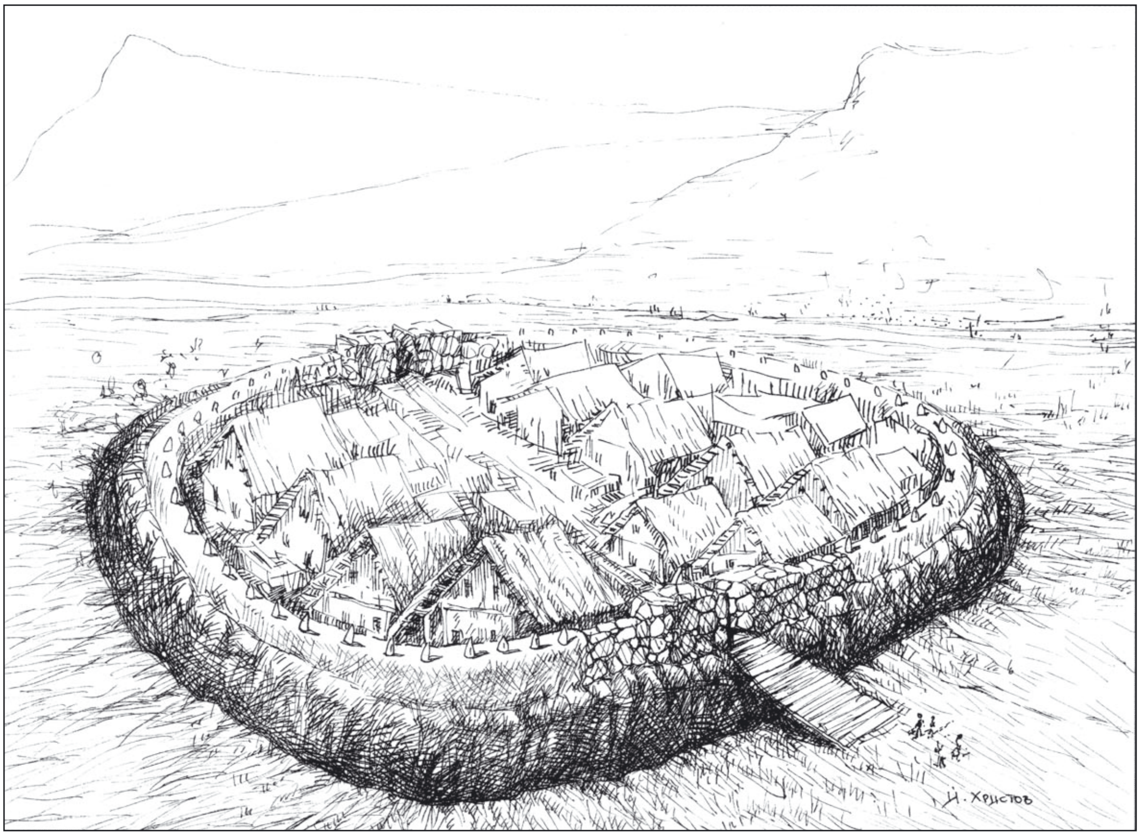

Fig. 6 Provadia: Proposed reconstruction of the site (after Nikolov 2010a, book cover).

at the site.[34] Furthermore, the construction of 120cm high storage vessels[35] or the sophisticated outline of motifs in thin lines, resulting in patterns in millimetre precision (Fig. 5) are certainly not mundane. Thus, pottery of the Gumelniţa type is no longer just a well-crafted product but far more the result of an improved, superior and perfected technology. Such sophisticated knowledge must have led to a higher status of certain individuals.

Provadia[36]

However, not only specialisations within a complex village community characterise the 5th millennium BC in the lower Danube area. Recently, at Provadia, a settlement near the homonymous river close to the coast was interpreted as being the first prehistoric town specialising in salt extraction. Unlike the two sites presented above, in Provadia houses were built of stone, and the site was surrounded by a fortification wall with bastions reaching more than 3m in height (Fig. 6).[37] In its immediate neighbourhood, only 150m away, five salt making installations were discovered, one of which measures c. 10 × 8m and is 1.85m deep. V. Nikolov interprets them as 'industrial' brine-evaporation installations that were filled with bowls containing the brine; the remaining space between the pots was filled with wood whose heat while burning caused the

34 Reingruber et al. 2011b, 48.
35 Hansen et al. 2011, 59, 63, figs. 8–11.
36 Nikolov 2010a; Nikolov 2012.
37 Nikolov 2012, 29.

evaporation.[38] Production bowls consist of two types: a deep biconical bowl for brine-evaporation in ovens, and coarse large conical brine-evaporation tubs used for the process of evaporation in special pits.[39] The end product must have been a hard conical salt cake ready for transport. Briquetage middens contained only objects related to the production process, suggesting mass production. It seems that in Provadia, apart from inter-communal specialisations in certain crafts, a large part of the community was dedicated to salt production, not only for its own needs but also for exchange.

Before Urbanisation: Specialised Production Centres

V. Nikolov advanced several criteria for defining Provadia as a prehistoric town with special status since Provadia represented a centre in a farming region, a centre of specialised production and trade, and a bureaucratic centre for organisation and management that needed fortification walls suggesting it may have also functioned as a military centre.[40] He further states that: '[…] the Varna Lake community not only managed to provide for their food all round the year by farming, fishing and hunting … but also to put aside sufficient surplus for trade'.[41]

Nonetheless, one main point for defining an urban centre relates to the question of whether the communities provided their own subsistence or had to acquire additional staple foods and supplies from villages beyond their territories.[42] If the latter holds true, this would require a complex organisation and management with special buildings for staples and individuals for planning, surveying and organising the process of relocation and redistribution. So far, no such institutionalised administrative centres can be demonstrated at any of the tell-sites. Certainly, the sites mentioned attest a complex social organisation with storage facilities like *pithoi*, probably serving a larger group, but these sites can hardly be considered urban centres.

For the time being, a hierarchical settlement pattern cannot be demonstrated for this region. Indeed, Pietrele has a sophisticated settlement plan, but other tell-sites must be investigated as thoroughly as Pietrele before a pattern of any kind can be established. Provadia with its elaborate defensive system is nonetheless not a unique site: Sushina, Shumen district, also has a stone-built defence system that dates to the middle and late Eneolithic.[43] There, a semicircular bastion, with a diameter of 3m and a preserved height of 3.5m at the centre of the wall, protected the western flank of the settlement. Furthermore, stone buildings are likewise known from the coastal sites of Durankulak[44] and Năvodari.[45] Todorova labels some of the houses in Durankulak as 'palaces' or 'sanctuaries'.[46] According to C. Lichter, such labels are not justified.[47] It seems as if stone constructions might be typical for the Varna Culture, deriving from the preceding Hamangia Culture.[48] Therefore, before a firm analysis establishes a settlement hierarchy, we may not speak of 'urban centres'. Nevertheless, the complex settlement patterns of the Late Eneolithic are matched by a high degree of specialisations in the settlements.

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38 Nikolov 2012, 14–27, esp. 22.
39 Nikolov 2012, 16, 18, 26, figs. 7, 17–18.
40 Nikolov 2012, 63–65.
41 Nikolov 2012, 58.
42 For discussions on this topic I am indebted to O. Joumarin.
43 Personal communication and presentation by S. Chohadžiev in Athens, June 2013.
44 Todorova 2002a, 15, fig. 8.
45 Voinea 2004–2005, 36, fig. 1.
46 Todorova 2002a, 12.
47 Lichter 1993, 82.
48 Boyadžiev 2004, 10.

Regional Resources and New Technologies

On the other hand, when comparing different regions in view of the availability of and closeness to natural resources interesting results attest the high degree of specialisations; not only inside a well-arranged village community but also in regionally specialised communities. For example, salt or rather brine deposits were extracted in the region close to the Black Sea, e.g. Provadia. In Nikolov's view, trade in this commodity would explain the wealth displayed in some of the Varna graves located only 35km away, implying that the whole region benefited from the salt production.[49]

Flint deposits

A similar trend is visible in access to flint deposits. As shown by F. Klimscha, most of the flint axes were found in the tell-sites close to the Danube River (Fig. 7). The farther away a site, the fewer flint axes are reported.[50] This holds true for sites south of the Balkan Mountains, west of the Olt and Jantra rivers and north of the Carpathians where only single axes were found, probably imported from the Danube area.[51] The oldest finds date to 4700–4600 cal BC at Radovanu but they become more numerous in Gumelniţa A1 with their peak reached in the phase Gumelniţa A2. Most of the artefacts were discovered at the sites of Pietrele, Căscioarele, Gumelniţa, Sultana, Boian and Cuneşti north of the Danube River, followed by sites close to tributaries of the Danube in the north (e.g. Tangâru, Bucşani, Jilava, Vidra, Vărăşti and Radovanu).[52] Axes also appear in the Dobrogea and farther north, close to the Cucuteni area in Lişcoteanca and Brăiliţa. Interestingly, the only find from a grave stems from Casimcea.[53] South of the Danube several such tools are reported from Ruse[54] and from sites around Razgrad.[55] The arch depicted by the sites between the modern cities of Giurgiu and Călăraşi in the north and Ruse and Šumen in the south is surrounding exactly the area of the high quality flint known as Luda Gora.

In the coastal areas, axes are almost completely absent, with occasional examples appearing only in Goljamo Delčevo and Sava.[56] Even fewer flint axes were found south of the Balkan Mountains. One stray find was recovered in the area of Stara Zagora and one flint axe is from Tell Azmak.[57] Therefore, it seems likely that the technology of producing flint axes retouched on both sides has its origins in the lower Danube region and from there the products – and also the knowledge – were 'exported'.

Most likely, flint axe specialists produced up to 40cm long 'superblades'[58] (Fig. 8) using the same deposits of high quality flints.[59] Blade production is a very ancient craft, developed dur-

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49 Nikolov 2010b, 487–501.

50 Klimscha 2007, 275–305. It is interesting to note that no flint-axes were found in the cemeteries of Durankulak and Varna. In Durankulak (Todorova 2002b, tabs. 1–203) most of the stone celts belong to graves of phases Hamangia I–III; the antler-axes with few exceptions only to graves dating to Hamangia IV–Varna I; the stone hammer axes started with the Varna Culture and only in Varna III do the two copper-axes appear (copper celts were dated to Varna II and III).

51 Klimscha 2007, fig. 8. Klimscha interprets these few finds as imports. On the other hand, a cluster of flint axes is evidenced in the area of the Cucuteni-Tripol'e Culture where this kind of tool was probably imitated (Klimscha 2007, 304).

52 Klimscha 2007.

53 Govedarica 2004, 104–105, pl. 19.

54 Georgiev – Angelov 1952, 125, fig. 92; Černakhov 2009, 53, cat. nos. 23–24.

55 Jungsteinzeit in Bulgarien 1981, 106–107.

56 Mircev – Zlatarski 1960, 21, fig. 40; Todorova et al. 1975, 205, pl. 92.

57 Kalchev 2005, 13.

58 Sirakov 2002, 218: blades longer than 20cm are labelled 'superblades'; blades between 15–20cm are called 'long blades'.

59 Klimscha 2011, 263 suggests that the chaîne opératoire might have been the same, since the block of raw material for axes must have been over 20cm long.

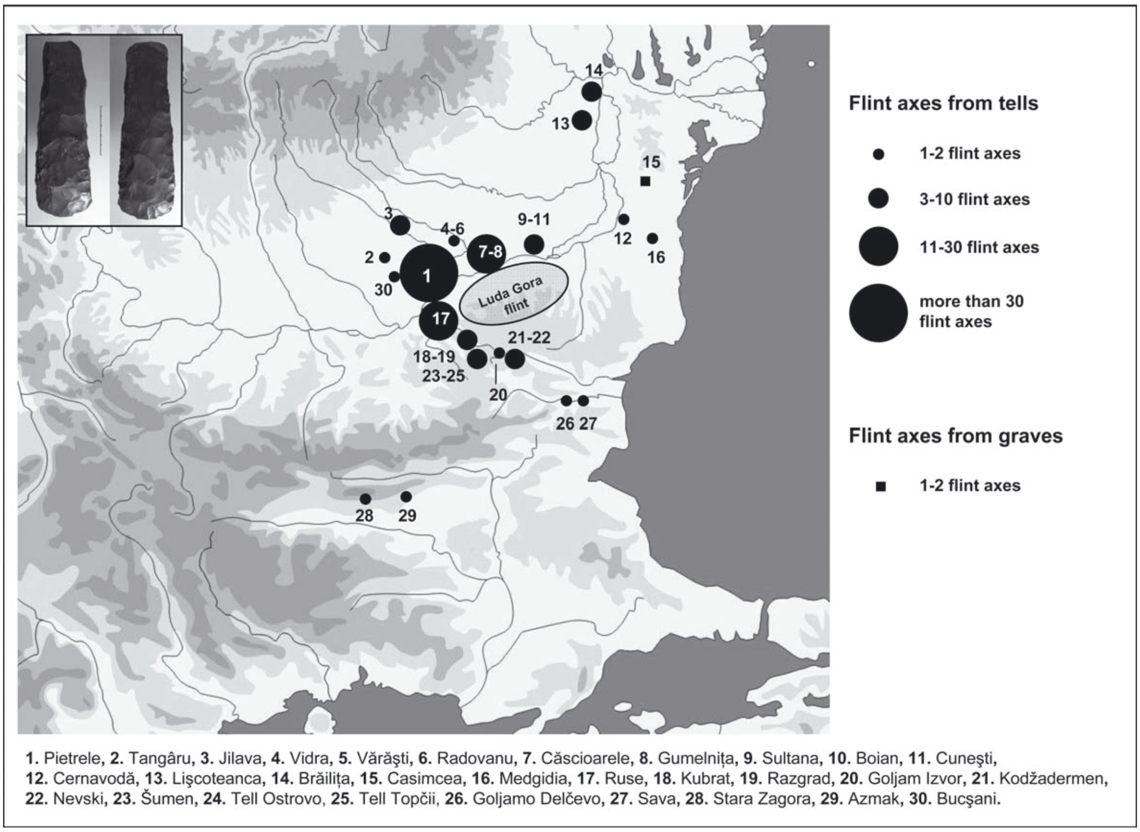

Fig. 7 Distribution of flint axes (photo of a flint axe from Pietrele: S. Hansen).

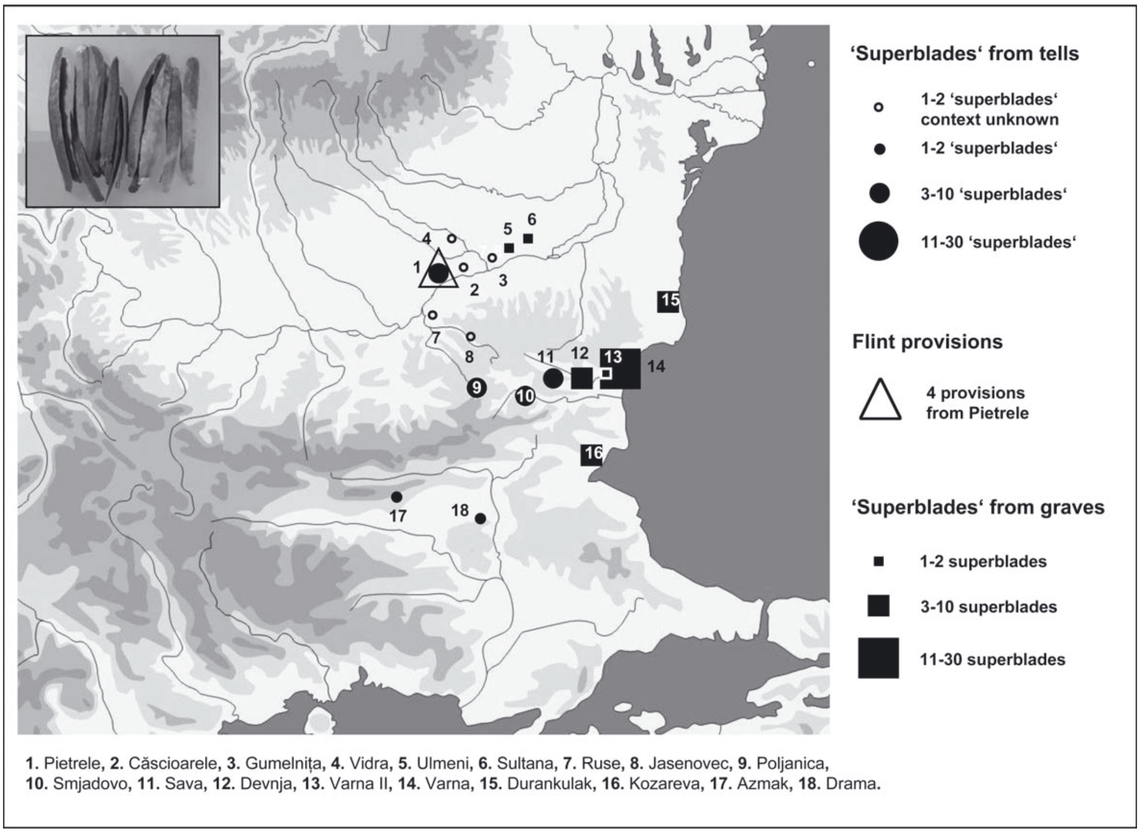

Fig. 8 Distribution of 'superblades' (photo of a provision in Pietrele: S. Hansen).

ing the Late Palaeolithic. Broad and strongly curved blades were obtained by applying direct or indirect percussion. In the Neolithic, the newly developed pressure technique allowed the production of regular, longer (since straighter) and also more narrow end products. Perfecting this technique probably by using a lever, as suggested by J. Pelegrin and N. Sirakov,[60] blade production resulted in considerably longer and straighter end products. Where exactly this technique was invented is difficult to assess,[61] but most of the finds derive again from the tell-sites along the lower Danube River. These 'superblades' were not the tool itself but the ingenious supply ready to be cut into fragments of various sizes, leaving the individual user to decide on the length of the final tool.

Exceptionally long blades measuring 38 to 44cm were found in the cemetery of Varna, mostly as single blades or in pairs.[62] From the 80 pieces gathered from literature[63] and museum visits,[64] 43 blades were recovered from graves and 30 in the settlements of Azmak,[65] Drama-Merdžumekja, Pietrele, Poljanica, Sava and Smjadovo. The context of additional seven pieces is not known. Most of the finds derive from Pietrele. Their length varies between 20 and 28.5cm. Five were found as individual pieces in different houses while three were part of a cache kept in a house – with one exception they all were located in trench B. Four other reserves, with mostly long blades (shorter than 20cm) can be additionally regarded as raw material supplies for blade production as attested by the fifth cache of blade fragments found in a ceramic vessel in the same level.[66]

Judging by the provisions and the multitude of flint axes found in Pietrele,[67] its inhabitants certainly had direct access to flint sources. Considering the vastness of the palaeolake directly south of Pietrele, – its expanse is calculated to more than 500km^2 by Dirk Nowacki and Jürgen Wunderlich[68] –, the deposits were easily reached by boat. The lake probably did not extend very far to the south of the Danube River; however, the area of Ravno and Kriva Reka, where flint sources have been located by Ch. Nachev,[69] is only 40km south of Pietrele. According to I. Gatsov and P. Nedelcheva, indications for the production of 'superblades' at the site itself are lacking, but it is conceivable that specialists from the northern banks of the palaeo-lake took regular trips by boat to the southern areas, returning with already prepared provisions of high quality flint.[70]

Only few sites with 'superblades' are well dated, eminent among them is Pietrele; long blades between 15–19cm are present there around 4500 cal BC, whereas superblades longer than 20cm do not appear in the settlement until c. 4400 cal BC. This evidence is supported by results from the cemetery of Durankulak, where in the Late Neolithic/Early Eneolithic pressure technique is observed, but only in the late Eneolithic does lever pressure appear.[71]

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60 Personal communication J. Pelegrin 2010; Sirakov 2002, 218.
61 They are also common in the Chalcolithic and Early Bronze Age in Anatolia (Herling 2007, 177–179).
62 Manolakakis 2005.
63 Sirakov 2002; Manolakakis 2005; Hansen et al. 2007, 59–69.
64 Especially from the museums of Giurgiu and Olteniţa with finds from Sultana, Căscioarele and Gumelniţa, as well as the Ruse museum.
65 'Superblades' occur in Azmak only in the uppermost levels. In levels of the early Eneolithic, blades were 'only' up to 15cm long (Manolakakis 2005, pls. 67–78); Kalchev 2005, 13.
66 Gatsov – Nedelcheva, in print; Hansen et al. 2006, fig. 22; Gatsov, Nedelcheva in Hansen et al. 2007, figs. 48–54.
67 Hansen et al. 2008, fig. 56; Klimscha 2011, figs. 13–15.
68 Benecke et al. 2013.
69 Nachev in Hansen et al. 2012, fig. 46. From these sources derived also the 'superblades' from Durankulak: In the Late Eneolithic more than 80% of the artefacts from Durankulak were made of flint from Radingrad (Sirakov 2002, 215, 217), pointing to a very high specialisation in production.
70 Hansen et al. 2007, 67.
71 Sirakov 2002, 220–221.

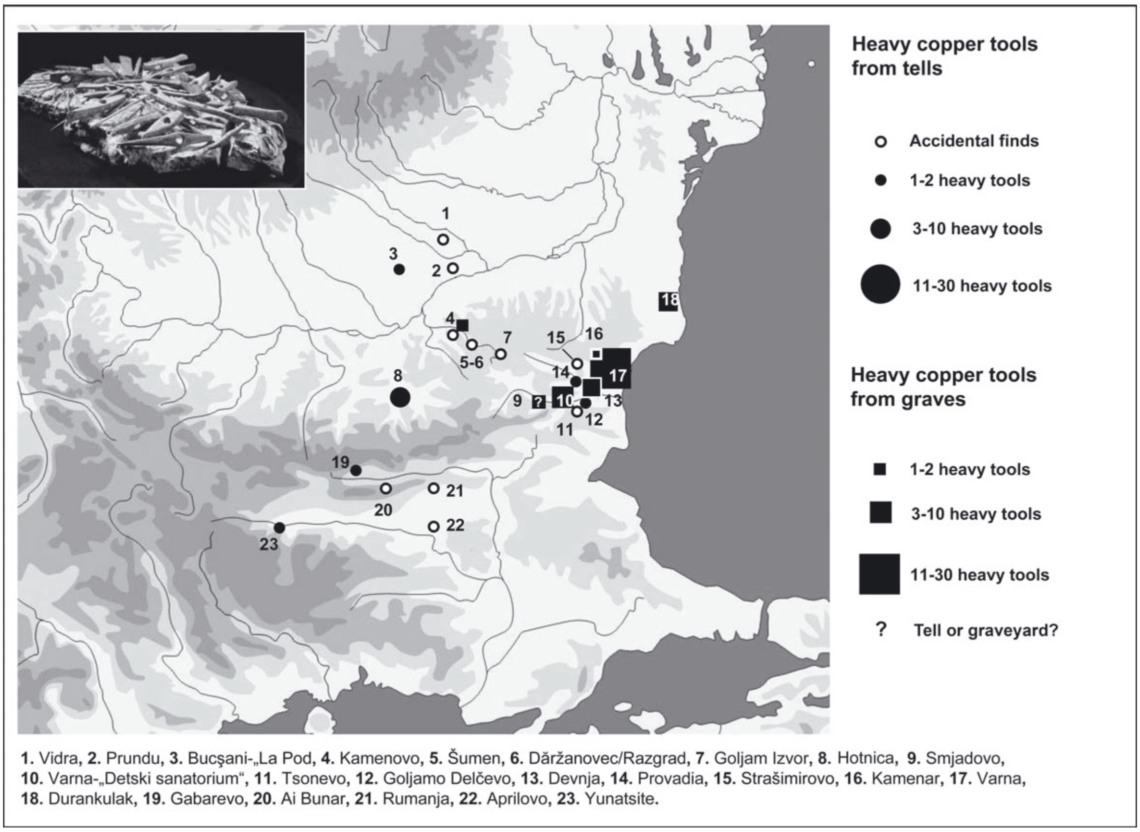

Fig. 9 Distribution of heavy copper tools (photo of tools from Varna: K. Dimitrov).

Copper

Social transformations in Copper Age communities can be related to the appearance of metals in this area[72] – both heavy copper tools and gold ornaments are abundant in some of the Varna graves but not in coeval settlements. Indeed, all the Eneolithic sites display a certain inventory of small copper objects, single pieces weighing less than 90g. They appear mainly in the layers postdating the 4,600 calBC threshold, as in Pietrele,[73] Căscioarele, Sultana, Hârşova, Bucşani and others.

Heavy copper tools[74] on the other hand, weighing more than 300g, have a good stratigraphic context only in exceptional cases and rarely are comprehensively published. Apart from those found in graves, these artefacts were reported as single objects and stray finds.[75] No heavy copper tools were found in any of the tells otherwise abundant with flint axes, no heavy copper finds are reported from a Gumelniţa A context, and none were found in the tells close to the Danube River. Presumably such finds are not expected there, since the few hints to their chronological classification point to the phase Gumelniţa B (Bucşani-'La Pod')[76]. A mould for casting copper chisels from Căscioarele also dates to this phase.[77] Furthermore, the axe from Vidra is believed to

[72] Hansen 2011, 275.
[73] Toderaş in Hansen et al. 2009, 56–60; Toderaş in Hansen et al. 2011, 95–99.
[74] Hansen 2009, 141–160.
[75] Compare catalogue in Ştefan 2008, 79–88.
[76] Bem 2002, 67.
[77] Vulpe 1975, 57, pl. 33.259–260.

be associated with Gumelniţa B, although it was not found in the regular excavation.[78] The hammer axe from Prundu is an isolated find (Fig. 9).[79]

The exact stratigraphic position of the Gumelniţa B period is a matter of debate. For example, at the site of Pietrele this phase represents rather a pottery variant occurring in the phase Gumelniţa A2 and not a separate stratigraphical and chronological unit.[80] In the archaeological literature, this phase is dated either to the early or sometimes to the middle of the 4th millennium,[81] centuries after the KGK VI complex ended.[82]

South of the Danube, well stratified examples of heavy copper tools are likewise rare. Apart from single objects found in the upper levels in Hotnica[83] and in level XVII in Goljamo Delčevo,[84] most were fortuitous finds.[85] In the cemetery of Varna 28 heavy tools of different varieties, mostly hammer axes, were found mainly in cenotaphs and presumably male graves. Their exact chronological position has not been clarified yet.[86]

Among the 200 copper objects in Durankulak are seven heavy tools, notably two hammer axes deriving from male graves of the final stage of the Varna Culture.[87] According to K. Dimitrov's analysis the metal came from two sources: from the Rosen/Medni Rid near Burgas and Ai Bunar in the upper Tundža region.[88]

Heavy tools south of the Balkan Mountains are even fewer and often derive from chance discovery and unclear find circumstances.[89] Even the hammer axes from the mine in Ai Bunar[90] were presented by H. Todorova as 'erworben bei Bergbauarbeiten'.[91] Although a major part of the metals found in the lower Danube region derive from the mines in Ai Bunar,[92] no stratified axes were reported from the tells in Azmak or Karanovo. Only in Yunatsite is the context of two axes of the Pločnik type known. They were found in a house associated with the final habitation phase.[93] The exact chronological position of hammer axes is, therefore, poorly understood, but at least the Vidra type of axes appears to date to the very end of the Gumelniţa and Varna cultures, around 4300 calBC or even to the unexplored centuries afterwards.

Traces of metal workshops in the west Pontic area are absent. For the time being, we have to assume that small metal artefacts were brought to the sites both as tools (hooks, awls, chisels) and as valuable items (adornments). The lack of heavy copper tools in the tells may be due to their re-melting, or their retrieval from the ruins of often burnt houses before the construction of a new house on top. Perhaps such items were just about to appear in the region, but the tells were aban-

78 Vulpe 1975, 22, pl. 2.22.
79 Vulpe 1975, 22, pl. 2.23.
80 Reingruber – Rassamakin, in print.
81 Ştefan 2008; Bréhard – Bălăşescu 2012.
82 Weninger et al. 2010; Reingruber, in print.
83 One of the three axes was found next to the skeletal remains of a male in the burnt upper horizon (Todorova 1981, 37, pls. 7.104; 8.125, 129).
84 Todorova 1981, 37, pl. 6/103.
85 Todorova 1981, 37–38, pls. 6–10; Ştefan 2008.
86 The ^{14}C-dates on human bones antedate by 200–300 years those dates obtained from the same graves on animal bones (Higham et al. 2007); therefore, the high BP-values deriving from human bones might be caused by the reservoir effect.
87 Dimitrov 2002, 146.
88 Dimitrov 2002, 146, maps 5–6.
89 Todorova 1981.
90 Chernykh 1988, 145–150, figs. 85, 217, cat. no. 42: 'probably' found in 1934–1935.
91 Todorova 1981, 36 (translation: 'acquired during mining works').
92 Pernicka – Anthony 2010, 170–171.
93 Manzanova 2011, 15, fig. 4. Lead-isotope studies would clarify if they do indeed belong to the older heavy copper tools of the Vinča Culture made of central Balkan ores. Nonetheless, these tools belong to the oldest stratified heavy tools in Thrace. It should be mentioned that the ceramic inventory of Yunatsite also displays strong affiliations to the central Balkans.

doned before they became more widely distributed. The oldest objects from the graves in Varna and Durankulak are certainly much younger than the heavy tools from the Central Balkans.[94]

Ore sources for the metal objects in Pietrele occur at Majdanpek, Čelopeč, Burgas-Strandza and Ai Bunar.[95] The whole upper Tundža region seems to have profited from the latter deposits and probable production centres.

Gold

The oldest known gold ornaments, like ring pendants, beads and discs, were found in the cemetery of Durankulak dating to the period Hamangia IV,[96] in the cemetery of Varna II from the same period,[97] and in Glina near Bucharest in the levels of the Late Neolithic Boian Culture.[98] Nevertheless, most of the gold objects derive from cemeteries of the KGK VI-complex (Fig. 10); north of the Danube four graves in Vărăşti contained gold objects, among them a ring pendant, a cylindrical and three round beads.[99] The cemetery of Chirnogi yielded five beads made from a thin gold sheet.[100] South of the Danube, grave 3 in the cemetery of Varna II contained 31 gold beads.[101] A total of 34 golden rings was found in a heavily disturbed grave in Reka Devnja.[102] Of the three ring pendants found in Sava, one is said to be from a grave.[103] Although in Durankulak 142 pieces weighing 50.5g were recovered,[104] the amount of gold found in the Varna necropolis is breath taking. Approximately 3000 pieces found there weigh a total of c. 6kg. Some ornaments do not show traces of usage, suggesting these pieces were produced especially as grave goods.[105]

Comparatively few gold objects have been found in tell-settlements. Single pieces or small groups of gold objects were found in some of the high tells along the Danube, e.g. Pietrele,[106] Căscioarele,[107] Gumelniţa,[108] and in Sultana-Malu Roşu.[109] Farther away from the Danube, however, golden objects are fewer. To the north single ring pendants appear in Vităneşti[110] and Vidra,[111] while to the south a variety of ornaments were reported from Hotnica,[112] Ruse,[113] Bereketska Mogila,[114] Drama,[115] Goljamo Delčevo[116] and Yunatsite.[117] A small gold bead was recovered in Sitagroi III.[118] Besides the ring pendants, which perhaps depict the human body, two anthropo-

94 Borić 2009, 191–245; Pernicka – Anthony 2010.
95 Hansen et al. 2008, 71.
96 Dimitrov 2002, 147.
97 Todorova – Vajsov 2001, 13.
98 Comşa 1974a, 87.
99 Comşa 1974b, 184.
100 Cojocaru – Şerbănescu 2002, 85–86, fig. 2a–e.
101 Fol – Lichardus 1988, 219–222.
102 Fol – Lichardus 1988, fig. 55.
103 Todorova – Vajsov 2001, 67–68.
104 Dimitrov 2002, 147.
105 Hartmann 1982, 39–40.
106 Reingruber 2007, fig. 15; Hansen et al. 2010, fig. 23.
107 Exhibition in the National Museum of Bucharest.
108 Dumitrescu 1961, 79, fig. 7. A ring pendant, a ring and a gold ingot weighing 22g were found in different excavation campaigns.
109 Hălcescu 1995, 11–18; Şerbănescu s.a., 15. Eleven gold pieces weighing 36.170g were recovered from oven debris.
110 Andreescu et al. 2009, 78, pl. 12.
111 Rosetti 1938, 38, pl. 21.2; Comşa 1974b, 15.
112 Todorova – Vajsov 2001, 45, 67–68.
113 Černakhov 2009, 73, cat. nos. 88–90.
114 Kalchev 2005, 56.
115 Personal communication P. Nedelcheva 2012.
116 Todorova 1982, 104.
117 Mazanova 2004, figs. 4–5; Manzanova 2011, 15.
118 Renfrew – Slater 2003, 319–320, fig. 8.1e.

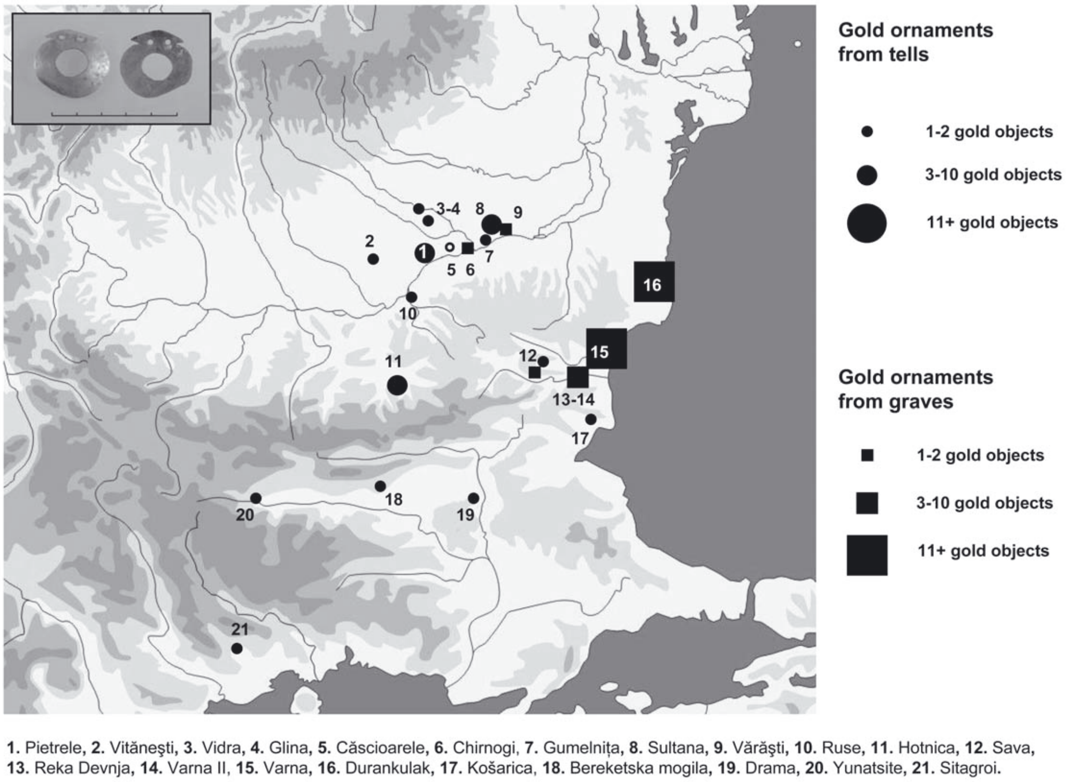

Fig. 10 Distribution of gold objects (photo of a ring pendant from Pietrele: S. Hansen).

morphic figurines have been reported from Ruse and Košarica. Both figurines are now lost. The example from Ruse was probably found together with human bones;[119] the one from Košarica was a stray find.[120]

The sources of placer gold are impossible to establish;[121] their provenance is given as 'alluvial'.[122] A. Hartmann suspects the origin of the variant containing platinum in Anatolia or the Caucasus.[123] R. Krauß suggests that the rivers flowing from the Balkan Mountains were rich in placer gold.[124] If the gold was indeed panned in the Kamčija and Provadia rivers, its excessive use in the cemeteries of Varna and Durankulak would have been the result of its availability close to the Black Sea coast; the few pieces found farther away could have been procured through trade there.

In addition to ordinary products made of clay, bone and stone, the wealth of the tells is constituted by: 1. Commodities exchanged on an interregional scale needed by specialists for specific tasks, e.g. small copper tools, graphite bars, salt and high quality flint; 2. Valuables such as ornaments made of *Spondylus* and copper, available to a larger part of the community, but not to everyone. Perhaps specialists had easier access to such items. Prestige goods like gold and heavy copper tools interpreted as insignias of power, influence and dominance are rarely encountered in

[119] Comşa 1974b, 184.
[120] Whereas Comşa 1974b, 185 identifies it as deriving from Košarica, Todorova – Vajsov 2001, 89 place it in the tell Kašlădere near Anchialo.
[121] Dimitrov 2002, 147–148.
[122] Bugoi et al. 2003, 375–383.
[123] Hartmann 1982, 37–43.
[124] Krauß 2008, 134.

tells. As a whole, the northern Danubian sites are rich in small metal finds but not in heavy tools. Pending the final publication of the Varna necropolis, which will clarify the relative and absolute chronology of the heavy copper tools, for the moment the evidence rather points to a very late appearance of heavy copper tools of the Vidra type in the region, much later than the appearance of Pločnik type axes in the Vinča Culture.[125]

Specialisation and Accumulation of Prestige

In the last decade, long-term projects with interdisciplinary methodologies, for example in Pietrele, established a differentiated picture of the Eneolithic society. Evidence for labour division and specialisation in certain crafts appear in the houses in the northern and southern rows on the tell Măgura Gorgana in Pietrele, yet prestigious objects were evenly distributed. Perhaps, not only certain individuals profited from the resources of the regions, but the wealth was shared at least among the inhabitants of the tell. Besides gold and heavy copper objects, ornaments made of *Spondylus* are also accepted by most archaeologists as prestige markers since this raw material is obtained from presumably very distant sources in the Aegean.[126] Initially, the logic of this argumentation whereby artefacts gain in prestige the further away their sources seemed to correlate with the exchange patterns observed for the 5th millennium BC. It is possible that items were produced as commodities in one region, and were 'transformed' into prestige goods in the neighbouring one. This might be the case with the 'superblades', perhaps also the flint axes. However, the latter objects show that unilinear interpretations do not cover the range of complexity of the situation. For example, if flint axes were indeed a status symbol used to express 'social significance',[127] their absence in all three cemeteries near the coast, in Varna, Durankulak and Kozareva, is puzzling. Superblades, on the other hand, were found in 25 of the 307 Varna graves, often in very rich male graves (e.g. Grave 43), interpreted accordingly as interments of social leaders. In Durankulak, on the other hand, two of three 'superblades' were found in female graves.[128] In addition to the cenotaphs, several male interments in Varna were lavishly furnished with prestige items and even with objects suggesting authority, as for example the stone sceptre on the shoulders of the interred in Grave 43.

A building with outstanding characteristics corresponding to one of the extraordinary graves in Varna continues to elude the archaeological record. The self-expression and imagery displayed in the graves stand in clear contrast to the situation in the tells. The question arises as to whether all of the objects placed next to the individual in Grave 43 indeed belonged to him in life. Were they his own possessions that were buried together with him? Or did these objects belong to members of the community, and were used to commemorate him, regardless if he used to be the leader of the group or rather a specialist in metal production or another member of esteem in the community. The highly diversified objects in some of the graves are difficult to explain as a repetitive funerary set; they could be seen as an accumulation to which several persons added their share. It is not unlikely that social competition enhanced by social pressure was the motivation for such depositions.[129] In this way, the balance between the members of the community might have been regulated, also explaining the cenotaphs as deposits controlling the disparities in the

[125] Borić 2009, 191–245; Radivojević et al. 2010, 2775–2787.
[126] Renfrew – Shackleton 1979, 183–189; Müller 1997, 91–106; contra Todorova – Vajsov 2001, 14–17; Todorova 2002a, 182; Haimovici 2008.
[127] Klimscha 2011, 263.
[128] Sirakov 2002, 246, fig. 16.
[129] See Hansen 2009, 286 for the implications of ostensibly optional, but nevertheless socially controlled gifts.

society.[130] Such an interpretation contradicts the model of an urban society with institutionalised political power structures. Therefore, judging by the situations reported for tell-settlements, Copper Age authorities were not institutionalised. Moreover, buildings with outstanding construction elements that mark them as special buildings in the settlements are absent. Also, in Pietrele there are no accumulations of copper or *Spondylus* objects in a specific building,[131] even figurines were distributed evenly.[132]

Power, therefore, might not only be measured in the accumulation of prestige goods in the houses but by the accumulation of knowledge and skills acquired. However, insiders' knowledge was not shared by everyone in the community. With their increasing indispensability, specialists might have become society leaders. Power at this stage appears to be person-related, not institutional; neither a central nor a hereditary authority can be demonstrated as of yet. Such a system is dependent upon the succession of leaders. In a short-term perspective, this form of leadership is stable for a few decades but not in an intermediate, let alone a long-term perspective.

Craft specialisation is certainly the catalyst for the processes of not only improving and optimising old techniques but also inventing new ones as was the case in the west Pontic area during the Copper Age. Specialists were presumably of high rank, and perhaps the driving force of the communities. However, not only single persons participated in the exchange of goods and prestige items. Whole regions appear to specialise in the extraction, production, exchange of raw materials specific for a particular region; for example, the coastal area produced salt, the Danube region procured flint, and the upper Tundža area extracted copper. Each region also profited from these activities. Yet, it was only the exchange of the end products among the different regions that led to the cultural florescence of the entire region. Therefore, the wealth of the tells cannot be explained by the organisational and management talents of independent persons but as the result of communication and ceaseless exchange between regions trading their minerals and possibly also their biological and natural resources.

We do not have enough consistent information to interpret the structure of the society in the 5th millennium BC, but the few glimpses gained thus far allow a better comprehension of the high level of complexity that distinguished these societies. Nevertheless, systems lacking complex administrative organisation, political alliances, and writing were even more vulnerable to changing conditions provoked by different factors: Not only cultural or social transformations but also changes in hydrology and climate should be considered as the cause for the deteriorations at the end of the 5th millennium BC.

Conclusions

Our knowledge about the organisation of Copper Age communities living on tells has increased considerably during the last decade. Whereas previously we pondered about sophisticated site-plans such as those from Poljanitsa, where c. 60 people lived per settlement phase, today such plans must be widened to incorporate the immediate surroundings of the tell. This has been shown to be a fruitful approach, for example in Pietrele where new methods of investigations were applied; it appears that the tell itself is merely part of a much more complex settlement system. Excavations at Pietrele have further shown that specialised tasks were carried out in specific areas. From Provadia we learn that a whole community was specialised in the extraction and distribu-

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[130] Chapman (2010, 79) envisaged Varna as an inter-regional cemetery with interments from 'communities across the western Black Sea region, if not from the whole of eastern Bulgaria and perhaps even farther afield'. The final publication of the cemetery by V. Slavchev will certainly contribute to the understanding of the complex social system of the 5th millennium BC, especially after clarifying the incomplete and sometimes contradictory descriptions of the grave goods.

[131] Hansen et al. 2009, 56–60; Hansen et al. 2011, 95–113.

[132] Hansen et al. 2012.

tion of a locally available commodity (salt), optimising old and inventing new techniques. New technologies might have been implemented first in areas where resources were readily available, but their exploitation was demanding, which provoked the development of new solutions. These encompass the manufacture of specific flint axes or 'superblades' around the Luda Gora plateau, the extraction of copper from the Balkan Mountains and the production of gold objects near the Black Sea coast.

The implementation of such specialised crafts most likely led to the growing need for an inventive and creative workforce, not only able to organise, but also to explore, transform, design and distribute materials for both daily (flint) and/or for specific use (metals). The rise of such specialists' social prestige might be reflected in some of the richly furnished graves of Varna and Durankulak. Yet, not a single house on contemporary sites can be securely assigned to a high-ranking person. In Pietrele, for example, the objects made of copper or *Spondylus*, classifiable as prestige goods, are spread evenly across the buildings, at least those on the mound itself. It seems that not only the specialists, but also the broader community benefited from the resources exploited in their region and from the exchange with their neighbours.

Nonetheless, the richness of the graves and the wealth of the tells does not automatically indicate an emerging urban society. Arguments proposed until now do not suffice for classifying the tell-sites as urban or pre-urban centres. Although there are differences in the size of tells, the height of the accumulated layers, the number of habitation levels and the duration of their use, the relationships between sites remains largely unknown and their interpretation a question for future research. Qualitative comparisons alone will not aid in elucidating this problem and data for large-scale quantitative analyses are lacking. Therefore, it is impossible to assess whether a hierarchy of settlements, with one settlement dominating neighbouring ones, existed. We do not know whether flat sites were subordinate to multilayer sites or – vice-versa – whether tells were dependent upon products delivered by potential satellite sites.

No ranking of sites can yet be established for the 5th millennium BC in the lower Danube region, and no one urban centre that held exclusive control over an entire region and its resources can yet be identified. Nevertheless, well organised rural societies are reflected in complex settlement lay-outs with activity areas for specialised crafts. Specialists might have been the driving force of the communities, with both their charisma and their knowledge contributing to their social prestige.

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The 4th Millennium: A Watershed in European Prehistory

Svend Hansen[1]

Abstract: The radiocarbon revolution has profoundly changed the chronology in prehistory and illustrates that the 4th millenium in western Eurasia was determined by a bundle of technical and social key innovations such as wheel and wagon, the domestication of the horse and donkey, and the breeding of woolly sheep. Furthermore, new metals (silver and lead) and new copper alloys appeared, and the production of metal goods expanded. New weapons, foremost long daggers and shaft hole axes quickly became widespread and were used by a new social type of warrior sharing a similar 'language' of representation: the mound over the single tomb containing lavish grave goods and large stone steles. These elements of social and technical change were not distributed in Europe as a 'package' but followed different paths. Their distribution, combination and recombination in the 4th millenium supported a kind of homogenisation in the 3rd millenium. This picture challenges our perception regarding the political and social organisation of these societies. Until now archaeology has attempted to balance the evaluation of its material culture with anthropological schemes of the neo-evolutionist school. Prehistoric societies are generally assigned to the level of chiefdoms, somewhere in between Palaeolithic bands and ancient states. The application of this scheme to the development of the Neolithic as well as the Bronze Age, however, arouses strong doubts as to its operative value. There were many ways – not just one – in which egalitarian societies develop into stratified societies whose determining principle is social inequality. It is, therefore, advisable to loosen the strong ties between archaeology and ethnology, for it is archaeology that observes long-term developments whereas the actual temporal depth of ethnological studies is, by contrast, quite shallow. Archaeology can trace the course of mankind's development in specific spaces and time and describe discontinuities. Hence, instead of imposing presupposed universalities about forms of social and political organisation upon the past the archaeological material should be interpreted free of generalisations.

Keywords: Southeastern Europe, Neolithic, Chalcolithic, social evolution, neo-evolutionism

The radiocarbon revolution caused a deep-going change in the chronology of prehistory, particularly the complete revision of the 4th and the 3rd millennia BC chronology. This was not a superficial correction: the picture had to be drawn completely anew. To understand the dynamics between the 5th and 3rd millennia BC it seems fruitful to draw attention to the technical and social innovations that occurred during these millennia.

Technical innovations played an important role in V. G. Childe's concepts of cultural development in prehistory. Childe maintained that key technologies such as the wheel, the ox-cart, the sailing boat and metallurgy were the decisive preconditions for the emergence of complex societies (the 'urban revolution') in Egypt and the Near East.[2] Doubtlessly, metal played a major role in Childe's concepts, and this is in accordance with a much older and broader tradition in historiography: namely that metals played the decisive role in technological and economical development from the Bronze Age onwards until modern times. For Childe, the introduction of metal marked the end of the economic independence of farmers and villages. In his view, mining, smelting ores and converting metal by casting and forging it into tools, weapons, vessels and ornaments were fulltime specialisations.[3] Consequently, the division of labour was connected with social control.

The Urban Revolution was a crucial point in history, and for Childe all important technologies then spread from the Near East to the Mediterranean and temperate Europe.[4] This kind of 'ex ori-

1 Eurasien-Abteilung des Deutschen Archäologischen Instituts; email: svend.hansen@dainst.de.
2 Childe 1982 [1942], 97.
3 Childe 2009 [1958], 78–79.
4 Cf. Childe 2009 [1958], 103–104.

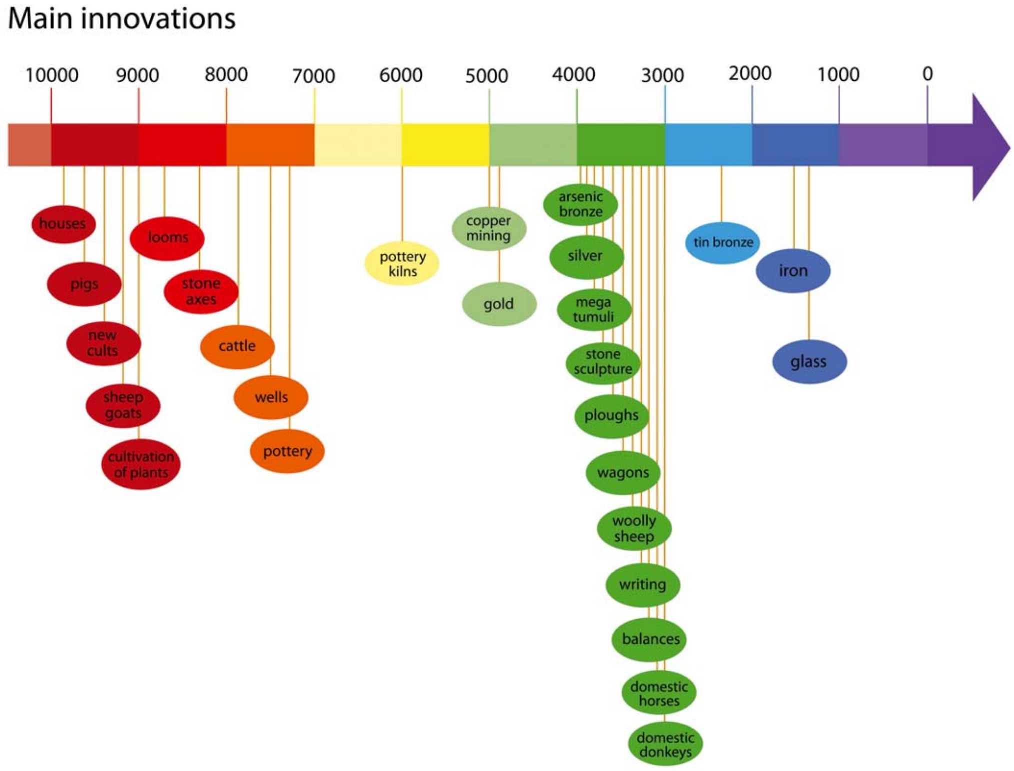

Fig. 1 Scheme of innovations. The diagram does not contain single inventions like Pre-Pottery Neolithic sculpture, but instead the large scale distribution. Datings are not precise (graphics: S. Hansen – A. Reuter).

ente lux' diffusionism was criticised by C. Renfrew,[5] when he claimed an independent invention of metallurgy in the Balkans in view of early radiocarbon dates from the cemetery of Varna. Yet, A. Sherratt sustained Childe's considerations by introducing the concept of the 'secondary products revolution', which became quite influential in European prehistory.[6]

For the last 20 years, technical innovations can be dated much more precisely thanks to calibrated radiocarbon dates, which have changed chronology, particularly that of the older periods between the 10th and the 2nd millennia BC (Fig. 1**)**.

The first innovation complex is connected with the 'Neolithic Revolution'. The emergence of the domestication of sheep and goat, pig and cattle took place between the 9th and the 7th millennia. During this time span several other major Neolithic technologies such as wheat cultivation, pottery-making, weaving, house-building, etc. were introduced. The first innovation horizon is also referred to as the 'Neolithic package'. Certain inventions of the Early Neolithic in the Near East co-occurred, for example, pottery, figurines, houses, polished axes, domesticated animals and – starting in the 7th millennium – transferred to other regions in the west and east of the Fertile Crescent. In the case of the Neolithic period, it seems clear that in many instances the Neolithic mode of production was introduced by settlers seeking new land.

The development of copper and gold metallurgy during the 5th millennium BC is especially noteworthy.[7] From a technical point of view, copper axes were not more effective than simple stone axes. People with copper axes could not cut trees in less time than people using stone axes. Hence, the question arises as to how the spectacular start of copper mining, production and con-

5 Renfrew 1969.
6 Sherratt 1997.
7 Pernicka – Anthony 2010; Hansen 2011.

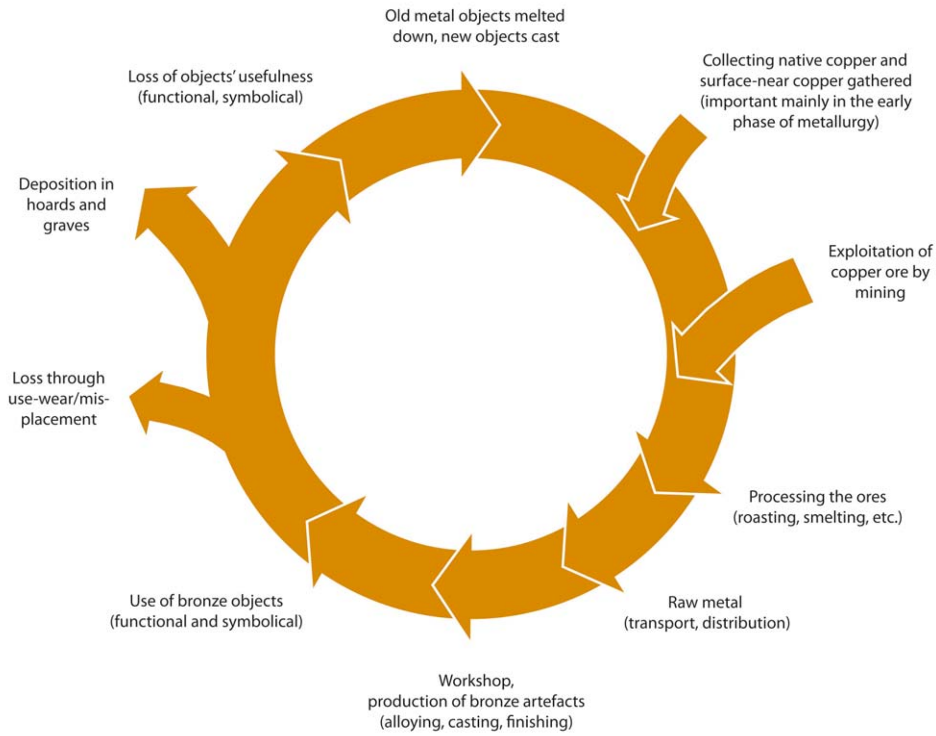

Fig. 2 Metallurgical cycle (graphics S. Hansen – A. Reuter).

sumption at the beginning of the 5th millennium BC can be explained. What was the motivation for these activities?

To a certain extent the answer is quite simple. The career of metal is built upon its practical advantages, which were evident from the very beginning when this material was used. It was possible to recast the metal, one of the two main practical benefits. It can be considered the first 'recycled' material. Every broken axe could be melted down and a new one could be cast (Fig. 2). With the recasting and production of a new object, a new technological property entered the world, and this is the second reason for the success of metals. Metal was the first material that could never be exhausted. It could be used and reused again and again for recasting without any serious loss of substance. This property had enormous economical and social consequences. Unlike stone, metal could be amassed in a useful way. It could be utilised for different purposes, and it was adaptable. According to necessity, ornaments could be melted down to make swords or axes for bracelets. Everything could be reused, and normally it was reused.

In a wider geographical perspective it is true that, in general, metal was neither the precondition for the rise of complex societies nor was metal production always linked to control by ruling institutions. However, in western Eurasia metal played an important role in the emergence of hierarchical societies. We may identify aspects or fields, in which this new material played an important role from the beginning. Each of them had many consequences.

I would like to emphasise the mental, intellectual or even philosophical consequences. Nevertheless, exploring the enormous technical and social opportunities offered by metal technology can be seen as a challenge to the thinking process. Nothing is known about how people in the Neolithic period perceived their world. The widespread attempt to enter the Neolithic world of ideas mostly projects the modern way of thinking onto the past. Nonetheless, I would assume that a new material with so many outstanding properties had consequences in nearly every sphere of perception.

The reality of recycling a substance that could never be exhausted was probably connected with the idea of partaking in these qualities. Copper could be infinitely amassed. As the owner of the metal, one could benefit from these properties. The immortality of the powerful person was an obsessive idea in Bronze Age Egypt and perhaps prior to that time as well. Excess and immoderateness (*Maßlosigkeit und Unmäßigkeit*), which K. Marx[8] connected with money is already visible in grave 43 in Varna with more than one kilogram of gold.

In the 5th millennium the stone and antler weapons were quickly replaced by metal forms, which had a lot of practical advantages (Fig. 3). It was possible to increase the size of weapons, an attribute that was restricted in stone. This is true especially for all dagger varieties. This revolution in weapon technology was one of the crucial advantages of the new material. At the end of the 4th millennium metal workers were able to produce swords with sharp cutting edges; this technology was in use until the introduction of the gunpowder 5500 years later. I shall return to this point below.

A second complex of innovations (Fig. 1) can be dated to the 4th millennium, specifically the second half of the 4th millennium, an innovative period with new metals, new weapons, as well as the woolly sheep, the wheel and the wagon, and the domestication of the horse. In the Near East writing and urbanisation changed the way of life.

Perhaps the most interesting transformation in Europe took place in the centuries between 3500 and 2900 BC. After the basic technologies, pottery production, house building, etc. of the Neolithic, in the second half of the 4th millennium further key technologies were introduced. This is primarily the period of Childe's 'urban revolution', and partly overlaps with Sherratt's 'secondary products revolution'.

The transfer of knowledge and how these innovations were integrated into the old system is not so easy to elucidate. Each innovation had its own problem. For example, in the case of technical innovation we should reconstruct the process of production (*la chaîne opératoire*), and ask whether certain innovations require special skills and knowledge. Who is using the innovation? Who is profiting from the innovation, and how and by whom was it introduced? Which social or ideological implications were related to a certain innovation?

Fig. 3 Tools and weapons made of copper and bone/antler. Copper items from Varna on the left side, bone and antler items from Pietrele on the right side (drawings after Todorova 1982, photos: S. Hansen).

8 Marx 1964, 255.

Fig. 4 Ur, grave 779 (photo: S. Hansen).

All of these innovations spread over Europe in an idiosyncratic way, which means that they were not part of a 'package', but could be composed in different ways. The wheel and the wagon were introduced around 3500 BC in the area between Mesopotamia and the Atlantic. The domestication of horse and donkey in the late 4th and early 3rd millennia essentially transformed the perception of space and time. This form of domestication led to a revolution in warfare in the 3rd millennium, as can be seen in Ur (Fig. 4). The appearance of the woolly sheep was the starting point for the textile revolution of the 4th millennium: woollen textiles were one of the economic foundations of Mesopotamia.[9]

It was a truly significant technical innovation, indeed, when at the end of the 5th millennium BC at the latest and in the first half of the 4th millennium BC daggers were produced by casting. Thereby, arsenical copper (as much as 10% arsenic) was likely an essential element for this process,[10] through which the formation of bubbles during casting and, thus, flaws in the blade could be diminished. Flaws in massive axes could be disregarded, but they were quite a problem when present in daggers with thin blades. Namely, when a blade is sharpened, the bubbles are exposed, and show that the blade is still pitted and notched rather than smooth and sharp.

It is generally assumed that naturally occurring copper and arsenic ores originally derived from sulphidic ores. However, another proposal based on substantial arguments suggests that supplementary elements were intentionally added to copper for the purpose of changing the qualities of the material.[11] In several cases attention has been drawn to alloys or metal compositions that are specific to certain object types. For example, the halberd found in the cemetery at Sabbione (Italy) consists of copper with 4.5% arsenic. Two flanged axes, oppositely, are made of pure copper.[12] Hence, one is tempted to conclude that the metal craftsmen knowledgeably sought out different kinds of copper, and further, that the silvery sheen of arsenic bronze was chosen for daggers. In the meanwhile, it has been possible to analyse *Arsenspeiss*.[13] This enabled the reconstruction of the technical procedure used to regulate the amount of arsenic to be added to copper. Arsenical and antimony bronzes opened new paths in metal production, especially for weapons. Nevertheless, important technical advances were also made in other fields of metal technology. Large vessels made of copper or bronze were part of the grave goods in richly furnished Maikop kurgans (Fig. 5) in the 4th millennium BC already. The existence of such high quality products implies that they were in great demand; therefore, enabling the existence of craft specialisation, which was necessary for the production of such cauldrons.

Beside these technical innovations there is a bundle of social innovations, which belong to a new type of ruler, whom I shall call the 'hero', but whom one can also refer to as the 'king'. The idea of such a king is offered in the Gilgamesh epic, which leads us back to the beginning of the

9 Liverani 2006.
10 Vajsov 1993, 141 fig. 36
11 Lechtman 1996, 509.
12 Pearce 2007, 84–85.
13 Rehren et al. 2012.

Fig. 5 Nal'čik. Copper or bronze cauldron (photo: S. Hansen).

3rd millennium BC.[14] Before Gilgamesh and his friend Enkidu departed for the cedar forest they went to the smiths and amourers: "Great celts they cast and axes each weighing one-hundred and eighty pounds; great daggers they cast, one hundred and twenty pounds each blade weighed; thirty pounds the guard at the grip; thirty pounds of gold to decorate them. Gilgamesh and Enkidu each carried six hundred pounds".[15] With their new weapons Gilgamesh and Enkidu set off for the cedar forest in the west. There they slew the guardian of the forest, Humbaba, and cut down the valuable cedar trees, which they subsequently sent down the Euphrates River to Southern Mesopotamia: a striking example for the violent usurpation of valuable raw materials.

Such heroes are probably represented in the large steles, which were erected and distributed since the 4th millennium from the Caucasus Mountains to the Atlantic Ocean. They display weapons, sometimes in larger numbers, identical to those we can find in the rich graves (Fig. 6). It is astonishing that these steles extended from the Caucasus to the Atlantic.[16] A. Vierzig has prepared her PhD on these steles at the Free University in Berlin and gathered information about more than thousand steles from the literature. In the last years, a surprisingly great number of these steles could be identified in new excavations and in museum depositories.[17] These monuments continue to impressively stand out in the landscape (Fig. 7).

For the first time in history individuals were buried beneath large grave monuments (Fig. 8). It is astonishing to see similarities not only in the grave monument, the tumulus, but also in details related to burial rituals between the Adriatic coast and eastern Anatolia.[18]

At the end of the 4th millennium a new dispositive, both technical and social, was established for a few centuries or perhaps for millennia, like the states in the Near East. Viewed against this backdrop, it is an enigma that the role of western Anatolia in this process is not yet clear. It is simply not plausible that Anatolia merely stood on the margins during these dynamic centuries.

The excavations in Çukuriçi Höyük have offered an important contribution to our knowledge of metal work in the early 3rd millennium.[19] The finds show the incorporation in a wide-ranging network, which has been analysed in detail by B. Horejs, M. Mehofer and E. Pernicka. Likewise, recent excavations in Çamlıbel Tarlası have also shown that metallurgy was practised in small-

[14] George 1999.
[15] George 2003, 201.
[16] Casini 1994; Philippon 2002; Pedrotti 2007.
[17] E.g. Ciugudean 2011; Martínez Rodriguez 2011; Nadler 2011.
[18] Primas 1996.
[19] Horejs et al. 2010.

Fig. 6 Arco, Italy. Stele with representations of weapons (photo S. Hansen).

Fig. 7 Ginestous, France. Stele in the landscape (photo: S. Hansen).

Fig. 8 Nal'čik. The large kurgan and newly built houses (photo: I. M. Čečenov).

scale settlements as well.[20] Two awls with pyramidal shafts are interesting, because the shafting principle is well known in the second half of the 4th millennium around the Black Sea. A dagger fits well into the picture of dagger production in southeast Europe. Of special interest is a mould for casting ring-shaped idols, which are common in the Balkans during the 5th and early 4th millennia. A wire made of lead is remarkable, for it might indicate silver production. A lead fragment from a late Chalcolithic context in Pekmez Höyük near Aphrodisias was mentioned by T. Zimmermann in a 2005 publication.[21] In another paper, he argues for dating the small hoard from Beycesultan from layer 34 to the time span between 3500 and 3300 BC.[22]

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20 Schoop 2011.
21 Zimmermann 2005, 194.
22 Zimmermann 2005, 256.

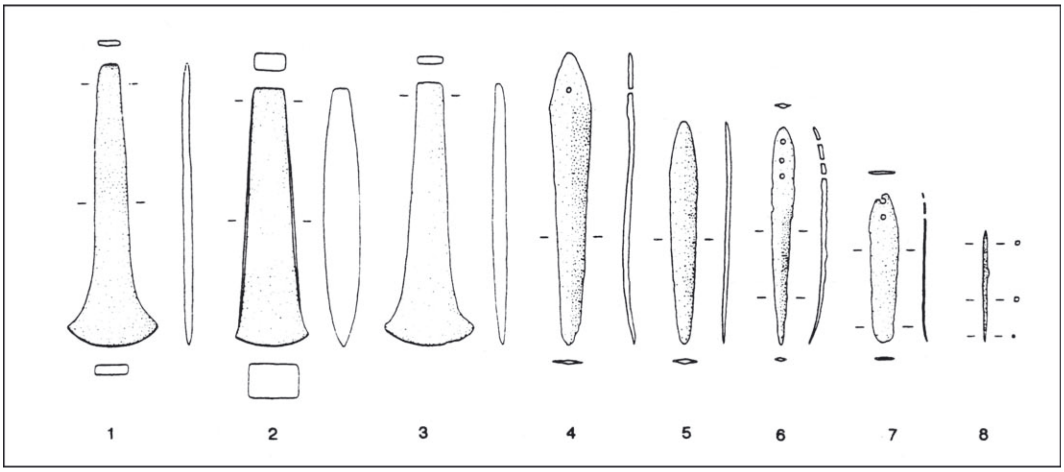

Fig. 9 Axes and daggers from Ilıpınar (after Roodenberg 2001).

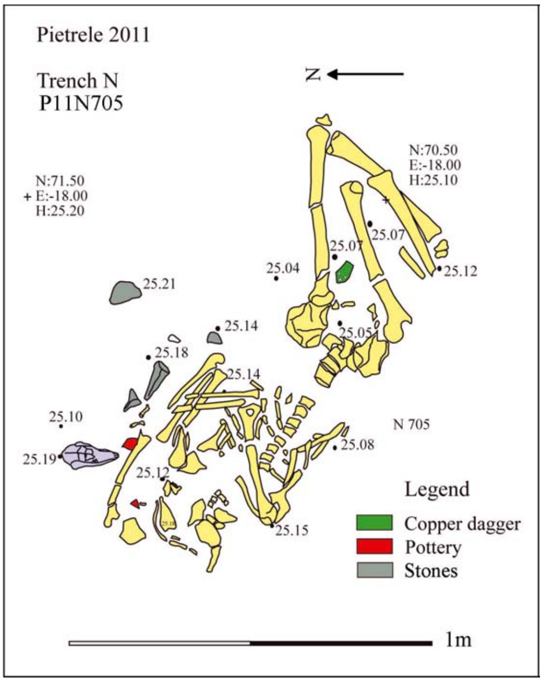

Fig. 10 Pietrele, inhumation grave (plan: M. Toderas).

Fig. 11 Pietrele, dagger (photo: S. Hansen).

The most impressive collection of late Chalcolithic metal objects (Fig. 9) was recovered from the cemetery of Ilıpınar.[23] Two of the flat axes fit well into an axe group that was distributed in the western Carpathian Basin and Italy. The daggers belong to a widespread type. In Pietrele on the Lower Danube (Romania), a grave with skeletal remains was uncovered in 2011 (Figs. 10–11). In addition to the human skull, a dog skull was also found. The dagger was twice folded and placed between the legs of the deceased. Typologically, the grave should be dated to the late 4th or early 3rd millennium BC.

23 Roodenberg 2001, 354, fig 3.

In all adjacent areas metallurgy played a prominent role: in the Balkans and Greece, in the Caucasus and the Near East. Considering the lack of evidence of the wheel and wagon in Anatolia, A. Sherratt wrote: "*Ihr Kleingläubigen, warum seid Ihr so furchtsam*? It is still one of the characteristics which distinguishes British from Germanic thinking in archaeology that a *Forschungslücke* is for them an obstacle, for us an opportunity. A gap in evidence is something a German archaeologist cannot cross. It is an insuperable barrier. For the British prehistorian, however, it is a challenge to the imagination, to extrapolate a plausible reconstruction from the nearest kind of evidence available, and by the application of general principles".[24]

Fig. 12 Weapon and tools from the Marinskaya kurgan (after Kantorovič – Maslov 2008).

There is one geographic region, in which all the above mentioned innovations can be observed in the second half of the 4th millennium: the northern Caucasus. The famous grave in Maikop has been dated to the middle of the 4th millennium. Nearly all of the grave goods are without analogy. The comparative objects that have been quoted in previous literature are all much younger. In addition to the precious vessels and beads, a set of bronze tools was part of the funerary furnishings. One piece is quite significant: a hoe. Only a few comparisons from sites in the Caucasus, but also from Eridu and Susa are known. Indeed, even tools were widely distributed through trade networks.[25]

The younger phase of the Maikop culture, the Novosvobodnaia phase, is assigned to the second half of the 4th millennium. A number of 'elite'-burials is known from that time. A tool and weapon set (Fig. 12) is present in all of them, similar to those in the grave at Marinskaya.[26] Large vessels, golden ornaments and beads made of precious stones could also follow the deceased into the grave. Daggers were important and 60 cm long swords were now produced (Figs. 13–14), comparable to the sword from Klady.[27] It is worth mentioning that swords were also already used in Arslantepe during the last quarter of the 4th millennium.[28]

On the other hand, the shaft-hole axe played an important role, as well. Two such axes (Fig. 15) were found in the big kurgan at Nalčik.[29] It was an innovative weapon that was used until the Late Bronze Age. In the 2nd millennium BC, shaft-hole axes were distributed over a vast area, between the Near East and northern Italy. A small shaft-hole axe (Fig. 16) was deposited as an offering in the Sile River near Treviso in the Veneto.[30] Elsewhere I have argued that the archaeological

24 Sherratt 2003, 419.
25 Hansen 2009a; Hansen 2010.
26 Kantorovič – Maslov 2008.
27 Rezepkin 2000.
28 Frangipane 2004.
29 Čečenov 1973.
30 Carancini 1984, 197.

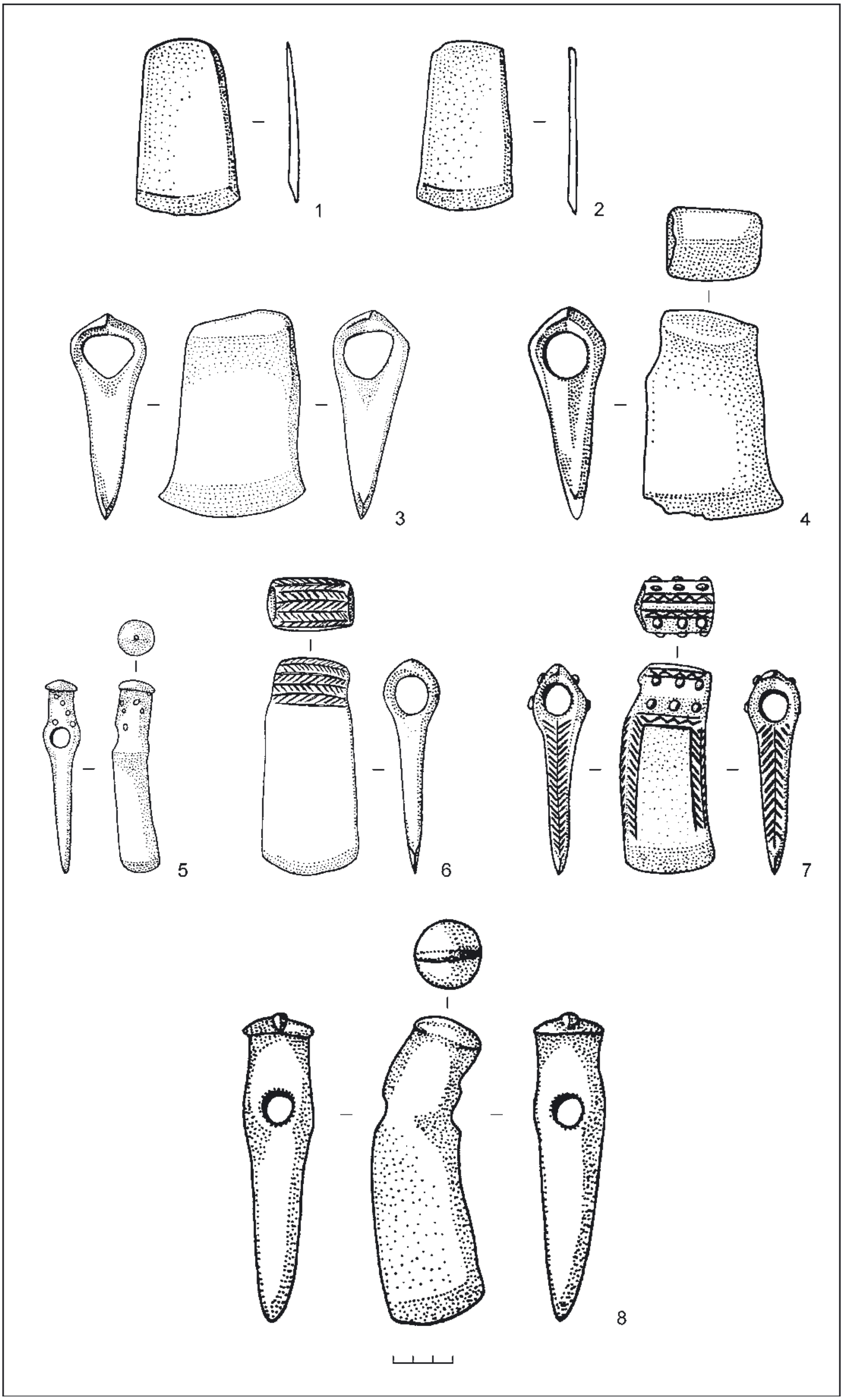

Fig. 13 Klady (after Rezepkin 2000).

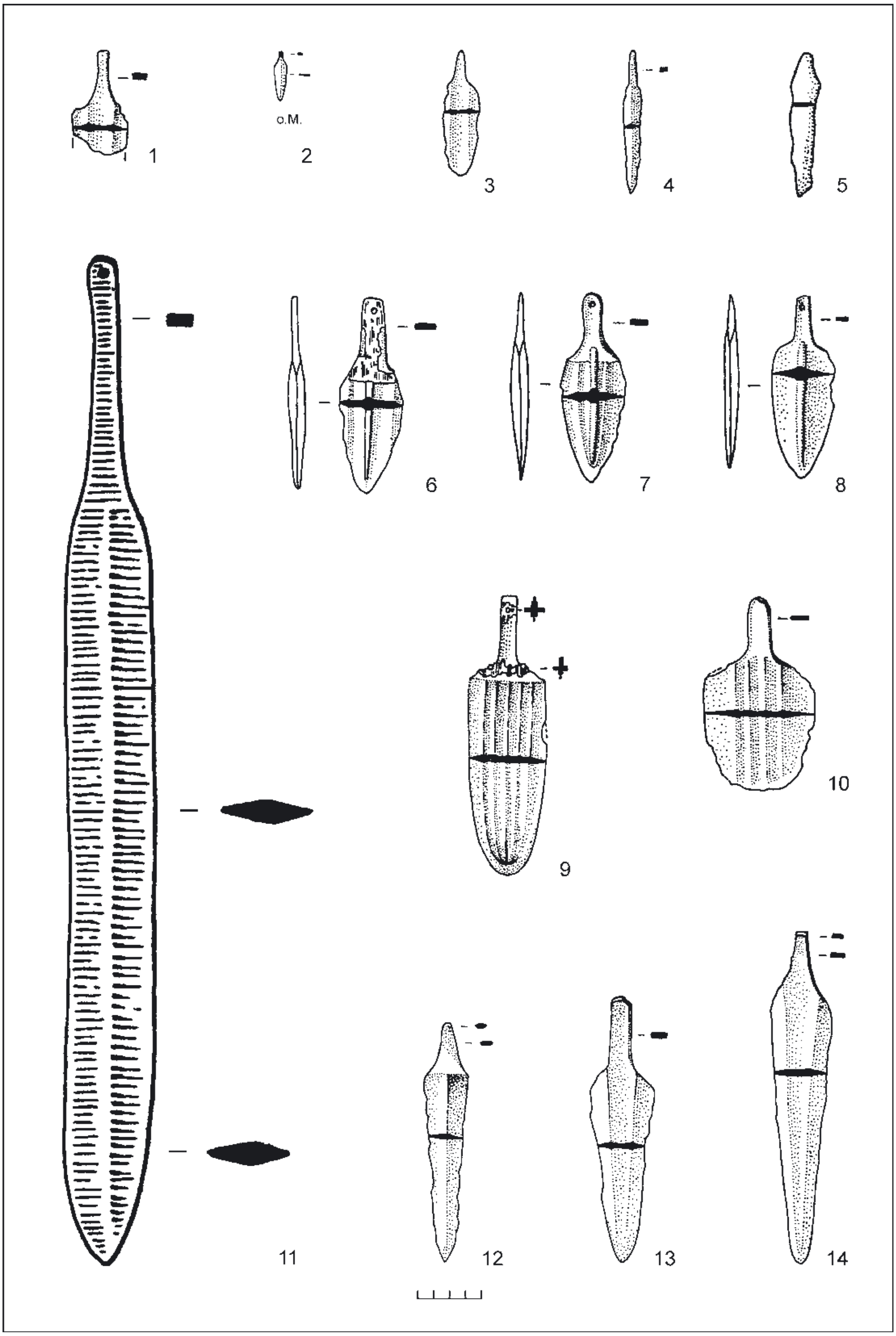

Fig. 14 Klady (after Rezepkin 2000).

Fig. 15 Nal’čik. Shafthole axes from the large kurgan (photo: S. Hansen).

Fig. 16 River Sile near Treviso (Museum Venice; photo: S. Hansen).

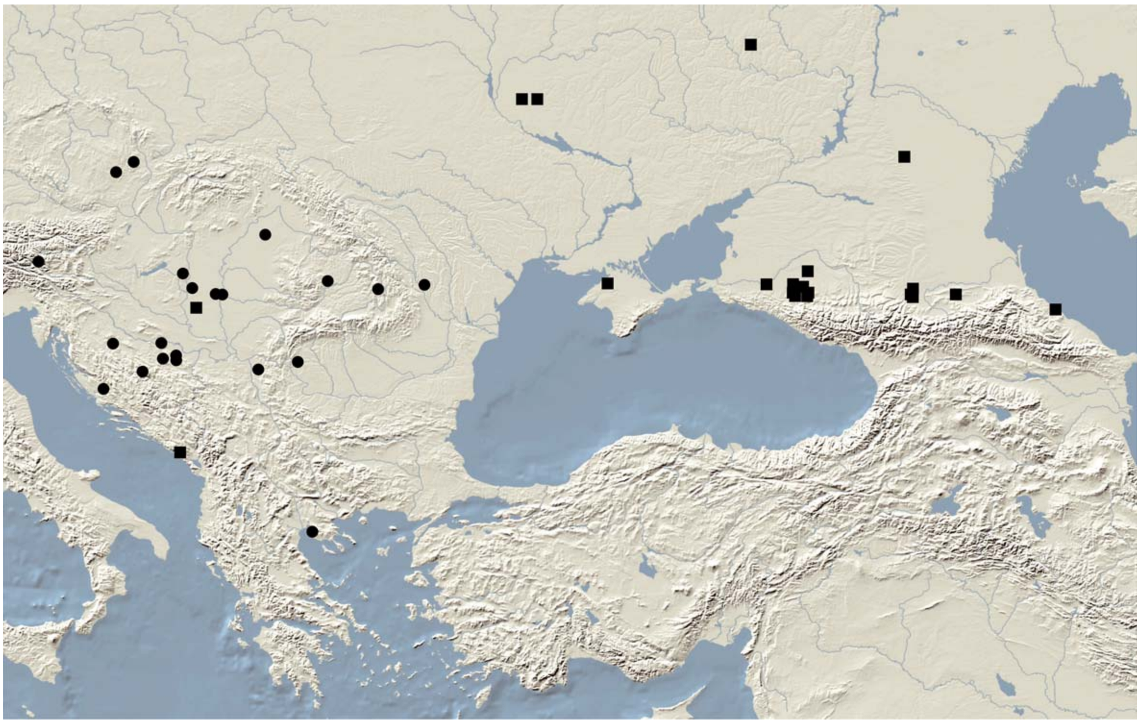

Fig. 17 Distribution of shafthole axes (modified after Bátora; published in Hansen 2009b).

detectability depends upon deposition practices.[31] Shaft-hole axes were used in the Caucasus and they are also known in the Carpathian basin since the late 4th or the early 3rd millennium BC. Yet, the deposition practice was different in both regions. In the Caucasus the axes were a component of the grave whereas in the Carpathians they became part of a hoard (Fig. 17). The largest hoard found in Vâlcele in Transylvania contained more than 40 axes, or perhaps as many as 55.[32] In regions that did not have comparable deposition practices, broken shaft-hole axes were melted down and the metal was reused for other objects. Moreover, the distribution map of clay moulds for shaft-hole axes also shows that their presence in the archaeological record depends upon depositional practices.[33]

Consequences

New weapons, foremost long, well cast daggers and shaft-hole axes rapidly became widespread. They were used by a new type of figure in society: the warrior, who shared a similar 'language' of representation, i.e. the mound over the single tomb containing lavish grave goods and the large stone stele. Sometimes even children and adolescents had to follow the dead potentate into the grave; thusly power was exerted upon the living.

The second half of the 4th millennium is one of the most earnest chapters in the history of mankind in the Near East and western Eurasia, a time characterised by an expansion of power unknown until then. The new forms of power were not simply the result of technological developments. New technical procedures were implemented by new positions of authority, and the

[31] Hansen 2009b.

[32] Soroceanu 2012, 109–111; Szeverényi 2013.

[33] Chernykh 1992, 54–60; Primas 2007, 14, fig. 24.

support and selection of new technical procedures were in the interest of power and remained connected with it.

This picture differs to some extent from the one that has been drawn until now based on ethnographic analogies. It is a tradition going back to the 19th century, which conceives that native societies of the 19th century in Africa, the South Pacific or South America illustrated the life and organisation of the Neolithic societies that existed 8000 years ago. Claude Lévi-Strauss speaks of 'Neolithic societies' when he describes the type of native societies without written language and mechanical assistance. For Lévi-Strauss, this master of differentiation indeed, these societies were the common denominator of humanity.[34]

Are native people really an illustration of our distant past? Since J. Lubbock and E. B. Tylor up to E. Service[35] and others, evolutionists were interested in the cultural development of societies. Moreover, they arrange societies into a certain order from 'primitive' to 'developed', from 'egalitarian' to 'ranked', etc. However, in actuality these 'developments' are not observable anywhere, because ethnological observations essentially only refer to the last couple of centuries. Therefore, considerations about the development of prehistoric political systems are based exclusively upon contemplations on plausibility, that is, how a development might have been. And therein lies their weakness, for they cannot explicate the transition from one to the other system. Thus, they argue with the alleged advantages of the respective 'more developed' systems, such as stability, which supposedly impelled a necessary development. Drawing from ethnological observations of different, but 'contemporary' types of social organisation on all five continents, evolutionists set up a seemingly logical sequence, which was altered to temporal succession (for example, the Melanesian 'big man' and the Polynesian 'chief').

Until now archaeology has attempted to balance the evaluation of its source material with anthropological schemes of the neo-evolutionist school (e.g. Service and others). Inevitably this has mostly led to the same result: prehistoric societies are generally assigned to the level of big man societies or chiefdoms, somewhere between Palaeolithic bands and ancient states. The seemingly plausible and unambiguous application of this scheme to the development of the Neolithic as well as the Bronze Age, however, arouses strong doubts as to its operative value. Obviously, societies developed in many and different ways during the 12,000 years after the end of the last Ice Age. Early forms of the state emerged in western Eurasia and in Egypt as early as the 4th millennium BC, while the population in Australia long maintained 'egalitarian' societies, well into the 20th century.

A way of looking at archaeological material should be developed that is free of cultural universalities. Namely, there are many ways – not just one – in which egalitarian societies develop into stratified societies. It is, therefore, advisable, at least when describing the formation of a ruling authority, to loosen the strong ties between archaeology and ethnology; for it is archaeology that observes long-term developments, whereas the actual temporal depth of ethnological studies is, by contrast, quite shallow.

Archaeology can trace the course of mankind's development in specific spaces and times and thereby name the discontinuities in history.

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[34] Lévi-Strauss 2012, 14.
[35] E.g. Service 1975.

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Troy, Baden Culture and Corded Ware – Correlations in the Balkan-Carpathian Region at the Turn of the 4th Millennium BC

Raiko Krauß[1]

Abstract: The 4th millennium BC in many ways is a time of change in southeastern Europe. After the discontinuation of tell-settlements in the Carpathian Basin and the eastern Balkan area one can see the formation of archaeologically less detectable settlement types nearly across the entire region. This may be interpreted as a reflection of a changing economy. Simultaneously, burial rites show a tradition whose roots lie as far back as the 5th millennium BC. Against the background of the changing settlement pattern, the transfer of technical innovations over wide areas of Europe is also noticeable – such as the use of the wheel and wagon, as well as a generally increased use of animal labour. Compared to the 5th millennium BC we find a significant decline in metal production, although in this period metal technology is beginning to spread over wide areas of Europe for the first time. This indicates that southeastern Europe lost its quasi-monopoly leadership in the production and use of metals. At the end of the 4th millennium, interrelated cultural groups emerge between the Carpathians and the northern Aegean Sea that can be described as Europe´s first Early Bronze Age culture. On the basis of new radiocarbon dates from a late Baden settlement in the west of present-day Romania, the interrelations between the late Copper Age in the Carpathian Basin, the appearance of the Early Bronze Age in the Aegean and the Final Neolithic in central Europe will be discussed.

Keywords: Balkan-Carpathian region, Final Neolithic, Early Bronze Age, Baden Culture, Corded Ware

The conceptualisation that Troy's ascension as a fortified city occurred parallel to the expansion of Corded Ware in the northeast of central Europe is quite recent indeed.[2] The chronometric dating revolution, facilitated by calibrated radiocarbon dating, made this acknowledgment possible. The links between the Aegean Early Bronze Age and the Corded Ware phenomenon remain unclear; this is due to the lack of finds from intermediary regions that would *directly* connect the two occurrences. Chronologically, the 'Baden' phenomenon occurs before Corded Ware and the commencement of the Early Bronze Age in the Aegean;[3] geographically, it is located between the two regions. In 1963, Nándor Kalicz attempted to create a direct relationship between the two areas.[4] A short time after, calibrated radiocarbon dates revealed that Baden Culture could not possibly be dated later than the Early Bronze Age in the Aegean but should be dated significantly earlier.[5] The thesis that the Baden phenomenon emerged from the migration of populations from northwestern Anatolia[6] was thus fundamentally refuted. This resulted in a flurry of research activity, which was aimed at elaborating an independent development for northwestern Anatolia and the Balkan-Carpathian region. On the basis of the latest findings, it is now time for a renewed discussion concerning these relationships.

A small, 15m^2-trench at Foeni-Gaz in the westernmost region of present-day Romania appeared, at first glance, to hold only unremarkable finds dating to the transition between the 4th and

1 Institute of Pre- and Protohistory and Mediaeval Archaeology, Eberhard Karls University, Tübingen, Germany; email: raiko.krauss@uni-tuebingen.de.
2 Korfmann – Kromer 1993; Furholt 2003; Kromer et al. 2003.
3 Stadler et al. 2001.
4 Kalicz 1963.
5 Neustupný 1973; Němejcová-Pavúková 1973; Němejcová-Pavúková 1974; Maran 1998; Sherratt 2003.
6 Kalicz 1963, 81–87.

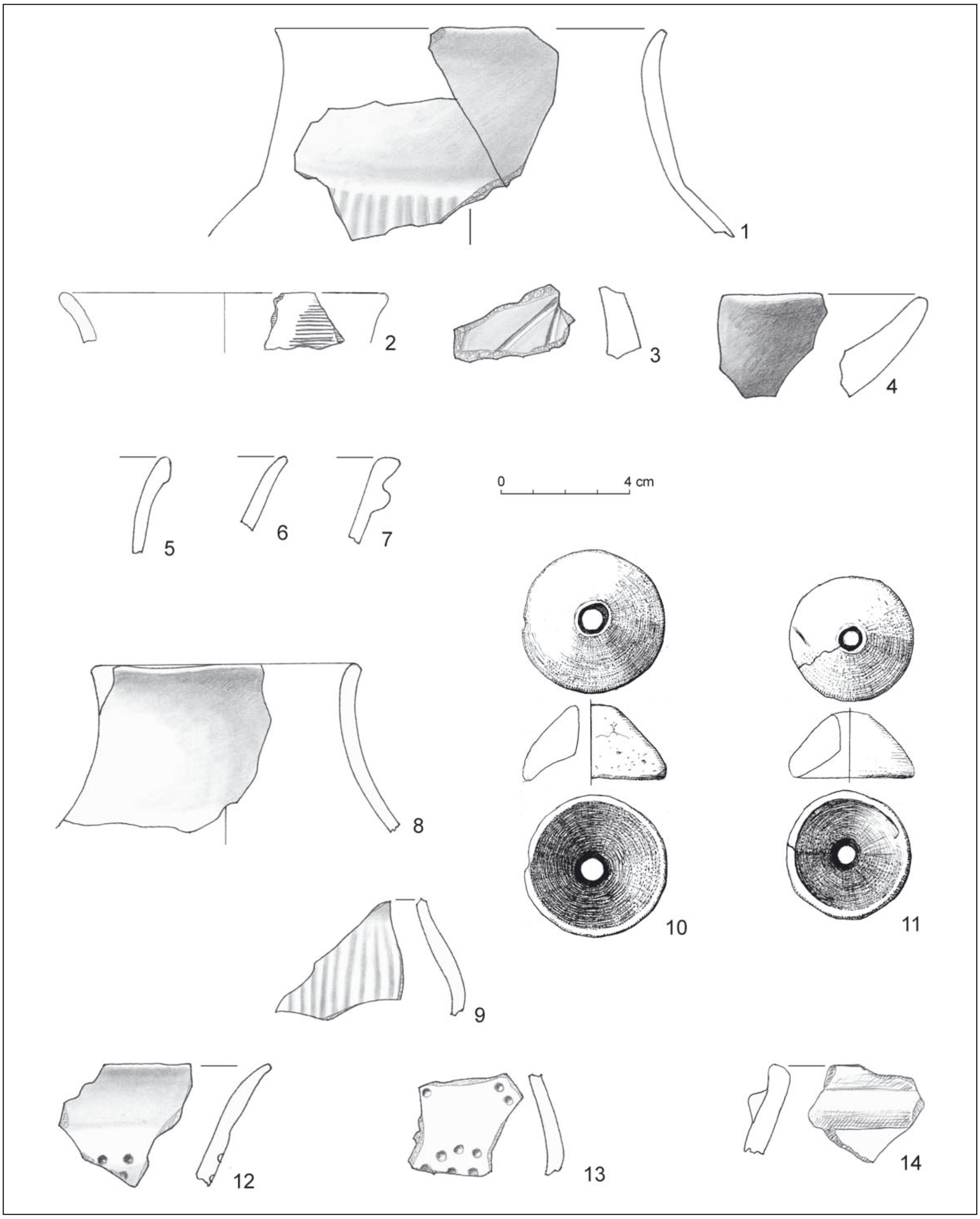

Fig. 1 Late Baden/Kostolac ceramic finds from features 3–5 in Foeni-Gaz, Romanian Banat.

3rd millennia BC. However, after careful evaluation, it is clear that this excavation sheds new light on the cultural relationships between northwestern Anatolia and the Carpathian Basin.[7]

[7] Krauß – Ciobotaru 2014.

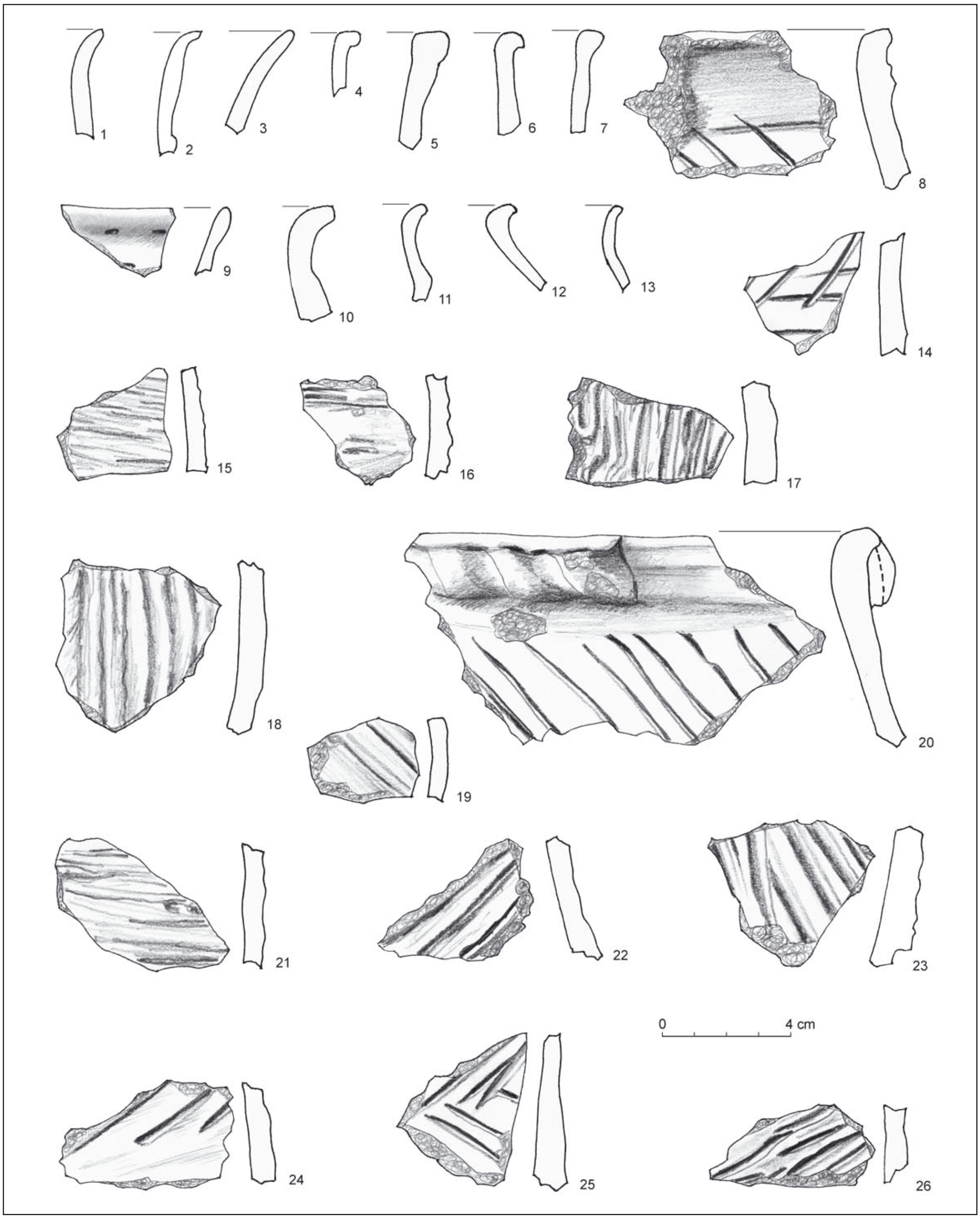

Fig. 2 Late Baden/Kostolac ceramic finds from features 3–5 in Foeni-Gaz, Romanian Banat.

Foeni lies in western Romania, between Timiş and the now canalised Bega River, approximately 45km southwest of Timişoara. In August 2009 the University of Tübingen, in cooperation with the Museum of Banat in Timişoara, carried out an archaeological survey just northwest of the locality adjacent to a modern gas plant (staţia de gaz). In a small area, a test trench revealed a complex find-situation. A habitation feature with material from the Baden Culture in its later variant, Kostolac, is of particular relevance to the topic of this volume. The feature is affected by ground intrusions, a roughly 5m-deep well shaft, beginning at the Early Bronze

Age level.[8] The well was ultimately filled in with material from the advanced Early Bronze Age of the Nagyrév Culture.[9]

Among the most significant pottery fragments from the Baden/Kostolac-habitation features 3–5 (Figs. 1–2) were several ceramic sherds with fluting. Other fragments show characteristic indentation- and scratch-ornamentation. Additionally, there are two conical spindle whorls, which also find their best parallels in the context of the Baden Culture. A decorative combination of indentation- and scratch-ornamentation is also seen on a fully-reconstructed large vessel, which can be grouped with an entire series of vessels from the Baden Culture (Fig. 3). In light of the clear typological parallels, ^{14}C-measurements on associated animal bones were quite surprising. The series consists of four AMS-dates from three cattle bones and one sheep bone, dating to the 28th to 26th centuries BC.

In the context of conventional dates for the Baden Culture, the dating of the habitation site at Foeni-Gaz is very late. The dendrochronological dating of Baden-Culture finds from Arbon-Bleiche 3 in the first half of the 34th century[10] pertains only to the Boleráz horizon from the *beginning* of the Baden development. The length of the 'Baden' phenomenon, particularly its *end*, has yet to be determined. Without overestimating the data from Foeni-Gaz, a comparison with other equally late-positioned, comparable finds reveals that dating the end of the Baden Culture to approximately 3000 calBC[11] can no longer be upheld.[12] In fact, it becomes apparent that the classical Baden horizon (Ossarn) extends into the 29th century. Accordingly, the late phase of Baden Culture in its southern variant Kostolac, and in its northern counterpart, the Bošáca variant, must date relatively later.[13] Thus, in the northern Carpathian Basin region, a temporal parallelism between late Baden Culture and the beginning of Corded Ware ensued.

There are now multiple data series from the northern region of the Carpathian Basin which, similar to the data from Foeni-Gaz, may be a continuation of the late variants of Baden Culture into the 26th century (Tab. 1).

The settlement of Bronocice, at the northern edge of the Beskids,[14] is considered the northernmost location and has a dated find with characteristic late Baden features. The Baden settlement there succeeds older layers from the Funnel Beaker Culture and begins at approximately 3200 calBC (layer IV). For the end of the Baden settlement in Bronocice (layer V), there exists a closed series of seven ^{14}C-dates, although admittedly, with quite a broad standard deviation of ±70 to ±140 yrs. Given the stratigraphic location of the dates within the series, however, the end can be narrowed down to the centuries between 2800–2400 calBC.[15] This late onset of the end of Baden is confirmed by a new data set from Balatonőszöd-Temetői dűlő.[16] Accordingly the *early* classical Baden begins around 3200 calBC and ends around 2900 calBC, roughly corresponding to the range proposed by Stadler et al.[17] of 3360–2930 calBC for the *entire* classical Baden. The new Hungarian dates, however, indicate a commencement at approx. 2900 calBC for the *later* development of classical Baden, which, after considering just the 1σ-intervals, extends to around 2690 calBC.[18] The 2σ-interval implies a date after 2600 calBC for the end of Baden. This longer duration for the Baden pottery style is also confirmed by a series of data from the burial site at Budakalász.[19] Con-

8 Krauß – Ciobotaru 2014, figs. 8–9.
9 Krauß – Ciobotaru 2014, pls. 5–26.
10 De Capitani et al. 2002, 209–216.
11 Cf. Maran 1998, 502; Schier 2010, 33.
12 As already stated by Forenbaher 1993, 246–247; Schwenzer 2005, 187–188.
13 Cf. Siklósi 2009, 462–465.
14 Kruk – Milisauskas 1990.
15 Kruk – Milisauskas 1990, 223–227.
16 Horváth et al. 2008.
17 Stadler et al. 2001.
18 Horváth et al. 2008, fig. 4.
19 Bondár – Raczky 2009.

sequently, the older graves with proto-Boleráz- and Boleráz-inventories belong with 2σ-intervals, within the 3640–3370 calBC time span. Graves with grave goods from classical Baden Culture chronologically fall with an interval of 3350–2880 calBC.[20] Significantly, late Baden – or Kostolac – finds do not appear in Budakalász. Corresponding to the data from Balatonőszöd-Temetői dűlő, and also from Foeni-Gaz, the late period appears to begin in the 29th century and ends by the 27th or perhaps the 26th century BC. As such, the 'Baden phenomenon', exists parallel with late Horgen, Cham and late Bernburg, as well as with the Globular Amphora Culture and the first appearance of Corded Ware. Indeed, the succession of Baden and Corded Ware has been determined for the area of southwestern Germany and Switzerland.[21] This may, however, be related to the fact that the later groups from the Baden Culture were not more widespread in the west.[22][23][24]

Fig. 3 Late Baden/Kostolac amphora from Foeni-Gaz, Romanian Banat; height 28.8cm.

20 Siklósi 2009, 462–465.
21 Maran 1998, 501–502.
22 Krauß – Ciobotaru 2014.
23 Kruk – Milisauskas 1990.
24 Horváth et al. 2008.

Site/Reference		Lab-Code	Context	Material (species)	^{14}C-Age [BP]	^{13}C [‰PDB]	Phase
Foeni-Gaz[22]	1	Hd-29516	Feature 5	bone (bos)	4017 ± 48	–21,2	Bad./Kostolac
	2	MAMS-10893b	Feature 3	bone (bos)	4126 ± 26	–27,2	Bad./Kostolac
	3	MAMS-10893a	Feature 3	bone (bos)	4133 ± 25	–20.2	Bad./Kostolac
	4	MAMS-11203	Feature 3	bone (ovis)	4214 ± 27	–17.3	Bad./Kostolac
Bronocice[23]	1	DIC-1792	3-B4	charcoal	4080 ± 110	n.d.	V (Baden)
	2	DIC-1740	10-B5	charcoal	4080 ± 65	n.d.	V (Baden)
	3	DIC-1795	4-B3	charcoal	4090 ± 140	n.d.	V (Baden)
	4	DIC-979	8-B7	charcoal	4200 ± 60	n.d.	V (Baden)
	5	DIC-978	1-A5	charcoal	4250 ± 115	n.d.	V (Baden)
	6	DIC-1794	6-B8	charcoal	4260 ± 70	n.d.	V (Baden)
	7	DIC-543	2-B2	charcoal	4320 ± 130	n.d.	V (Baden)
	8	DIC-361	39-B1	charcoal	4240 ± 115	n.d.	IV/V (Baden)
	9	DIC-977	1-B8	charcoal	4320 ± 55	n.d.	IV (Baden)
	10	DIC-1736	56-A1	charcoal	4330 ± 60	n.d.	IV (Baden)
	11	DIC-1797	6-B2	charcoal	4340 ± 70	n.d.	IV (Baden)
	12	DIC-1739	95-B1	charcoal	4340 ± 75	n.d.	IV (Baden)
	13	DIC-541	54-B1	charcoal	4440 ± 80	n.d.	IV (Baden)
	14	DIC-717	29-A3	charcoal	4440 ± 80	n.d.	IV (Baden)
Balatonőszöd-	1	Deb-13381	pit 2689	animal bone	4110 ± 50	–19.3	EC-Baden
Temetői dűlő[24]	2	Deb-13389	grave 37, pit 1489	human bone	4200 ± 35	–19.2	EC-Baden
	3	Deb-13245	grave 50, pit 2019	human bone	4220 ± 50	–19.7	EC-Baden
	4	Deb-13387	pit 426	charcoal	4310 ± 50	–24.5	EC-Baden
	5	Deb-13386	pit 2596	animal bone	4330 ± 35	–19.4	EC-Baden
	6	Deb-13382	pits 1072-1096	animal bone	4360 ± 45	–20.2	EC-Baden
	7	Deb-13292	grave 67, pit 426	human bone	4380 ± 45	–19.7	EC-Baden
	8	Deb-13374	pit 1036	animal bone	4390 ± 60	–19.9	EC-Baden
	9	Deb-13244	pit 203	bone (bos)	4440 ± 60	–20.3	Boleráz
	10	Deb-13412	pit 1612	bone (canis)	4440 ± 70	–19.9	Boleráz
	11	Deb-13286	grave 79, pit 2635	human bone	4440 ± 45	–19.4	Boleráz
	12	Deb-13411	pit 2060	animal bone	4445 ± 45	–19.5	Boleráz
	13	Deb-13395	grave 74, pit 2614	animal bone	4460 ± 50	–20.3	Boleráz
	14	Deb-13379	well 1, pit 1099	human bone	4480 ± 70	–20.6	Boleráz
	15	Deb-13277	grave 23, pit 426	n.d.	4520 ± 60	–19.9	Boleráz
	16	Deb-13291	pits 2327-2346	animal bone	4550 ± 80	–20.4	Boleráz
	17	Deb-13398	pit 2581	animal bone	4680 ± 45	–20.9	Boleráz
Budakalász[4]	1	VERA-3544	grave 158	human bone	4170 ± 40	–22.6	Boleráz/Baden
	2	VERA-3545	grave 174	human bone	4215 ± 40	–21.7	Boleráz/Baden
	3	VERA-3543	grave 75	human bone	4295 ± 40	–19.8	Boleráz/Baden
	4	VERA-3549	grave 378	human bone	4340 ± 35	–19.6	Boleráz/Baden
	5	VERA-4376	grave 19	human bone	4370 ± 35	–20.1	Boleráz/Baden
	6	VERA-3547	grave 182b	human bone	4375 ± 35	–18.7	Boleráz/Baden
	7	VERA-4381	grave 383	human bone	4400 ± 40	–20.5	Boleráz/Baden
	8	VERA-4375	grave 13a	human bone	4420 ± 35	–21.6	Boleráz/Baden
	9	VERA-4379	grave 252	human bone	4440 ± 40	–23.1	Boleráz/Baden
	10	VERA-3548	grave 182c	human bone	4445 ± 35	–21.5	Boleráz/Baden
	11	VERA-3546	grave 182a	human bone	4455 ± 30	–20.8	Boleráz/Baden
	12	VERA-4377	grave 142b	human bone	4460 ± 40	–22.3	Boleráz/Baden
	13	VERA-4378	grave 230	human bone	4465 ± 40	–22.9	Boleráz/Baden
	14	VERA-4382	grave 403	human bone	4510 ± 35	–21.0	Boleráz/Baden

Tab. 1 New radiocarbon dates (and older ones from Bronocice) for the Baden-Culture in the Carpathian basin (EC=Early Classical).

In the northwestern Carpathian Basin region, in particular, signs pointing to a symbiotic relationship between Late Baden and Corded Ware can be found. For instance, the older find horizon of the Moravian Bošáca group is still clearly in the Baden tradition.[25] Typological correlations are found in the fluting and in the composition of the borders created by pin-pricks that ornate the vessels in the Baden tradition.[26] A boundary line, between the late Baden groups of the Carpathian Basin and the early distribution area of Corded Ware in Moravia and eastern Austria, remains, in any case, difficult to determine. Of notable importance, several early beakers, from Franzhausen-Mitte and Inzersdorf in the Traisen Valley, for instance, also show an *impresso* motif in the Baden tradition rather than the later, customary cording.[27] In the northern Carpathian region, it is the Chłopice-Veselé group, which follows Bošáca that first shows clear relations to the Corded Ware.[28]

With the expansion of the Chłopice-Veselé group throughout the Eastern Moravian-Western Slovakian region to the Danube,[29] the Corded-Ware phenomenon achieved its southernmost point within the Carpathian Basin after 2600 calBC.[30] Only after the encroachment of the Bell-Beaker phenomenon in the Carpathian Basin, in the 26th/25th century, do Baden pottery elements become undetectable within this 'refuge'. In its place, a new element appears which coexists alongside the Corded Ware, Globular Amphora and late Vučedol pottery. This new addition is subsumed under the collective terms Makó/Kosihý-Čaka[31] and Somogyvár-Vinkovci.[32]

While the framework for the end of Baden in the Carpathian Region in the 27th, or even the 26th century is significantly important, the historically much-discussed research topic of Baden Culture's relationship to the south is also of great interest.[33] In retrospect, a clear parallel emerges between its youngest occurrence and the older settlement layers of Troy, specifically with phases Troy Ia to If (Fig. 4). The development of Baden Culture begins, indeed, a little earlier, but subsequently runs parallel to the settlement activity of the entire Early Bronze Age settlement of Ezero in the Thracian plain.[34] This phenomenon was determined 30 years ago by Němejcová-Pavúková on the basis of typological comparisons and ^{14}C-data available at the time.[35] Within the Ezero sequence, the 29th and 28th centuries correspond to the Mihalič phase.[36] In the lower reaches of the Danube, the last offshoots of the Copper-Age tell-cultures in the Balkan region end with Cernavodă III. Whereas isolated tell-settlements from the 4th millennium have been verified on the Romanian bank of the Danube (e.g. Cernavodă itself, as well as Hîrşova and Gumelniţa), south of the river, in Bulgaria, only single-phase settlements (e.g. Pevec, Hotnica-Vodopada, Galatin and many others) have been verified. Parallel to the Baden Culture in the middle Danube region, in the southern Carpathian area the Coţofeni Culture developed out of this substrate. The stylistic transitions from Coţofeni to late Baden- and Kostolac-pottery are, indeed, blurred here as well.[37] Moreover, with regards to burial customs and settlements, Coţofeni appears as heterogeneous as the Baden phenomenon. The characteristic burial mounds first show up in the western Black Sea region and along the lower Danube

25 Pavelčík 1981.
26 Pavelčík 1981, pls. I–II.
27 Neugebauer – Neugebauer 1992, figs. 1.3; 6.9.
28 Machnik 1981; Pavúk 1981.
29 Pavúk 1981, fig. 5.
30 Furholt 2003, 136.
31 Bertemes – Heyd 2002.
32 Kalicz-Schreiber – Kalicz 1998.
33 Cf. Kalicz 1963; Neustupný 1973; Němejcová-Pavúková 1973; Němejcová-Pavúková 1974; Maran 1998; Sherratt 2003.
34 Georgiev et al. 1979.
35 Němejcová-Pavúková 1981, 268–282; figs. 16–17.
36 Bojadžiev 1998, 357–358.
37 Roman – Németi 1978, 49–55.

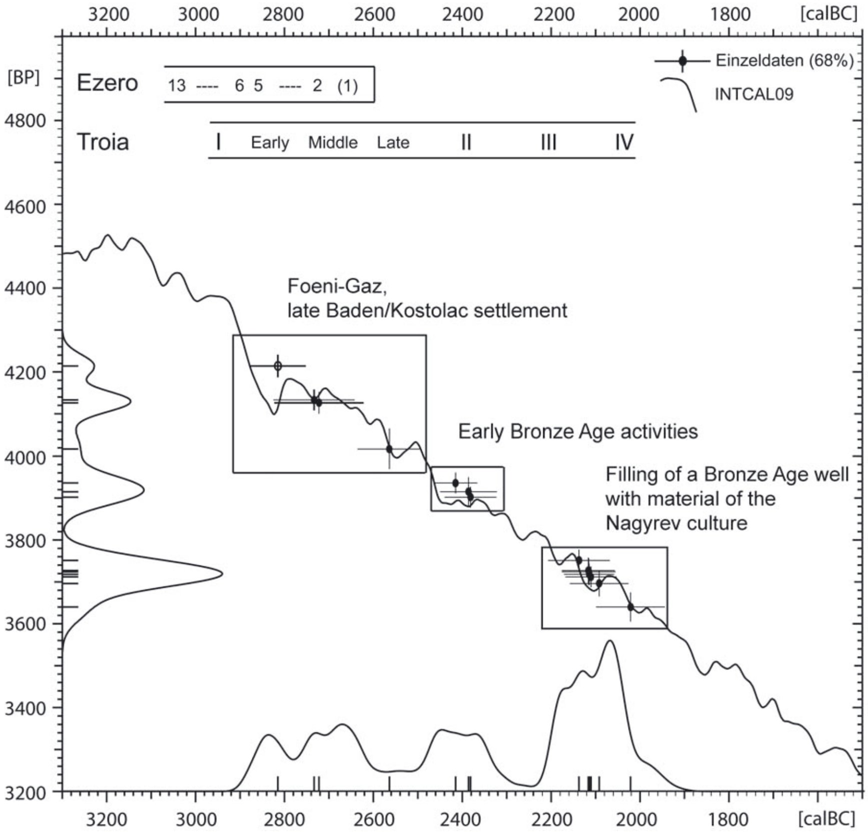

Fig. 4 Calibration of radiocarbon dates from Foeni-Gaz on IntCal 09. The Ezero and Troy sequences are depicted above (graph: Bernhard Weninger, Cologne [according to Krauß – Ciobotaru 2014]).

and expand into the Tisza region beginning with the Pit Grave Culture, whose influence moved westward from the north Pontic steppe zone.[38]

In the second half of the 4th millennium, in the central Balkan region, the north-south flowing river systems in particular, emerged as important communication zones between the north Aegean and the Carpathian Basin. The spread of Bratislava-type dishes were evaluated as evidence associated with this connection by Němejcová-Pavúkova[39] and later by Maran.[40] Likewise, Maran has also suggests a general relationship between the north Aegean and the Carpathian region based on the fluted pottery.[41] Fluted pottery appears along the lower Danube with the *Scheibenhenkel*-horizon in the 4th millennium[42] – during the so-called transition period, according to Bulgarian-Romanian terminology. We see here, however, a clear border between an older horizon in the tradition of the 5th millennium, with horizontally-fluted vessels and isolated incidents of graphite ornamentation, and sites that were chronologically, but also typologically related to the Baden Culture of the second half of the 4th millennium. The first chronological unit was named by Ivan Vajsov 'Post-Eneolithic', the second 'Proto-Bronze Age' (Fig. 5).[43] The finds

38 Kalicz 1989, 126–131.
39 Němejcová-Pavúkova 1981, figs. 12, 14.
40 Maran 1998, figs. 5–6.
41 Maran 1998, 503–508.
42 Cf. Georgieva 1993.
43 Vajsov 2002.

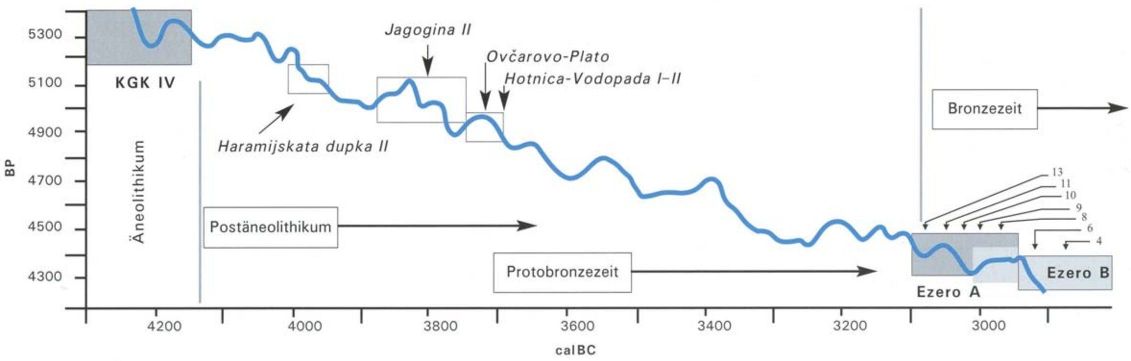

Fig. 5 Chronological scheme for the so called transition period from Eneolithic to Early Bronze Age in Bulgaria (Vajsov 2002).

from Hotnica-Vodopada,[44] Teliš IV[45] and Koprivec,[46] as well as Cernavodă I and III,[47] belong to the first chronological unit. There are also some findings from Drama-Merdžumekja in Thrace, which are connected with Cernavodă III.[48] The finds previously published by Maran[49] from the Kovačevo and Dăbene settlements belong to the second period ('Proto-Bronze Age' according to Vajsov), which is related to Baden Culture. The materials from Vaksevo VII,[50] Galatin-Čukata,[51] Sălcuţa IV, as well as some of the materials from Ostrovul Corbului and the Peştera Hoţilor at Băile Herculane,[52] can be added to this group. The geographic distribution of the sites suggests a network of relations between the Baden fluted pottery of the Carpathian Basin and the sites with such pottery collated by Maran in the North Aegean. The fluted fragments from Foeni-Gaz (Figs. 1.1; 10) can be coalesced with these other finds, to buttress this view.

Regarding the chronological relationships across the Balkans as far as Sitagroi, and thereby to material from the north Aegean, we can identify clear links between the Early Bronze Age materials from Junacite (EBA III following Bulgarian terminology), phase II of the Tei-Culture in Muntenia,[53] and Sitagroi Vb. These assemblages all feature cups with pointed bases, *Kantharoi*, and conical cups.[54] The links between Muntenia and Thrace via the northern Bulgarian Danube lowlands have already been discussed elsewhere.[55] A parallelisation of Sitagroi Va with classical Vučedol Culture is already established, particularly on the basis of bowls with incised decoration around the rim,[56] thus providing evidence for relations between the Slavonic-Syrmian region and Greek Macedonia. In light of the persistence and longer duration of Baden pottery traditions in the Carpathian Basin, and in line with earlier conclusions by Fohrenbacher[57] and Schwenzer,[58] we also now posit a correlation between Sitagroi IV and *Late* – though not already

44 Ilčeva 2009, pls. 23–51.
45 Gergov 1992, figs. 6–7; Stefanova 2002.
46 Nikolova 2001, fig. 1.
47 Roman 1977.
48 Lichardus – Iliev 2001, pls. 12–13.
49 Maran 1998, fig. 3.
50 Čochadžiev 2001, figs. 83–87.
51 Georgieva 1987, fig. 2.
52 Roman 1971, figs. 3–5, 7–8, 29–32.
53 Cf. Leachu 1966, fig. 19; Nikolova 1999, fig. 4.1–2.
54 Sherratt 1986, fig. 13.20, 24, 27.3.
55 Krauß 2006.
56 Maran 1998, 340–343.
57 Fohrenbacher 1993, 46.
58 Schwenzer 2005, 188.

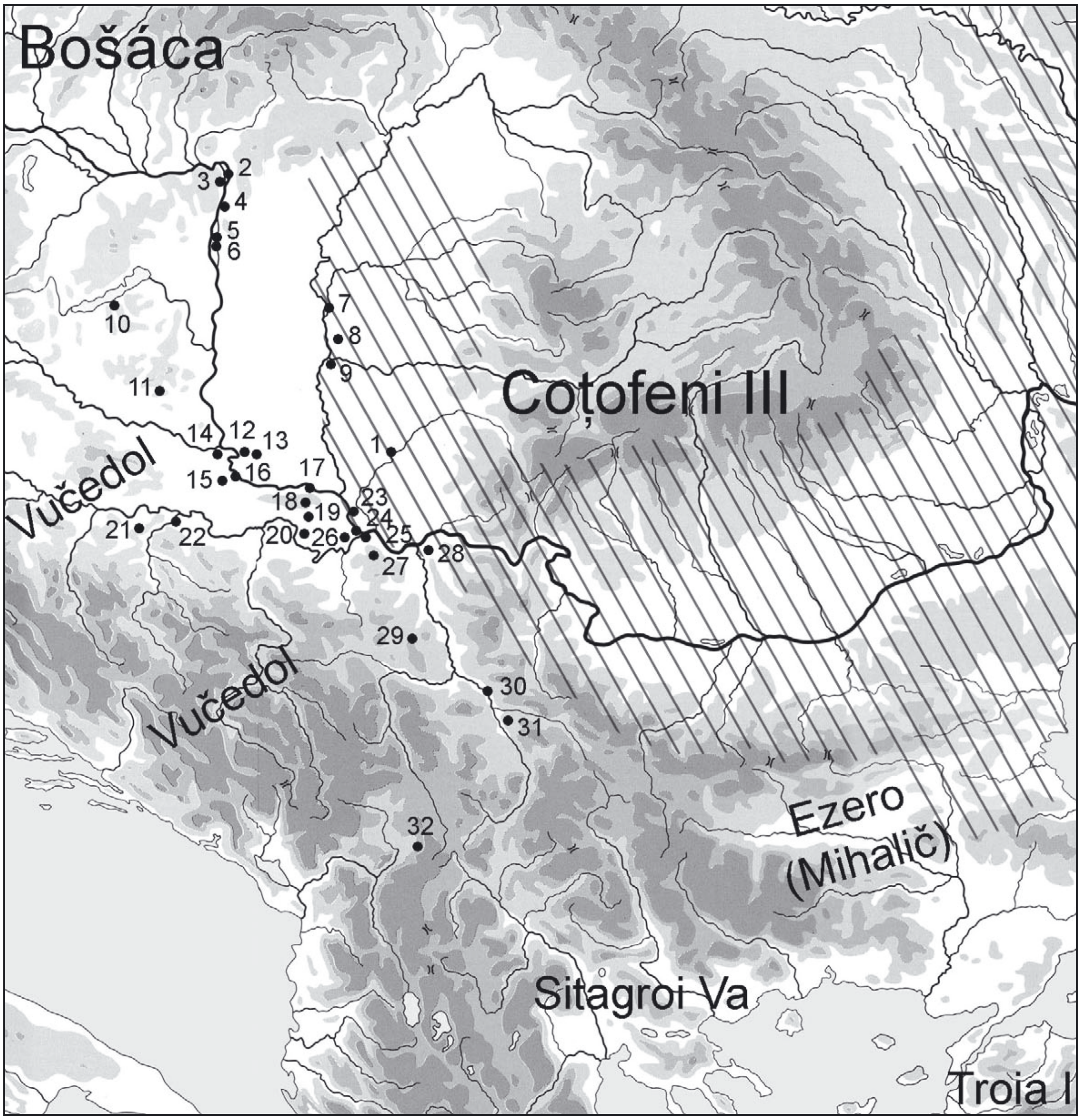

Fig. 6 SE-Europe at the turn from the 4th to the 3rd millenium BC. Sites of Late Baden and Kostolac cultures (after Tasić 1979, 241, map 5; Horváth et al. 2008; Furholt 2009, 203 with additions). Hatched areas depict the region with burial mounds (after Kalicz 1989, fig. 3). 1. Foeni-Gaz; 2. Szigetmonostor; 3. Szentendere; 4. Békásmegyer; 5. Budapest-Tabán; 6. Szigetcsép-Tangazdaság; 7. Szentes; 8. Hódmezövásárhely; 9. Deszk; 10. Balatonőszöd; 11. Pécs-Vasas; 12. Bogojevo; 13. Odžaci; 14. Sarvaš; 15. Cerić; 16. Vučedol; 17. Petrovaradin; 18. Vrdnik-Pećine; 19. Ruma; 20. Gomolava; 21. Vis kod Dervente; 22. Pivnica kod Odžaka; 23. Belegiš-Šančine; 24. Zemun; 25. Belgrad-Kalemegdan; 26. Dobanovci-Ciglana; 27. Šuplja stena-Avala; 28. Kostolac; 29. Korićane; 30. Jelenac-Aleksinac; 31. Bubanj; 32. Hisar-Suva Reka.

with *Classical* – Baden.[59] Following the reevaluation of presently available ^{14}C-ages, we know that Sitagroi IV can be narrowed down to the centuries between 3550 and 2650 calBC[60] or more precisely to 3110–2650 calBC.[61] Therefore, data for Sitagroi IV tend to be slightly older than dates from Foeni-Gaz. The data from the Late Baden/Kostolac settlement feature, between 2800

59 Cf. Parzinger 1993, 267; Maran 1998, 344–345.
60 Stadler et al. 2001; Wild et al. 2001.
61 Schwenzer 2005, 186.

and 2600 calBC, indicate a correlation with Sitagroi Va. Consequently, an even longer duration for Late Baden, spanning into Sitagroi IV–Va must be presumed. A synthesis of the relationships discussed here, in conjunction with the available data, advances the idea that Late Baden material synchronises with Vučedol, Mihalič, Sitagroi Va and Troy I (Fig. 6).

Notably, the search for typological equivalents of our material within this horizon was halted due to methodological limitations. Nevertheless, large bulbous vessels with lateral, short strap handles (*Bandhenkel*), which are characteristic for Sitagroi Va,[62] seem comparable to the large amphorae from Foeni-Gaz (Fig. 3). Furthermore, a similar pricked decorative motif, found on various fragments of this vessel, is also encountered in Ezero IV (Mihalič phase).[63] However, convincing parallels indicating a regular exchange of goods and ideas between the Aegean north coast, the Balkans and the Carpathian Basin, are not so readily identifiable. Instead, archaeological material assemblages are more indicative of a pronounced regionalisation. This insight might explain why chronological relationships between the aforementioned cultural spheres were not identified prior to the more intensive study of calibrated radiocarbon ages.

In conclusion, I would like to emphasise that a direct typological comparison between the late occurrence of Baden Culture and the Aegean-Thracian Early Bronze Age remains problematic. The connection postulated by Kálicz in the 1960s, between early classical Baden Culture and Troy II and III by way of anthropomorphic vessels, cannot be established chronologically. This occurrence may be an incident of coincidental and converging appearances, because layers Troy II and III date between 2500–2180 calBC,[64] and the Baden face urns remain limited to the final years of the 4th millennium. Nevertheless, the ^{14}C-data indicate that the entire Ezero Culture in Thrace can be considered parallel to the Baden phenomenon. Furthermore, the beginning of the settlement of Troy I also overlaps with the end of Baden Culture – and does so over a period of at least 300 years, specifically, from the 30th – 27th centuries BC. This findings should be reason enough to restore, to a certain extent, Nándor Kalicz’s standing and to reconsider the relationship between the Aegean Early Bronze Age and the Late Copper Age in the Carpathian Basin.

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[62] Sherratt 1986, fig. 13.18.2, 19.
[63] Georgiev et al. 1979, fig. 156.
[64] Korfmann – Kromer 1993; Kromer et al. 2003.

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Formation or Transformation? The 4th Millennium BC in the Aegean and the Balkans

Zoï Tsirtsoni[1]

Abstract: Fortified settlements, rich, organised necropoleis and elaborate metalworking, which traditionally mark the start of Early Bronze Age, appear in western Anatolia at the end of the 4th millennium BC as new occurrences. However, in the Aegean and the Balkans, these features were already present, to different degrees, during the 5th millennium BC, and frequently at those very same areas (and even at the same settlements) where they reappeared little before 3000 BC. Therefore, the question is advanced here in a quite different way than in Anatolia: rather than speaking about 'formation', we could speak about 'transformation'. But how do societies pass from one socio-economic order to the next? Is there a critical point in this transformative process, and if yes, where should this be situated? At the end of the 5th millennium BC, when most of the settlements that flourished in the preceding period are abandoned, or during the early centuries of the 4th millennium BC, when external influences seem to grow, especially in the northern part of the Balkans? Perhaps during the period around 3500 BC, when northern trends reach the Greek peninsula, or as late as 3300 BC, when the redistribution of settlements is materialised (and when, incidentally, western Anatolia enters the scene again)? The paper discusses the different aspects of these phenomena, focusing on the chronological order of the events, as it is established through recent research, and on the geographical distribution of some key sites between the lower Danube and the Cyclades in relation with their environmental background. We also insist on the question of archaeological (non)visibility, which is essential for our understanding or misunderstanding of these major transformations.

Keywords: Aegean, Balkans, 5th millennium BC, 4th millennium BC, social transformation, chronology, radiocarbon

Aegean and Western Anatolia: Two Different Trajectories

Settlements with 'urban' features, such as fortifications, differentiation in the use of space (e.g. workshops) presumably reflecting a differentiation among social groups, and exchange networks for raw materials and finished products (including metals), appear in the Aegean and southern Balkans and in western Anatolia at the end of the 4th millennium BC. During the same period, organised cemeteries, with relatively well built tombs eventually containing rich offerings, are also present in both areas. These phenomena are fully established by approximately 3000 BC (phase Troy I = Anatolian EBA I = Aegean EBA II), but their emergence clearly starts a few centuries earlier, in the years 3300–3200 BC (phase Kum Tepe II = Anatolian Late Chalcolithic = Aegean EBA I). Although disparities in terminology could suggest that the situation is different in the two areas,[2] nearly all scholars agree that the two regions evolved in parallel and that we are dealing with two stages of the same development.[3] What differentiates the two regions, however, is what precedes these developments.

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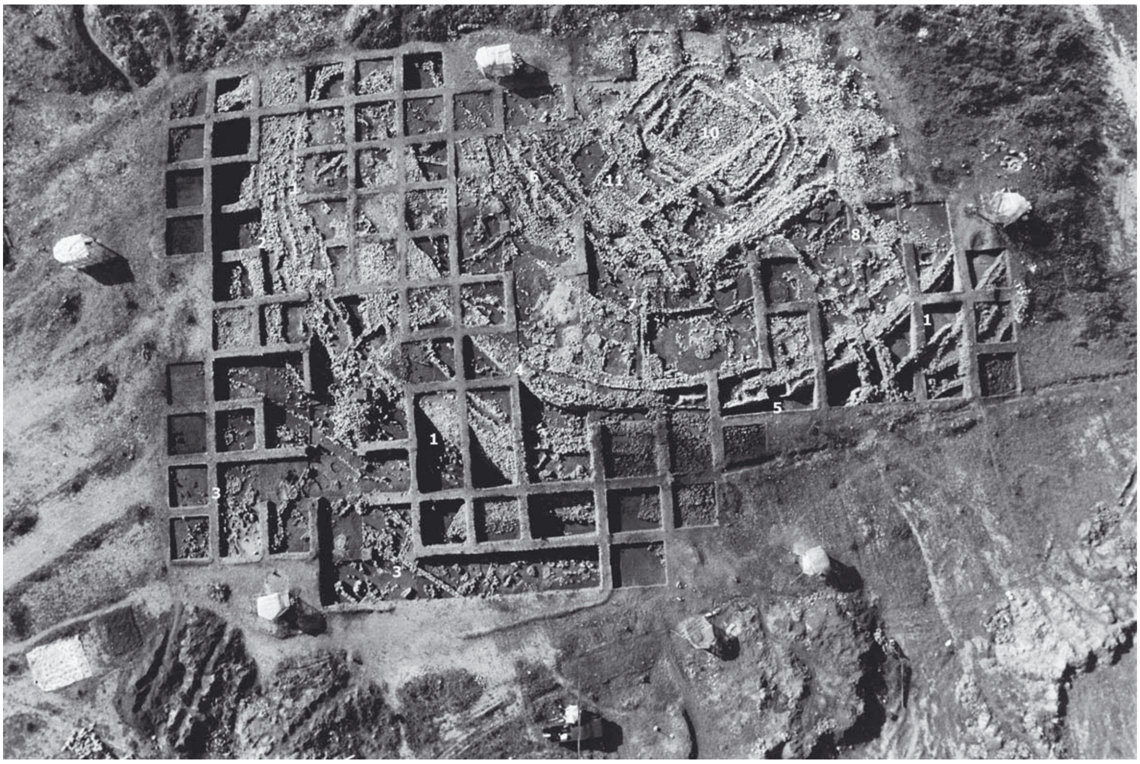
1 CNRS, UMR 7041 Archéologies et Sciences de l'Antiquité; Maison d'Archéologie et d'Ethnologie R. Ginouvès, Nanterre, France; email: zoi.tsirtsoni@mae.u-paris10.fr.

2 The question of discrepancies in the relative chronology and the consequences for our interpretation of the historical phenomena behind the terms used is recurrent in the local, as well as in the broader archaeological literature. It will not be further developed here.

3 The convergence between the two was one of the initiatives, and also one of the main outcomes of the symposium behind the present volume. For similar initiatives, see Erkanal et al. 2008; Şahoğlu – Sotirakopoulou 2011.



A. Palioskala, Thessaly (courtesy G. Toufexis)

B. Skarkos, Cyclades

Fig. 1 Examples of late 5th and late 4th/early 3rd millennium settlements in the Aegean-Balkan area.

Indeed, in the Aegean and the Balkans, most of these features were already present, to various degrees, in the 5th millennium BC, frequently at those very same areas (and even at the same sites) where they reappear little before 3000 BC. Settlements, such as Sesklo and Dimini in Thessaly, Mandalo and Dikili Tash in Greek Macedonia, Yunatsite and Ezero in Thrace, or the recently excavated Provadja in northeastern Bulgaria and Strofilas in the Cyclades, remind of the more developed sites of the Early Bronze Age (Troy, Poliochni, Skarkos, Myrtos, etc.) regarding the architectural forms as well as the wealth and variety of materials present.[4] The same holds true for cemeteries, whether one takes Varna, with its ca. 300 tombs and its 6kg of gold, or the much more modest necropolis of Kephala on Kea, which prefigure the EBA cemeteries in Cyclades (Pelos, Chalandriani), Euboea (Manika), Attica (Agios Kosmas, Tsepi), and elsewhere (Figs. 1–2).[5] Nothing comparable is known from western Anatolia, where evidence for 5th millennium sites is almost completely absent.[6] Even if we accept that this is partly due to poor or maladapted research, it is still a fact that, under the present circumstances, the EBA phenomena in the two regions display very different backgrounds. Thus, in western Anatolia one is compelled to discuss the formation, i.e. the emergence of a new social system, whereas in the Aegean and southern Balkans a transformation process seems possible as well.

On the other hand, the occurrence of similar phenomena in the same area separated by 1000 years is not necessarily evidence for a relationship between the two; one has to prove that there is some kind of derivation, and not just analogy. This begs the question of whether there is a relationship between the 5th millennium and the late 4th millennium BC phenomena in the Aegean and the Balkans. And if so, what kind of relation this is.

The Relation between the Neolithic/Chalcolithic and the EBA Phenomena in the Aegean and Southern Balkans

The answers to this question, thus far, are quite contradictory (Fig. 3).[7] In the north, especially in Bulgaria, the dominant version is that of discontinuity. Indeed, most scholars believe that there is a cultural and demographic collapse towards the end of the 5th millennium BC (the end of the local Kodžadermen-Gumelniţa-Karanovo VI and Krivodol-Sălcuţa-Bubanj Hum Chalcolithic 'cultural complexes', hereafter respectively KGK-VI and KSB), which is followed by an occupation gap of several centuries in the region ('Transitional period').[8] This hypothesis is based on evidence from a large number of more or less contemporaneous destruction episodes of previously flourishing settlements, especially tells, and subsequent lengthy abandonment (up to one millennium according to the ^{14}C dates, for example, in Karanovo and Ezero), or permanent abandonment (e.g. at Ovčarovo, or Goljamo Delčevo).[9] Rich cemeteries disappear as well, and many specialised crafts are lost (high-quality decorated pottery, figurines, metalworking). The few new sites recorded are smaller and poorer than those of the preceding period, and also established in new locations, especially caves and flat open-air sites in highlands and river terraces. This remodelling of the social and cultural landscape is interpreted as the result of

[4] No detailed bibliography is given, since most are reference sites that are well known to the archaeological community. For those excavated more recently, see Televantou 2008; Televantou 2009 (Strofilas); Nikolov 2012 (Provadja).

[5] Again no detailed bibliography is given. For the Aegean, one can always refer to the synthesis of Cavanagh – Mee 1998, and recent manuals, such as Treuil et al. 2008; Cline 2010. For the Balkans, the last synthesis is the one by Nikolova 1999.

[6] State of research in Düring 2011; see also contributions in the present volume.

[7] See also Tsirtsoni 2010; Tsirtsoni (forthcoming a; forthcoming b).

[8] See, among others, Todorova 1978; Boyadziev 1995; Todorova 1995; Bojadžiev 1998; Bailey 2000, 240–262; Merkyte 2007, 39–57; Anthony 2010; a very useful critical synthesis is also given by Ivanova 2008.

[9] For absolute chronology in prehistoric Bulgaria, see Boyadziev 1995; Görsdorf – Bojadžiev 1996; Bojadžiev 1998.

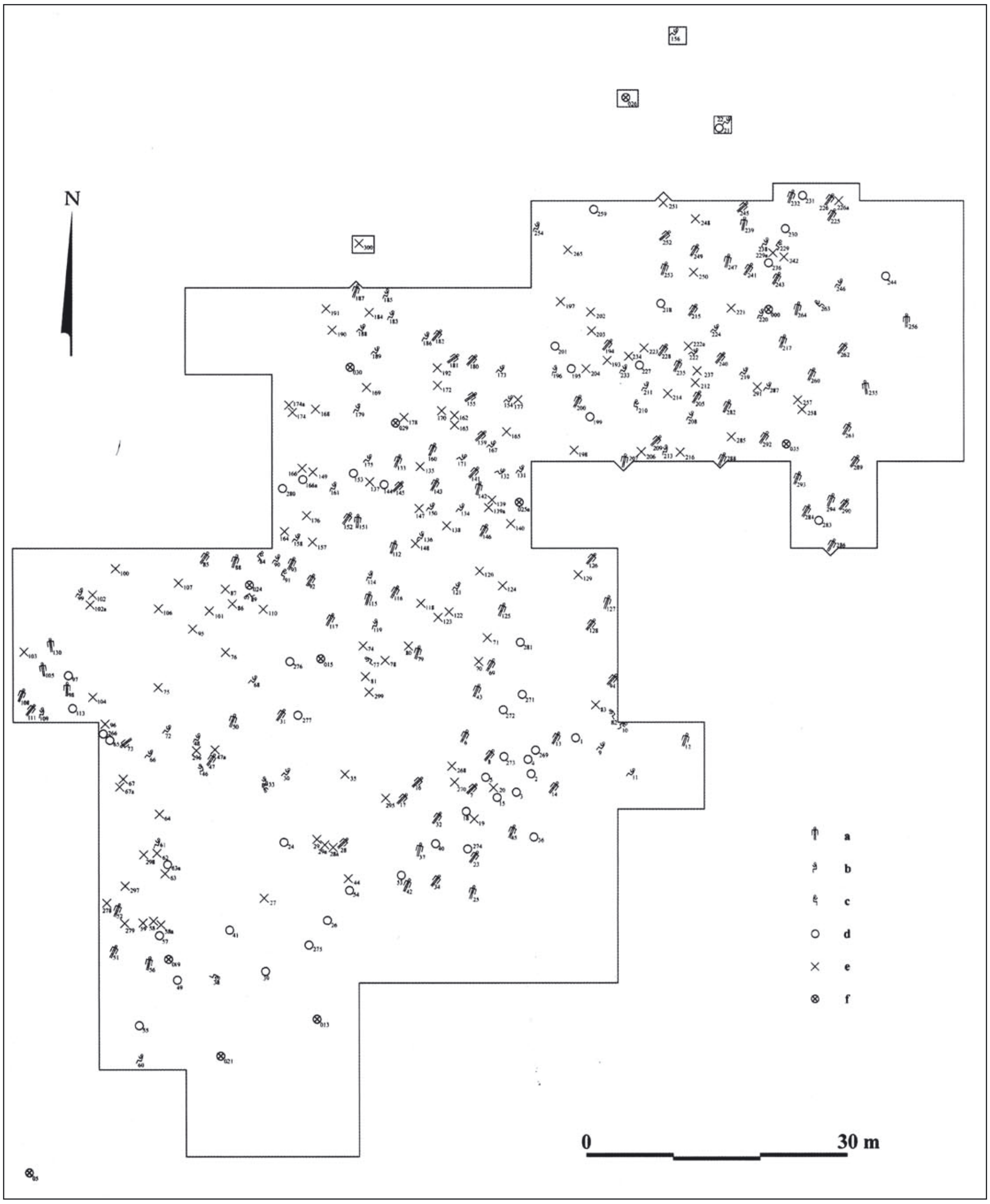


Fig. 2 Examples of late 5th and late 4th/early 3rd millennium cemeteries in the Aegean-Balkan area: A. Varna, NE Bulgaria (after Slavchev 2010, fig. 9.10).

important environmental (climatic) changes[10] or invasions,[11] which, according to the available radiocarbon dates, would have first affected the eastern lowlands (i.e. the area of the eastern cultural complex KGK-VI, before 4000 BC), then the northwestern part of the country (i.e. the area of the KSB Culture, towards 3900/3800 BC). The Early Bronze Age appears five or six centuries later as something radically new and almost completely exogenous, with only a few

[10] Todorova 1995, 89–90; Weninger et al. 2009, 34–44. The local changes would associate with the 6–5.2 ky calBP Rapid Climate Change event.

[11] Boyadziev 1995, 173; Bojadžiev 1998, 358–359. The steppes invasion hypothesis was formulated by M. Gimbutas, prior to the introduction of radiocarbon dating in the area.

Fig. 2B Manika, Euboea (after Cavanagh –Mee 1988, fig. 3.13).

exceptions of early infiltrations and/or mixing with earlier ‘survivors’ near the northern frontier of the country (cultures of Cernavodă I, Galatin, Peveč, etc.). The new EBA cultural formations are classified into two main entities, the ‘Pit Grave’ Culture to the north and the Ezero Culture to the south, one deriving directly from the steppe regions north of the Black Sea, the other connected with the developments in western Anatolia and northern Aegean. Both show further affinities with the EBA phenomena in the central Balkans (Boleráz, Baden), which are presumed to reach the country with the newcomers.[12]

On the contrary, in Greece the transition from the Neolithic to the EBA is generally regarded as a smooth process with minor external influence.[13] It is designated by the term ‘Final Neolithic’ or ‘Chalcolithic’, spans 1500 years (from the late 5th to the early 4th millennium BC) and links the achievements of the two periods.[14] Here too, there is evidence for a break in occupation, especially in some tell settlements with long sequences, like Mandalo, the first where the existence of a long gap was pinpointed through radiocarbon dating 30 years ago.[15] Similar data from other

[12] Panayotov – Dergachov 1984; Alexandrov 1995; Panayotov 1995; Nikolova 1999.

[13] The only exception so far is Coleman 2000, who adopts the idea of a cultural and demographic collapse at the end of the 5th millennium, followed by the arrival of new populations (the Greeks) at the mid-4th millennium. However, his ‘scenario’ (this is his term) has not met much approval. He rediscussed it recently: Coleman 2011.

[14] Treuil 1983; Coleman 1992; Alram-Stern 1996, 95–101; Andreou et al. 1996; Dimakopoulou 1996; Alram-Stern 2007. The term ‘Final Neolithic’ has been heavily criticised since its launch by C. Renfrew (1972), it seems to be, however, the one preferred by most English-speaking scholars. ‘Chalcolithic’ is the term used by most scholars of the German school. The prolongation of the term ‘Late Neolithic’, either alone (Treuil 1983; Treuil et al. 2008, 61–62) or subdivided into further stages (Sampson 1993; Sampson et al. 1999), has been altogether less convincing and is only followed by a few. The recent tendency is in favour of a term that would imply more strongly the use of metals (Chalcolithic or Copper Age), with respect also to the periodization systems used in other neighbouring areas: see for instance Broodbank 2008, 285; Sherratt – Sherratt 2008, 292; and several papers in Hansen – Raczky forthcoming. The subsequent debate is to decide when this Chalcolithic or Copper Age period begins; see Aslanis 1992, and more generally Tsirtsoni 2010 and Tsirtsoni forthcoming a.

[15] Maniatis – Kromer 1990.

Date BC	Periodisation (Balkan terminology)	Rhodopes Struma valley	Thrace	North-East Bulgaria	North-West Bulgaria	Periodisation (European terminology)	Former Youg. Macedonia, Serbia
5400	**Middle Neolithic**	Balgarčevo II Damjanica I–II	Karanovo III	Usoe	Kurilo	**Middle Neolithic**	Vinča A, Anzabegovo IV
5200	**Late Neolithic**	Balgarcevo III Damjanitsa III Promachon- Topolnica	Karanovo IV	Hamangia I–II			Vinča B
4800	**Early Chalcolithic** **Middle Chalcolithic**	Slatino	Marica I–IV Karanovo V	Hamangia III Hamangia IV	Gradeshnitsa	**Late Neolithic**	Vinča C
4500	**Late Chalcolithic**		Karanovo VI	Varna Gumelniţa	Krivodol-Sălcuţa	**Early Chalcolithic (or Copper Age)**	Vinča D Crnobuki I–II Bubanj Hum Ia
4000	**Transitional (Final Chalcolithic)**	Kolarovo Yagodina					Crnobuki III Bubanj Hum Ib
3800	**Proto-Bronze**			Cernavoda I Pevec Hotnica- Vodopada	Sălcuţa IV Galatin		
3300	**Early Bronze Age**		Ezero A	'Pit graves'	Magura	**Middle Chalcolithic (or Copper Age)**	Baden
2800		Kovačevo	Ezero B Mihalic	Ezerovo	Coţofeni		Kostolac

Date BC	Periodisation (dominant Aegean terminology)	Periodisation (alternative Aegean terminology)	Crete, Cyclades Peloponnese	Thessaly	Macedonia, Aegean Thrace
5400	**Late Neolithic I**	LN Ia	Knossos V–VI Franchthi 3–4 Tharrounia Ia Saliagos I Ftelia	Tsangli-Larissa Arapi	Sitagri I Makri II Paradimi I–III Dispilio Dikili Tash I Makryghialos I Sitagri II
4800	**Late Neolithic II**	LN Ib	Knossos IV Saliagos II Tharrounia Ib	Otzaki Dimini	Paradimi IV Makryghialos II Sitagri IIIA Dikili Tash IIA–C Sitagri IIIB–C Kastri Aghios Ioannis
4500	**(Final Neolithic or Chalcolithic)**	LN IIa	Alepotrypa Knossos II–III Franchthi 5 Tharrounia II Kephala Athens Agora	Rachmani Petromagoula Mikrothives	
4000		LN IIb			
3300	**Early Bronze Age I**	EBA I	Eutresis III–IV Grotta-Pelos	Pefkakia 1–2	Sitagri IV Dikili Tash IIIA
2800	**Early Bronze Age II**	EBAII	Eutresis VI–VIII Kampos-Syros	Pefkakia 3	Sitagri Va Dikili Tash IIIB

Fig. 3 Comparison of the periodisation schemes used in Bulgaria (upper table) and in Greece (lower table) for the Neolithic/Chalcolithic and Early Bronze Age periods (state of research prior to the 'Balkans 4000' program; various sources).

sites in northern (e.g. Sitagroi, Dikili Tash), as well as in southern Greece (e.g. cave of Kitsos in Attica, or Limnes in the Peloponnese), indicate that very few of the previously flourishing communities continued to be active during the first seven or eight centuries of the 4th millennium BC (ca. 4200/4000–3300/3000 BC).[16] However, radiocarbon evidence is generally regarded as nonconclusive, and scholars working in Greece consider, whether implicitly or explicitly, that this could be a problem related to absolute dates, rather than a true hiatus.[17] An increase in the use of caves and rock-shelters in relatively remote areas is sometimes connected with changes in the environment during the second half of the 5th millennium BC (i.e. approximately at the same period as in Bulgaria). It appears, however, that this tendency had already started in the first half of the 5th millennium, and many of these sites are abandoned in the late 5th or early 4th millennium as well.[18] Settling new environments or locations that will be considered as the 'hallmark' of the Aegean EBA historical landscape, namely coastal sites and promontories, is a tendency that also starts in the early 5th millennium.[19] The material culture displays several signs of change (e.g. some pottery styles, and free-standing clay figurines disappear), but these are taken to reflect internal evolutions rather than a collapse or forced acculturation.

The Chronological Issue and the 'Balkans 4000' Project

It is clear that the chronology of the events during the critical period that separates the last stages of the 'mature' Neolithic/Chalcolithic and the first manifestations of what is accepted to be the Early Bronze Age are at the core of the issue, and that no proper answer concerning the relation between the two can be put forth until a set of points are clarified.

The first issue at hand is the existence, or not, of a gap between the two series of events. Until recently, no more than 60 out of the c. 500 ^{14}C dates available for the Late Neolithic/Chalcolithic and early EBA periods in Greece and Bulgaria fell within the time span 4000–3300 calBC, and many of those that did had very big statistical errors and could fit earlier (5th millennium) or later (late 4th millennium) spans as well.[20] On the other hand, this very same lack of precision, and even their rarity, which could be taken to reflect biases in sampling, left room for hope that a series of new measurements from better selected samples in the same or at other sites, could provide a different picture.

The second point is the extent and duration of the gap, as well as its eventual homogeneity, according to the type of sites, their location, or topography. Its pace or progression could also be of importance, as it might pinpoint the origin of the factors behind this gap.[21]

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16 Coleman 1992, vol. 2, 204, fig. 2; Manning 1995; Johnson 1999; Alram-Stern 2007.

17 For instance: Treuil 1983, 139; Andreou et al. 1996, 558; Johnson 1999, 330.

18 Diamant 1974; Sampson 1993; Sampson et al. 1999; Mavridis 2006.

19 For instance, the well known settlements of Emporio or Tigani in the eastern Aegean, or the more recent Strofilas in the Cyclades (see footnote n. 4).

20 Bulgaria: Görsdorf – Bojadžiev 1996; Greece: Coleman 1992; Sampson et al. 1999. The majority of the dates prior to 1990 had errors between 100 and 300 years BP, which provided intervals of one thousand calendar years or more after calibration. The quality of measurements has been considerably improved in the subsequent years, reaching values under 60–70 years BP in most laboratories.

21 The duration of the gap in Bulgaria has been used as a sign of the size of the collapse; see among others, Todorova 1995, 89–90; Weninger et al. 2009, 34–44. Regarding the significance of its progression, see also Boyadziev 1995, 173; Bojadžiev 1998, 358–359; Vajsov 2002, 161–164; Ivanova 2008, 164; Anthony 2010, 48–51. For a long time H. Todorova claimed that the gap started earlier in the south (i.e. in Greece) and that a hiatus existed between the Dimini-Dikili Tash II-Sitagroi III and Rachmani-Mandalo-Sitagroi IV 'cultures', corresponding roughly to the second half of the 5th millennium BC. This scheme has been used occasionally by other scholars (for instance Merkyte 2007, 42), despite the fact that it is not at all supported by the Greek evidence, neither in terms of cultural parallelisms (for the second part), nor in terms of chronology.

Fig. 4 Map of the Aegean-Balkan area with the sites dated in the frame of the 'Balkans 4000' program (background C. Finetin/P. Darcque, UMR 7041, Nanterre); other sites are shown in grey.

These were the main concepts behind the launching, in 2007, of an ANR research program covering parts of the two countries, Greece and Bulgaria. Labelled 'Balkans 4000: A la recherche du millénaire perdu', this program focused on the presence or absence of a gap separating the last events assigned to the Neolithic/Chalcolithic period and the earliest occurrences of the Early Bronze Age. Its aim was: a) to proceed to new, more accurate ^{14}C dates, from samples (preferably short-living) freshly collected in secure archaeological contexts, in order to complete and renew the available evidence, and b) to test possible explanatory patterns, according to the geographical situation, nature and type of the dated sites (lowlands/uplands, settlements/cemeteries, tells/flat sites/caves, long-living/short-living, etc.). Thirty-four archaeological sites have been selected to represent the different profiles, all recently excavated or with ongoing fieldwork at the time of the project (Fig. 4). The program also included a palaeo-environmental axis, whose aim was to investigate the environmental conditions before, during and after the presumed 4th millennium gap in a number of selected areas, in order to test its possible connection with climate changes, but also with taphonomy (erosion, alluviation, etc.).

The methods and results of this research, which involved in total more than forty persons, have been presented in detail elsewhere.[22] Here, we only briefly discuss some of the most interesting outcomes and attempt to interpret the historical consequences. Naturally, we take into consideration the previously existent dates, recalibrated at 2σ with the latest calibration curves (IntCal09).

Circumscribing the Neolithic/Chalcolithic – Early Bronze Age Gap

The results of the c. 200 new high-precision radiocarbon dates produced by the 'Balkans 4000' program[23] confirm the existence of a substantial break in occupation in both countries towards the end of the 5th millennium BC, or little after that. At the present state of the record, there is no 5th millennium site that extends uninterruptedly to the late 4th millennium. This concerns 'young' sites that had only been founded two or three centuries ago, as well as long-established settlements, which might have already experienced other hiatuses in their occupation (Figs. 5–6). It is important to note that the break concerns not only settlements, but cemeteries as well (e.g. Smyadovo, in northeast Bulgaria),[24] and also sites that lay in different natural environments, as well as sites with different profiles. It may appear, in fact, as if this hiatus is best documented at tells, however other types of sites, such as flat settlements or caves (e.g. Kryoneri and Sidirokastro, both in the Struma Valley in Greek eastern Macedonia)[25] were equally affected.

The majority of the abandonment events seem to take place in the third quarter of the 5th millennium, i.e. between 4400 and 4200 calBC. ^{14}C dates from the last destruction layers in most sites fall indeed within this interval.[26] However, other possibilities exist: the heterogeneity of the gap's upper limits, i.e. the date of the sites' abandonment, and the random character of their distribution at a regional scale, is indeed the second point to underline. In Thessaly for instance (Fig. 7), some sites seem to stop being occupied before 4500 calBC (e.g. Vassilis),[27]

22 Tsirtsoni forthcoming a. Part of the archaeological results are also briefly discussed in Maniatis et al. 2014; Tsirtsoni forthcoming b. The results of the palaeo-environmental research are presented in Lespez et al. 2014; Lespez et al. forthcoming.

23 Standard deviation between 30 and 50 years BP, giving after calibration at 2 sigmas (95%) intervals of approximately 150–250 calendar years.

24 See Chohadziev – Venelinova 2006; Chohadziev – Venelinova 2007; Chohadziev, in Tsirtsoni forthcoming a.

25 Regarding Kryoneri, see Malamidou 2007; Malamidou, in Tsirtsoni forthcoming a. In respect to Sidirokastro, see Poulaki-Pantermali et al. 2004; Siros et al. 2007; Siros – Miteletsis, in Tsirtsoni forthcoming a. The sequences of both sites are also discussed in Maniatis et al. 2014.

26 See also Tsirtsoni forthcoming b.

27 A flat settlement, recently excavated by the Ephorate of Larisa; see Toufexis et al. 2009. The slight possibility to also have deposits that post-date the main LNII occupation layer was rejected by the ^{14}C dates.

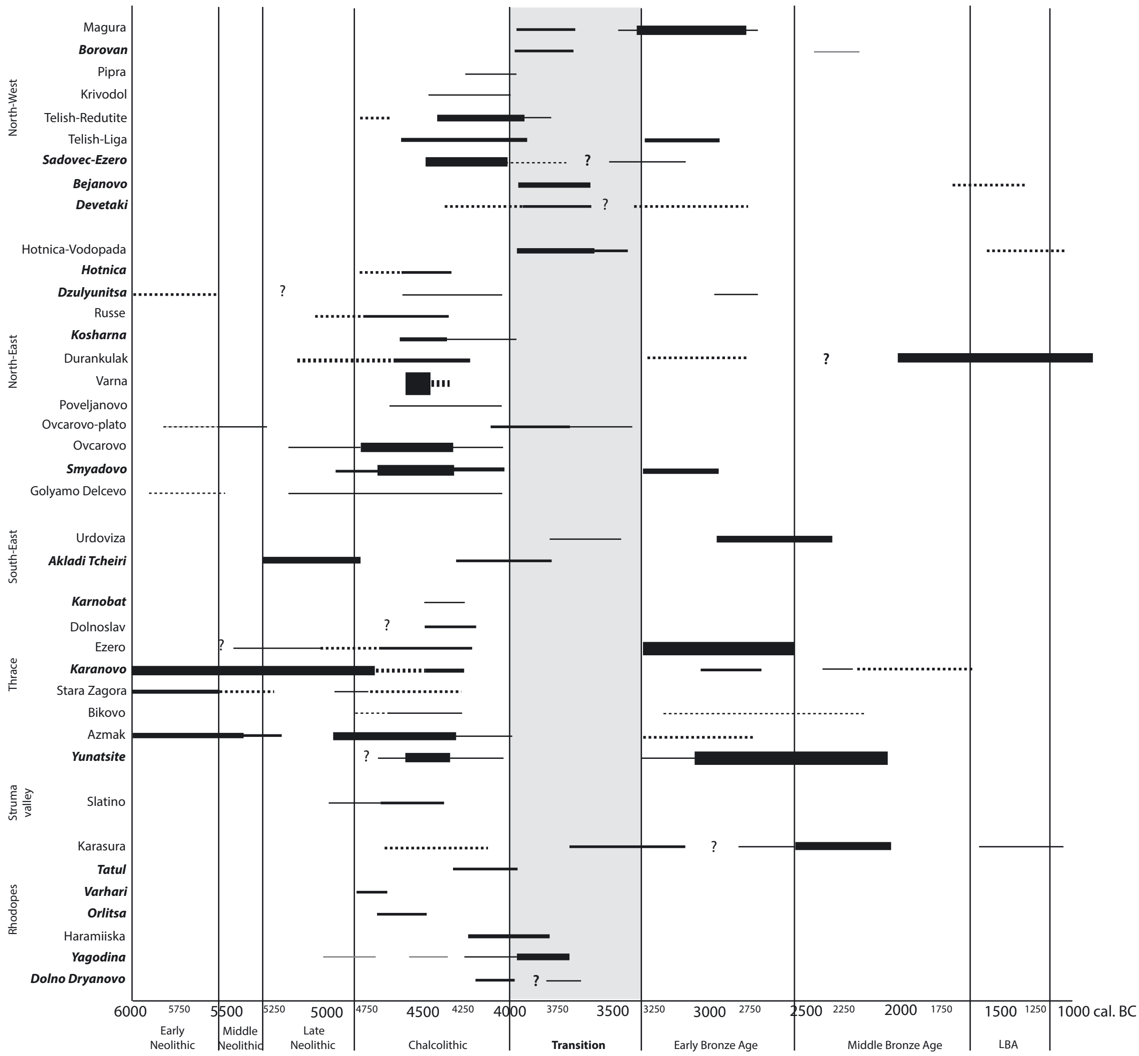

Fig. 5 Graphic showing the duration of occupation in Neolithic/Chalcolithic sites with ^{14}C dates from Bulgaria; sites dated in the frame of the 'Balkans 4000' program are shown in bold italics. Solid lines correspond to the parts dated by ^{14}C (thickness of lines proportional to the number of dates), dotted lines to the parts attested only archaeologically. No statistical treatment is applied.

others around 4400–4300 calBC (Pefkakia,[28] Rachmani[29]), and others continue until 4000 or 3800 calBC (Prodromos,[30] Palioskala,[31] Galini[32]). Flat settlements and tells are found together in almost all groups.

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28 Recalibration of the dates given by Weisshaar 1989, 139.

29 A sample taken from the fill of one of the Final Neolithic wells, excavated by G. Toufexis in the late 1990s; see Toufexis et al. 2000; Toufexis 2008, 571–572.

30 Not to be confounded with the Early Neolithic Prodromos excavated by G. Hourmouziadis in the early 1970s, from which it is distant by c. 2km. The site discussed here, called also 'Magoula Aghios Ioannis', has been investigated by the Ephorate of Karditsa between 2007–2008 as a rescue operation. See Karagiannopoulos, in Tsirtsoni forthcoming a.

31 This important Late and Final Neolithic settlement was investigated in the late 1990s during the works for the partial reconstruction of the former lake Karla in the eastern Thessalian Plain. See Toufexis 2003; Toufexis, in Tsirtsoni forthcoming a. Additional excavations are currently underway.

32 Toufexis 1999; Toufexis 2008, 569–570.

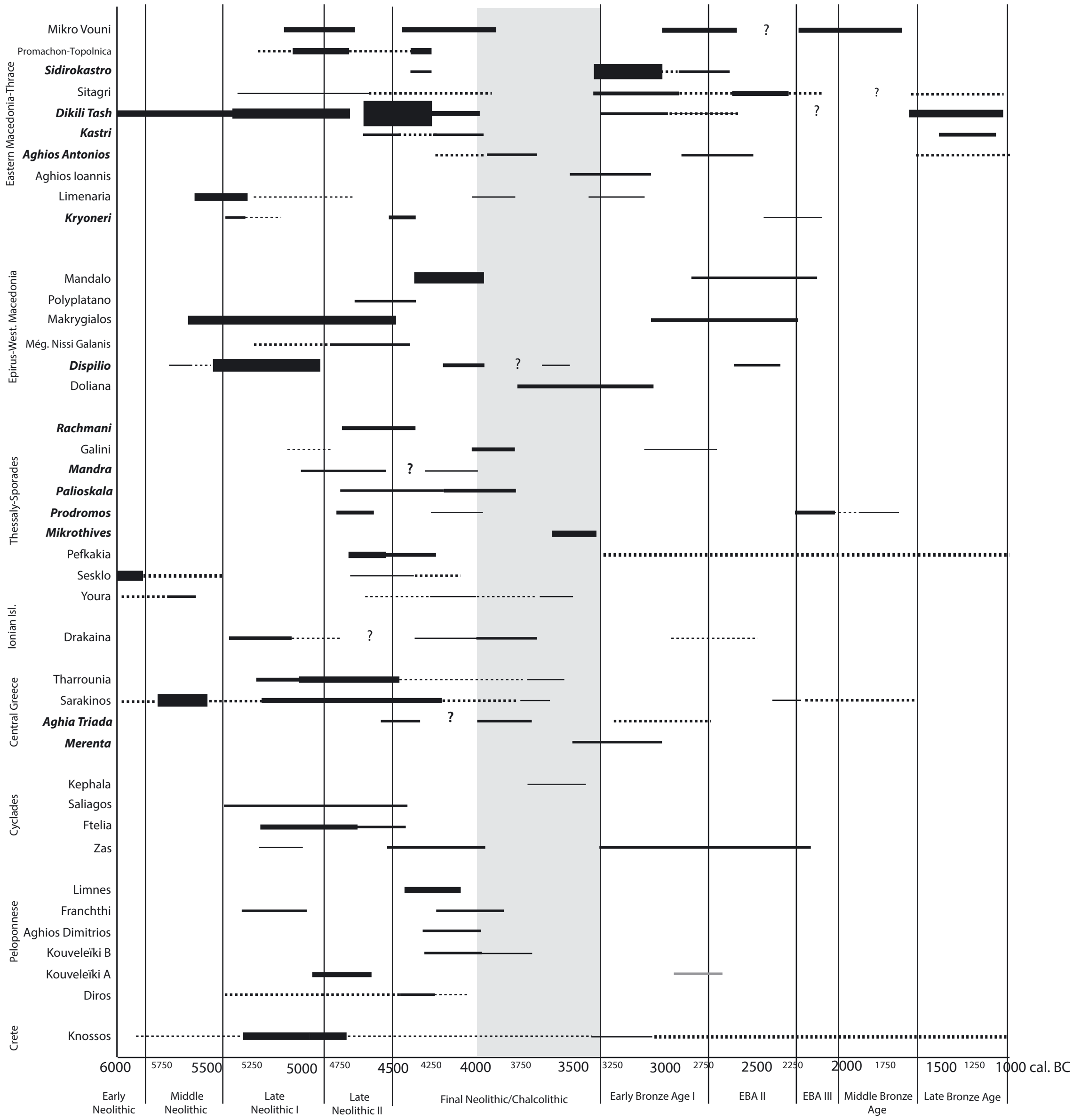

Fig. 6 Graphic showing the duration of occupation in Neolithic/Chalcolithic sites with ^{14}C dates from Greece; sites dated in the frame of the 'Balkans 4000' program are shown in bold italics. Solid lines correspond to the parts dated by ^{14}C (thickness of lines proportional to the number of dates), dotted lines to the parts attested only archaeologically. No statistical treatment is applied.

We get a similar picture at approximately the same time in most other regions. In northwestern Bulgaria, for example, some sites are abandoned, or change use as early as 4300 calBC (e.g. Lîga[33]), others seem to continue until 4000 or 3900 (e.g., Sadovec-Ezero,[34] Teliš-Redutite[35]),

[33] Merkyte et al. 2005, 34–35.
[34] This multi-layered settlement was first investigated during a salvage expedition, which also produced a few ^{14}C dates: Merkyte 2007, 21–22. The samples dated in the frame of 'Balkans 4000' come from subsequent systematic excavations: Gergov 2007; Gergov 2008; Tsirtsoni forthcoming a.
[35] Gergov 1992; Görsdorf – Bojadžiev 1996, 152.

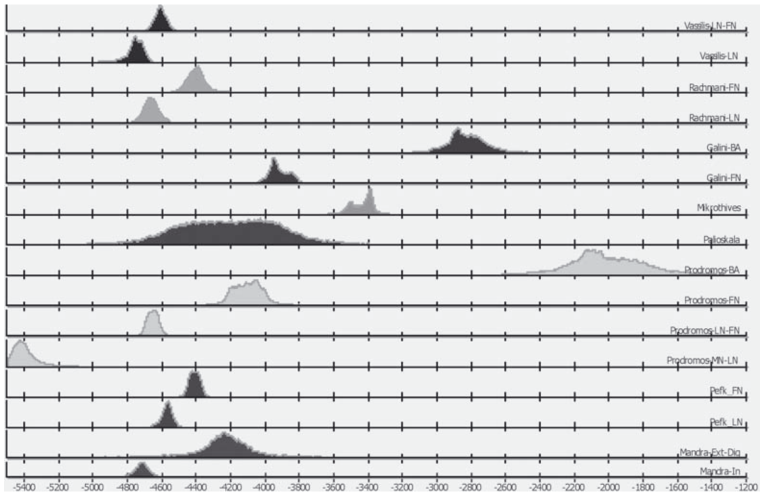

Fig. 7 Diagram showing the distribution of ^{14}C dates from Neolithic/Chalcolithic sites in Thessaly; data are statistically processed with the program RenDateModel (© CNRS-Iramat).

whereas others reach 3800 or 3700 calBC (Bejanovo,[36] Borovan[37]). This means that a number of chronological 'thresholds' exist,[38] whose distribution is, however, random at a supra-regional scale. In other words, there is no clear pattern that would suggest any kind of geographical progression of the abandonment, for instance from the north to the south, or from the coasts to the interior. It is true that more sites end at c. 4300 calBC in northeastern than in northwestern Bulgaria, and that, conversely, more sites enter the 4th millennium in the northwest than in the northeast, but the two kinds of evidence, as well as a number of intermediary patterns are found in both regions.

As a result, no region seems to be completely vacant. The only exception is Bulgarian Thrace, which, in the present state of our knowledge, has no sites dating after 4200 calBC. But this could be a problem of taphonomy and archaeological visibility rather than a true emptying of the region.[39]

Evidence from other regions indicate that occupation continued in some settlements for at least one or two more centuries, but due to the erosion and/or the later constructions the traces of this late occupation are poorly preserved in the main sequence (i.e. in the part where most ^{14}C samples come from). This is especially true for tells. Traces can be detected in the site's periphery, where

36 Valentinova – Gushterakliev 2008; Valentinova, in Tsirtsoni forthcoming a.

37 A flat site near Vratsa, investigated from 2008–2009; see Ganetsovksi 2008; Ganetsovksi 2009; Ganetsovksi, in Tsirtsoni forthcoming a.

38 It is possible that some of these 'thresholds' result from an artificial concentration of dates, due to the specificities of the calibration curve. This does not mean that an event dated in the 4200/4000 calBC interval, for instance, could actually have occurred at 4500 BC (although, statistically, this in not totally impossible). It rather means that we are not (yet) able to go beyond a certain degree of precision (4200, 4100, or 4000?), which is greater or lesser according to the parts of the curve. For the period under consideration, the two best-known 'plateaux' occur at around 5200 BP (= 4000–3800 calBC), and around 4500 BP (=3300–3000 calBC). For a discussion, see Boyadziev 1995, 153–155; Bojadžiev 1998, 354–355; Johnson 1999, 330–332; Maniatis – Papadopoulos 2011, 30–34.

39 The question of visibility in the Thracian Plain, whose lower parts are constituted mainly by heavy marshy soils (locally called smolnitzas) was already evoked in Dennell – Wembley 1975; they concluded (p. 101) that 'some minor Neolithic sites may have been buried by subsequent [EBA] smolnitza formations', adding however that marshy areas probably would not have been favourable for prehistoric (i.e. Neolithic) settlement. The latter part of their proposition is not proven though. See Gaydarska 2007, 43–50 for further information. The same authors admit that there may have existed "other living sites, relating to summer grazing on the Sredna Gora [mountains] and on the smolnitzas, which were too ephemeral to leave evidence in the archaeological record". Similar considerations have been expressed about the visibility of FN sites in Thessaly: Johnson – Perlès 2004. Also see discussion, infra.

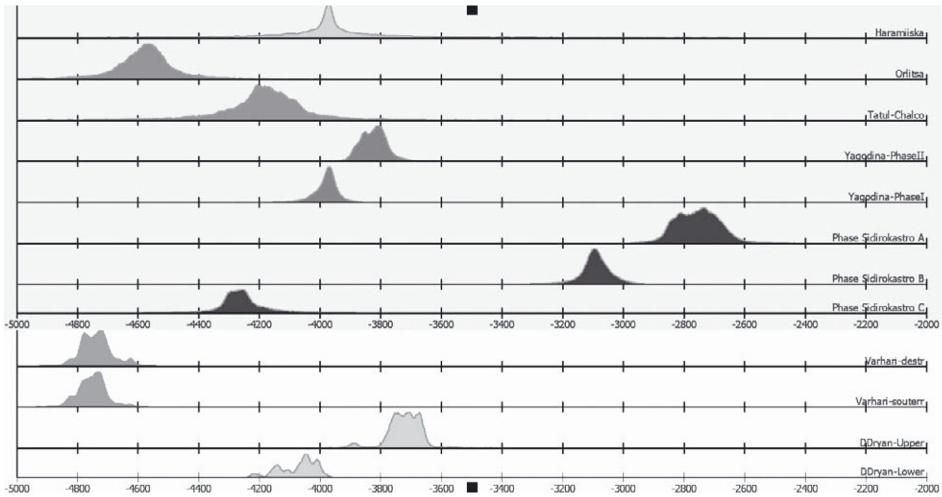

Fig. 8 Diagram showing the distribution of ^{14}C dates from Neolithic/Chalcolithic sites in the Rhodopes; data are statistically processed with the program RenDateModel (© CNRS-Iramat).

the later levels are preserved as colluvial deposits in a secondary position: we have one certain example of this situation at the tell settlement of Dikili Tash (Greek eastern Macedonia),[40] and possibly a second one, at Mandra in Thessaly.[41] Perhaps some of the Thracian tells have undergone a similar evolution.

Conversely, some of the hypotheses concerning the prolongation of habitation in specific regions or landscapes may be a consequence of the better preservation. A good example is found in the Rhodopes on the Greek-Bulgarian border, an area where the Chalcolithic is traditionally acknowledged to survive longer. The dominant scenario is that the area was first settled at the end of the 5th millennium BC, as the result of a movement of populations from the abandoned lowland tells. Both these statements (i.e. the late start and the prolongation after the end of tell settlements, until 3800 or even 3600 cal BC) are used as arguments to support the 'catastrophe' scenario in the Balkans, by natural causes or invasions.[42]

The new ^{14}C dates show that settlement in the area commences well before the end of the tells in the neighbouring Thracian plain; therefore, it is not the work of refugees (Fig. 8). The two settlement patterns, therefore, coexist from the early stages of the Chalcolithic period. One should note that the two sites that represent this early group (Varhari and Orlitsa)[43] are totally flat and are located in small river valleys in the mountains. They probably would not have been discovered if modern road-construction in the region had not been undertaken. This bespeaks the reliability of our corpus and brings to the fore the discussion about archaeological visibility. As for the second point, i.e. the prolongation of the Rhodopes sites beyond the end of the activity on tells, it appears to be only half-true. Several sites, such as the caves of Yagodina and Haramiiska already dated in previous years,[44] or the more recently excavated open-air site of Dolno Dryanovo,[45] survive until

40 Darcque et al. 2014; Darcque et al. forthcoming. In fact, a more thorough analysis of the evidence suggests that traces of these later occupation events could also be found in the main body of the tell; see chapter on Dikili Tash, in Tsirtsoni forthcoming a. This reconstruction has been confirmed by the finds of the 2013 excavation at the site site; see <http://www.chronique.efa.gr/index.php/fiches/voir/4078> (last accessed 24.10.2014).

41 According to a ^{14}C date from the fill of one of the ditches that surrounded the Late Neolithic settlement. A group of graves (not dated) were placed in this fill, and subsequently covered by later colluvia; see Toufexis et al. 2006.

42 Todorova 1995, 90; Bojadžiev 1998, 358–359.

43 See the respective papers by J. and K. Boyadzhiev, in Tsirtsoni forthcoming a.

44 Görsdorf – Bojadžiev 1996, 154. Only Yagodina has been subjected to further dating by the 'Balkans 4000' project, which confirm and refine the older ones: Todorova – Avramova, in Tsirtsoni forthcoming a.

45 Todorova, in Tsirtsoni forthcoming a.

Date BC	Periodisation (dominant Aegean terminology)	Periodisation (alternative Aegean terminology)	Crete, Cyclades Peloponnese	Thessaly	Macedonia, Aegean Thrace
5500	Late Neolithic I	LN IA	Knossos V–VI Franchthi 3–4 Tharrounia Ia Ftelia Saliagos I	*Tsangli-Larissa* *Arapi*	**Dikili Tash I-early** Sitagri I Makri II, Paradimi I–III Dispilio, Makryghialos I, Sitagri II **Dikili Tash I-late**
5300					
4900	Late Neolithic II	LN IB	Knossos IV Saliagos II Tharrounia Ib **Aghia Triada LNI**	*Otzaki* *Dimini classique* Pefkakia LN **Mandra, Vassilis, Palioskala, Rachmani, Prodromos**	Paradimi IV Makryghialos II Dispilio, Sitagri IIIA **Dikili Tash II-early** **Kastri LN II**
4500	Final Neolithic or Chalcolithic	LN IIA	Alépotrypa Knossos II–III Franchthi 5 Tharrounia II **Aghia Triada LNII**	Pefkakia FN **Palioskala, Rachmani** ↑	**Kryoneri** **Dikili Tash II-late** Sitagri IIIB–C ↓
4200				**Mandra** **Palioskala** **Prodromos**	**Dispilio** **Dikili Tash II-final** **Sidirokastro** **Kastri**
4000		LN IIB	**Aghia Triada FN** Kephala Tharrounia IIb	**Palioskala**	**Kastri FN** **Aghios Antonios**
3700					
3500				**Mikrothives**	
3300			**Merenta Trans.**		Aghios Ioannis
3200	Early Bronze Age I ↓	EBA I	Eutresis III–IV *Grotta-Pelos* **Merenta EBAI**	Pefkakia 1–2	Sitagri IV **Dikili Tash IIIA** **Sidirokastro B**
2800	Early Bronze Age II	EBA II	Eutresis VI–VIII *Kampos-Syros* **Merenta EBAII**	Pefkakia 3	Sitagri Va **Dikili Tash IIIB** **Sidirokastro A**

Fig. 9 Proposed periodisation of the Bulgarian and Greek Neolithic/Chalcolithic and Early Bronze Age, in standard fonts, 'cultures' are in italics; in bold are the sites dated by

Periodisation (Balkan terminology)	**Rhodopes Struma valley**	**Thrace**	**North-East Bulgaria**	**North-West Bulgaria**	**South-East Bulgaria**
MIDDLE NEOLITHIC	Balgarčevo II Damjanitsa I–II	Karanovo III	*Usoe*		
LATE NEOLITHIC	Balgarčevo III Damjanitsa III Promachon-Topolnica	Karanovo IV	*Hamangia I–II*	*Kurilo*	**Akladi Tseiri I**
EARLY CHALCOLITHIC MIDDLE CHALCOLITHIC	**Varhari** Slatino **Orlitsa**	*Marica I–IV* Karanovo V	*Hamangia III* *Hamangia IV* **Smyadovo**	*Gradešnica*	**Akladi Tseiri II**
LATE CHALCOLITHIC		**Karanovo VI, Yunatsite I Karnobat**	Varna *Gumelniţa* **Kosharna Smyadovo Hotnica**	*Krivodol-Sălcuţa*	
TRANSITION (FINAL CHALCOLITHIC)	Kolarovo **Tatul Yagodina I D. Dryanovo**		**Dzulyunitsa (graves)**	Liga, Telish-Redutite **Sadovec**	**Akladi Tseiri III** Sozopol
	Yagodina II **D. Dryanovo**		Cernavoda I Pevec Hotnica-Vodopada	↑ *Sălcuţa IV* Galatin **Bejanovo Devetaki, Borovan**	**Akladi Tseiri (graves)**
PROTO-BRONZE ↓		Drama-Merdžumekja			
				Sadovec (graves)	
			'Pit graves' **Smyadovo**	Liga (graves)	
EARLY BRONZE AGE		Ezero A **Yunatsite IIA Karanovo VII**		Magura Coţofeni	
	Kovačevo **Tatul**	Ezero B **Yunatsite IIB**	Ezerovo		

integrating the results of the 'Balkans 4000' program and other recent evidence. Individual sites are the program. The arrows indicate the most significant adjustments introduced.

after 4000 BC, but others, like Tatul,[46] do not survive that long. On the other hand, some tell sites in the neighbouring plains, like Dikili Tash for instance, may also endure as long.[47]

Getting back to our 'thresholds' and their correlation, or not, with some of the broadly acknowledged chrono-cultural stages, I would like to briefly discuss the case of Thessaly (Fig. 9). It is time we accept that the 'Rachmani Culture' is not a long-lasting phenomenon spanning the whole LN-EBA transition, as it is usually presented in the Greek archaeological literature;[48] neither is it a phenomenon taking place at the end phases of this transition after a hiatus, as it is sometimes argued in the Bulgarian literature.[49] It is a local version of the mature Greek Neolithic – parallel to the Bulgarian Late Chalcolithic – which succeeds directly to the so-called 'Dimini Culture', and ends, like its Bulgarian counterpart, well before the end of the 5th millennium BC. M. Johnson had already claimed this several years ago, based, among other elements, on the ^{14}C dates from Pefkakia.[50] The addition of dates from more sites, including Rachmani itself, now confirms this claim. Occupation continues in Thessaly, and there are sites that remain inhabited until 3900 or 3800 calBC, but we should stop referring to them as 'Rachmani', unless we agree to minimise completely the chronological dimension of this term. Similarly we should stop referring to the post 3800 calBC phenomena in southern Greece as 'Attica-Kephala'. Very interesting things are certainly happening both in Attica and the Cyclades in the second and third quarter of the 4th millennium, but it becomes confusing when addressing them by the same name applied to developments of the late 5th and early 4th millennium.[51]

At the other end of the gap, i.e. the date of the settling (or resettling) of the EBA sites, the results from 'Balkans 4000' are less revolutionary. Indeed, no EBA level at any of the investigated sites has provided dates prior to 3300–3100 BC. The only exception comes from the site of Merenta in Attica, a rather atypical settlement with subterranean rock chambers, whose beginnings seem to go back to c. 3400–3350 calBC, and which continues to the 'normal' EBA I/II, with dates after 3000 BC.[52] However, the unique properly speaking 'transitional' settlement is Mikrothives in Thessaly, which provided several dates to approximately 3600–3500 calBC. Unlike Merenta, it does not continue into the EBA; therefore, it stands as a true 'missing link' between the two major periods, both by its chronological position and its material characteristics.[53]

This brings us back to what seems to be the most important point of our analysis: the regional continuities. As has been stated, taken individually all the Neolithic/Chalcolithic sites seem to be abandoned at some point in their history, and most of them display gaps that reach or exceed an entire millennium. However, when considered at a regional scale, gaps are significantly smaller, as the individual sequences largely complete each other in most areas, indicating that settlements are simply changing location. This is particularly evident in the case of the Rhodopes (supra), especially when the data on both sides of the modern frontier are considered. Indeed, if we only included data from Bulgaria we would get the impression that activity ends around 3700/3600 BC and does not start again before c. 2500 BC (i.e. in the advanced EBA), when we have the first available dates from Tatul.[54] If we add however evidence from Sidirokastro, on the Greek side of the frontier,[55] we obtain a regional sequence that stretches from the Early Chalcolithic (= Greek

46 Ovcharov et al. 2008; Leshtakov et al., in Tsirtsoni forthcoming a.
47 Supra, footnote 40.
48 Supra, footnote 14.
49 Supra, footnote 21.
50 Johnson 1999.
51 E. Alram-Stern had already convincingly argued in favour of this position on the basis of pottery analogies: Alram-Stern 2007.
52 Kakavogianni et al. 2009; Kakavogianni et al., in Tsirtsoni forthcoming a.
53 Adrymi-Sismani 2007. The one-layered settlement at Aghios Ioannis on Thasos, also labelled Transitional, seems to synchronise better with the earliest phase at Merenta: see Maniatis – Papadopoulos 2011; Maniatis et al. 2014.
54 Leshtakov – Tsirtsoni, forthcoming.
55 Supra, footnote 25.

Late Neolithic II) to the end of the Early Bronze Age, and beyond,[56] with 'only' a 300–400 years gap, between roughly 3600 and 3300 BC. With new finds, this gap could possibly decrease even more. Similar examples are also found in other regions, like the island of Thasos, Attica, and Thessaly. When considered individually, a site like Prodromos displays a two millennia gap, but if we take Thessaly as a whole, there are no more than 200–300 years separating the last pre-Bronze Age occupation from the first ^{14}C-dated EBA event.

Formation or Transformation?

With respect to the initial question, whether there exists, or not, a relationship between the late 5th and late 4th millennium BC phenomena in the Aegean and the Balkans, the following statements can be made:

1. According to evidence from settlements, the transition from the former to the latter would be a transformation process rather than a new start after a generalised break. There seems to be continuity in occupation at the broad regional level, but with several local gaps, which obviously result from changes in the mode of land use: a greater mobility in the settlements themselves, but also in the choice of places for the dead, the exploitation of raw materials, etc. In addition to short-distance intra-regional movements (e.g. people moving from Rachmani to Palioskala, and from there to Mikrothives, etc.) one might expect to find some more distant movements, which would explain the redistribution of the population at a supra-regional level, especially the transfer from the north, where we have a greater density of sites in the Neolithic/Chalcolithic period, to the south, where we have a greater density of sites in the EBA.[57] Such redistribution does not necessarily imply a massive migration; it could proceed by small or medium-scale movements of some portions of the original groups. This point will be developed below.

The continuity is further supported by similarities in the material culture of the two periods, which can only be explained if one recognizes that the original creative forces (i.e. the populations living and working in the Aegean and the Balkans during the Neolithic/Chalcolithic period) continued to develop and exchange with each other during the following centuries, even if we actually lose sight of them.[58] The presence at the Transitional-period settlement of Mikrothives of *Spondylus* bracelets and ceramic conical cups that call to mind the marble cups of Varna or Kephala (older by c. 900 and 300 years respectively),[59] alludes to the persistency of some technological traditions and aesthetic preferences over the ages, as well as to the maintenance of networks connecting people together. The late 4th millennium specimens should not be considered as parallels of those of the 5th millennium; they are rather their 'descendants', i.e. a recomposed (simplified, transposed or enriched) version of the original products. External elements are of course present in the EBA material culture as well, and witness the progressive opening of the local societies to neighbouring 'cultures'.[60]

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[56] Tatul is also occupied in the 2nd millennium (Middle Bronze Age): Leshtakov – Tsirtsoni, forthcoming.

[57] This difference in distribution should be considered, however, with a lot of scepticism for it might reflect problems in preservation and taphonomy (compare supra, footnote 39), as well as research biases. In areas to the north where the remains of the two periods have undergone the same kind and the same degree of investigation, the overall density of settlements is to be comparable: Lespez 2008, 297–300, 396. The contrary is observed in southern Greece (e.g. Laconia, Argolid): see Mee 2011, 10, with further references.

[58] Compare also Merkyte 2007, 47.

[59] Adrymi-Sismani 2007, 76, and pl. XII: n. For the 'Final Neolithic' marble conical cups, see also infra, footnote 77. The date retained here for the Varna cemetery is the one provided by Higham et al. 2007, but it is possible that not all tombs are contemporaneous and that there also exists a slightly later period of use of the cemetery (Higham et al. 652; and V. Slavchev, oral communication). We do not know if the grave that contained the marble rhyton (Grave 41) belongs to the earlier or the later group. The date provided for Kephala is from Coleman 1977, 100, who considered it too low; also see Coleman 2000, 124.

[60] The progressive character of the introduction of such external elements is now demonstrated; for example, see the discussion about the 'shell-tempered ware' in Manzura 1999, 97–103 (summarised also by Ivanova 2008).

2. The transformation process does not start at the end of the Late Neolithic-Chalcolithic period, i.e. the last centuries of the 5th millennium BC or the early 4th, but already during its heyday. 'Alternative' ways of living, such as settlements in mountains, caves, flat settlements in relatively remote landscapes, or small coastal sites, coexist indeed in all areas with the 'mainstream' ones (tells or big flat sites in plains and river valleys) since the beginning of the period (ca. 4800 BC),[61] sometimes even before, since the Late Neolithic I (ca. 5200 BC).[62] Again, Rhodopes and the adjacent plains (Thrace to the north, Drama to the south) with its variety of sites can be taken as exemplary. The different types of sites probably functioned together and constituted elements of an entire socio-economic system; tells or large flat sites are not the only but just the most conspicuous part of this system.

3. For reasons that are still not well understood, this conspicuous part of the system falls apart towards the end of the 5th millennium BC. Two issues, however, should be noted. First, whatever the reasons, this is not an abrupt event but a rather slow process, although not patterned in any particular way as discussed above.[63] Second, the breakdown of one of the system's branches might better be explained by social and economic factors, although some environmental changes are possible, especially in landscapes that were particularly sensitive to such changes, for instance sea and lake shores.[64] Changes in temperature or precipitation could indeed weaken such ecosystems. They do not explain, *stricto sensu*, the sites' abandonment but might have disturbed some of the economic and social relationships that maintained the system. On the contrary, it is very unlikely that the abandonment would be a consequence of an overexploitation of land potential around long-living settlements.[65] The first significant effects of erosion in continental plains are registered in fact, at the end of the EBA, or later.[66]

Perhaps at some point people did not need, or were not able to afford anymore this 'conspicuous' lifeway: high tells with the accumulation of products, rich cemeteries, complex production and exchange systems, etc. However, this disengagement does not come as an abrupt decision but as the result of a series of small progressive changes.[67]

Thus, it appears that there is, already during the Late Neolithic II/Chalcolithic, a progressive 'transfer of attention' towards other types of artefacts, or types of expression. This transfer produces, unavoidably, a certain decline in some crafts – usually the same that were most visible in the previous periods.[68] The decline of painted pottery is observed in southern Greece before

[61] For instance, Varhari and Orlitsa in the Rhodopes.

[62] For instance, Ftelia and Saliagos in the Cyclades, Tharrounia in Euboea, Akladi Tseiri on the Black Sea coast. Other sites, especially, caves, are inhabited even earlier (beginning of Neolithic or before), but not all regions are represented, neither have we evidence that they were occupied continuously in the later stages of the Neolithic. Mee (2011, 10) describes the trends in settlement at the Neolithic-EBA transition by the term of 'gradual shift'.

[63] Compare Ivanova 2008, 177–179.

[64] There is some evidence from palynological studies around the Bulgarian Black Sea coast indicating changes in the exploitation of the natural environment (proportion of arboreal-non arboreal plants, presence of anthropogenic indicators, etc.) at the transition from the Chalcolithic to the EBA period: Filipova-Marinova – Bozilova 2003. These changes seem to be connected with a transgression of the Black Sea level during the same dates ('Fedorov's trangression'); see Shilik 1997; Govedarica 2003. However, no direct impact of this transgression is seen further inland. Similarly, the research conducted in the lower Struma Valley in the frame of the 'Balkans 4000' project showed that part of a settlement located very close to the shore of the former lake of Achinos was submerged at the end of the 4th millennium BC (after 3600 BC). This event indicates greater hydrological activity of the watercourses that alimented the lake, but (i) the possible connection with broader climatic changes is far from evident, (ii) no water rise in recorded at only a few meters from this spot, meaning that the impact of such events is local and would not have produced the abandonment of the whole area around it: see Lespez et al. 2014; Lespez et al. forthcoming.

[65] Anthony 2010, 51.

[66] Dennell – Webley 1975, 108. These erosive events are seen as the result of extensive clearings, for arable land, in the surrounding hills. See also Lespez 2008, 235–239, 380.

[67] A similar idea is expressed in Bailey 2000, 260–261.

[68] Papadopoulos 2002, 280; Papadopoulos 2007, 323–324.

the mid-5th millennium BC.[69] In the same years, the areas further north (Thessaly, Greek Eastern Macedonia, Bulgaria) witness an 'explosion' of high-skilled painted wares, some of which are the products of specialised workshops and are exported in relatively great distances ('Classic Dimini' Pottery, eastern Macedonian Black-on-Red).[70] They coexist with other pottery productions (graphite painted, incised, with or without addition of a paint after firing), which, although sometimes fancier in appearance, are technically simpler and progressively replace the more demanding fine painted wares of the previous period.[71] In other words, the decline of the pottery in the 4th millennium started during the 'climax' stages of the 5th millennium.[72]

4. The change in settlement patterns has been interpreted by many authors as a turn towards pastoralism and animal husbandry, in contrast to the previous model, which was more focused on land cultivation. This idea, which is of course connected with A. Sherratt's hypothesis about the 'secondary products revolution', is definitely a valuable one although not entirely satisfactory. The main objection comes from the fact that this 'new' exploitation model is not so new, since it starts at least at the beginning of the 5th millennium and coexists with the lowland farming sites. More importantly, many of the caves or mountainous settlements are abandoned at exactly the same time as some of their neighbouring tells, possibly as the result of similar decisions.

As the late C. Mee recently put it, "[a greater reliance on pastoralism] does not explain why the pattern of settlement changed, only how it would have been possible'; he added: 'There was evidently an element of choice and one that may have made communities more interdependent".[73]

Factors of Change

In fact, there must have been more than one element of choice. Given the overall duration of the transformation and its multidirectional character, we should assume that several factors were involved.

One of them is perhaps connected with the exploitation of raw materials, or the transformation and distribution networks. I suggest that the abandonment of many Late Neolithic/Chalcolithic settlements, could actually be an effort to get progressively closer to something, for instance to a more accessible or easier to exploit raw material source, or one that is better connected with skilful craftsmen, rather than an effort to move rapidly away from something (rise of water level, foreign invaders, etc.). Two examples illustrate this hypothesis.

The first concerns stone-, and more specifically, marble-working. It is known that much of the marble objects found in northern Greek settlements in the late 6th – early 5th millennia (LN I Dispilio, Limenaria) are made from marble coming from the Cyclades.[74] At a first glance, such an import seems surprising, especially on an island like Thasos, which has very good quality marble

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69 We mean here by 'decline' both the decrease, in quantity, of painted wares and the drop in technical skill or sophistication, compared to the more high-skilled productions of the previous MN and LNI periods. Which is actually, as I have stated elsewhere (Tsirtsoni 2010), one of the reasons why the cultural changes that take place at the end of the Neolithic are less visible in southern than in northern Greece.

70 The brown-on-cream 'classic Dimini' painted pottery travels as far as Greek western Macedonia and Albania: Kotsakis 2010. The Black-on-Red from Greek eastern Macedonia is exported along the entire Struma Valley and down to Thessaly: Malamidou et al. 2006; Tsirtsoni et al. 2007.

71 Recent evidence from Dikili Tash indicates, however, that Black-on-Red Pottery is produced with the same standards until at least the last quarter of the 5th millennium (4300–4200 cal BC): see <http://chronique.efa.gr/index.php/fiches/voir/3406/ > (last access 25.7.2014); Darcque et al. forthcoming b.

72 The idea of a gradual decline of pottery in northern Greece as well is also found in Demoule – Perlès 1993, 401.

73 Mee 2011, 10.

74 Yfantidis 2008, 81; Maniatis et al. 2012. The possibility is still under investigation at other settlements like Dikili Tash or Promachon-Topolnitsa, where fine marble objects (vases, beads) are found in both LNI and LNII/Chalcolithic contexts. For Dikili Tash: see Darcque – Tsirtsoni 2010, 60 fig. 9. For Promachon: Koukouli-Chryssanthaki et al. 2007, 73 fig. 53.

sources and in antiquity was itself a major exportation centre.[75] One has to admit that either the Neolithic inhabitants had not yet discovered these sources, or, more likely, they did not have the know-how to work them. The number of objects increases over time, both in these areas and further north (e.g. in northeast Bulgaria);[76] and although their provenance has not been determined by analysis, most scholars feel comfortable with the idea that they may derive from the south, as part of the long-distance exchanges taking place in the well-established socio-economic system of the Aegean-Balkan *'koini'*.[77]

We could presume that at some time towards the end of the 5th or the beginning of the 4th millennium BC, the inhabitants of such a site, for instance Limenaria, would have decided to move closer to the source, in order to acquire the skill or gain greater benefit from this exchange system.[78] Perhaps, it was only part of the village's inhabitants that moved, whereas others (those that were not interested in this type of craft-working or exchange) stayed on the island. The latter could have eventually joined their neighbours at Kastri (an already existent settlement in the nearby mountains)[79] and continued to live in their mixed economic system, whereas the former (the 'migrants') would have participated in the further consolidation of exchange networks between the two sides of the central Aegean. This is of course only one among several scenarios, but it might have been one of the components of the progressive shift from the northern to the southern Aegean, and the replacement of the very long-distance exchanges of the 6th–5th millennia by the mid-distance exchanges of the 4th millennium.

The second example concerns metals. This would not be the first time that the transfer of metallurgical activity correlates with the depopulation (true or apparent) of a particular region in the Balkans. Indeed, it seems that the abandonment of several sites of the Late Neolithic Vinča 'Culture' in Serbia, including Vinča itself, is associated with the cessation of the pioneering metallurgical centre of Rudna Glava. According to the recent ^{14}C dates, this event took place as early as 4600 cal BC[80] and could be one of the explanations for the particular growth of the Bulgarian Chalcolithic sites in the following centuries, when the activity moved to the copper mines in the present Bulgarian territory (Aibunar, Medni Rid, etc.).[81] A shift in the opposite direction (towards the area of the Bodrogkeresztúr Culture) is believed to have occurred at the end of the 5th millennium.[82] However, other movements might have existed as well.

In Greece, the first metal objects also appear in Late Neolithic I (i.e. before 5000 BC), but the first evidence of local metalworking date to the Late Neolithic II.[83] Firm evidence concerning the

75 Koukouli-Chryssanthaki et al. 1999.

76 Vases at Varna (Le premier or de l'humanité, 134: cat. Nr. 275; 138–139: cat. Nr. 291–293), marble bracelets at Durankulak (Avramova 2002, 198). Also, marble figurine and 'button' in Hotnica (Chochazdiev – Chochazdiev 2006, 65 figs. 3.2, 6.); the latter with exact parallels at Dikili Tash.

77 Chapman 2013, 324, postulates that the marble conical rhyton found at Varna, as well as other objects in the same area, are of Aegean origin, although not necessarily Cycladic: he considers more probable a manufacture in western Anatolia, based on the evidence from the workshop at Kulaksizlar (Takaoğlu 2005; Takaoğlu 2011). The existence of such a workshop definitely strengthens the hypothesis of a 5th millennium network of marble-working on both sides of the Aegean; it does not speak, however, against the existence of similar workshops in the islands, whether in the Cyclades or the Dodecanese, given that both those areas display, in addition to raw materials, several sites with complete or fragmentary specimens: Kea-Kephala (Coleman 1977, 106, pl. 23); Samos-Tigani (Felsch 1988, 221–222, pl. 75); Strofilas (Televantou 2009, 136).

78 In the precise case of Limenaria, the time of abandonment would most probably lay in the years around 3900/3800 BC: see Maniatis – Fakorellis 2012, 287, tab. 1. However, the site's sequence displays also an important hiatus in the course of the 5th millennium; consequently, it is not impossible that the transfer process had started earlier.

79 The coexistence of the two settlements has been confirmed by ^{14}C dates produced in the frame of the 'Balkans 4000' project; see Koukouli – Papadopoulos, in Tsirtsoni forthcoming a.

80 Borić 2009.

81 Which were, however, already active in the Late Neolithic.

82 Pernicka et al. 1997, 131–133; Pernicka – Anthony 2010, 170–173.

83 Zachos 1996; Zachos 2010; Zachos – Douzougli 1999.

exploitation of copper mines in northern Greece is lacking, although it is known that copper is present in many areas (e.g. Pangaion, Chalkidiki, the Rhodopes).[84] On the other hand, the exploitation of copper, gold and silver mines in southern Greece (Sifnos in the Cyclades and Lavrion in Attica) is not directly attested before the 4th millennium BC,[85] although isotope analysis of objects found in 5th millennium contexts suggests that it might have started earlier.[86] What does all of this tell us? That, like in the case of marble, there may have been a north–south transfer of populations connected with the exploration (or the more intensive exploitation) of southern resources, and possibly with the exploration of new techniques.[87] In this scenario, the 'entrepreneurial' and most visible part of the society migrated, leaving behind the rural, more conservative population. The latter was, however, far from being cut from the developments, as illustrated by Mikrothives (an apparently flourishing settlement with a mixed economy, open to exchanges with both the southern Aegean and central Europe)[88] or its contemporary Doliana in Epirus (a smaller site in a relatively remote mountainous area, which produced pottery displaying connections with central Europe).[89]

Could a similar transfer and exploration of new resources also take place towards the east (Anatolia)? The question deserves to be examined. Such a movement could explain some of the 'peculiar' 4th millennium assemblages found there (İkiztepe),[90] or the presence of a mid-4th millennium bronze workshop as far as Çamlıbel Tarlası, in north-central Anatolia, where 'ring-idols' were produced among other items.[91]

In summary, in the aforementioned scenario, the 5th millennium Aegean-Balkan civilisation would have dissolved slowly into a number of components, under a series of pressures whose details are still unclear. Some of these components continued to develop locally, whereas others moved further away. In this way, the Late Neolithic/Chalcolithic populations would have abandoned part of the external shape of their socio-economic organisation in the places where it was previously present, but they would have preserved its 'essence'. The re-composition of the descendants of those original populations, mixed with new ones, produced the phenomena of the late 4th millennium. This same 'essence' ultimately afforded a new cultural form, which was different from the previous one, and yet very much alike.

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84 The question of gold is put in different terms since it is believed that most of the gold used for Neolithic/Chalcolithic ornaments is of alluvial origin, and, therefore, could be collected in riverbeds.

85 Wagner – Weissgerber 1985.

86 McGeehan-Liritzis 1988; Gale – Stos-Gale 2008. The validity of the archaeological context is questionable only for the silver jewels from Diros. They were recovered from outside the cave and could actually be of a different date.

87 This might be especially true for silver, whose production seems to start earlier in the Aegean than in the Balkans. For the present state of research, see the papers of Kakavogianni et al. 2008, Papadopoulos 2008, Vasilakis 2008.

88 Adrymi-Sismani 2007; Tsirtsoni, forthcoming a.

89 Douzougli – Zachos 2002. Here too, like in Mikrothives, are found the characteristic 'Bratislava bowls'; for the distribution of such vessels, see state of research in Bondar 2002.

90 Zimmermann 2007, 216–217; Düring 2011, 236.

91 Schoop 2009, 65, fig. 62.

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Times of Change: Greece and the Aegean during the 4th Millennium BC

Eva Alram-Stern[1]

Abstract: This paper deals with the cultural development of the Greek mainland and the Aegean from the Chalcolithic (Attica-Kephala Culture, Athens North Slope phase) to the beginning of the Early Bronze Age (Pelos Culture). This period is visible in the landscape by an augmentation of sites in areas neither favourable to agriculture nor settled in earlier periods. This augmentation is seen in connection with the adoption of a new agricultural system and as the result of a higher frequency of relocation of settlements. The few architectural remains so far excavated show a delimitation of settlement area by walls and ditches. House plans point to a high variability in house architecture. The Chalcolithic also sees the emergence of new burial customs including extramural cemeteries. Throughout the Aegean, the pottery of this period has a quite homogeneous character from a technological point of view. Already during the Attica-Kephala Culture crusted ware and scoop-shaped vessels are distributed over a wide area. During the Athens North Slope phase so-called Heavy Burnished Ware with its characteristic shapes becomes frequent throughout the Aegean. The highly prestigious eating or drinking bowls of type Bratislava appear from the Balkans to central Greece and so-called 'cheese pots' are widespread throughout the Aegean. Such distribution of special purpose vessels points to similar technological developments over a wider geographical area. Concerning metallurgy, lead isotope analysis of copper objects indicates a close relation between Aegean metallurgy and that of the Balkans but also a growing importance of northern Greek sources. Copper is exploited in the central Cyclades on Kythnos and Seriphos as well as in Laurion in Attica; silver from Laurion and Siphnos also gains in importance. An intensification of exploitation of these sources probably led to the emergence of independent Early Bronze Age cultures in the Aegean. Ring pendants as known from the Balkans are produced and distributed as far as the southern Aegean. Axes and daggers are used from the beginning of the 4th millennium BC. Whereas axes lose ground in the central and southern Aegean, daggers soon become part of the attire and function as status symbol in warlike Early Bronze Age society.

Keywords: Greece, Aegean, Chalcolithic, Early Bronze Age, settlement patterns, pottery, metallurgy

The aim of this paper is to point out cultural developments present in the finds of the 4th millennium BC in central and southern Greece, as well as in the central and western Aegean. The time frame encompassing the 4th millennium includes the period that in Greek prehistory has been named the Final Neolithic.[2] Due to the increasing evidence of metal tool production during this period, German scholars prefer the term Chalcolithic.[3] Accordingly, the last centuries of the 4th millennium are connected to the initial phase of Early Bronze Age I (Fig. 1).

Chalcolithic Chronology in Central and Southern Greece

According to the work conducted by Colin Renfrew and David French in southern Greece this Chalcolithic or Final Neolithic period should be separated into two stages, the Attica-Kephala Culture and the Athens North Slope phase.[4] Research carried out by Joseph Maran shows that, in Thessaly, the Attica-Kephala Culture should be chronologically equated with the so-called Rachmani period, and the Athens-North Slope phase synchronised with a development found

1 Institute for Oriental and European Archaeology OREA; Austrian Academy of Sciences; Austria; email: eva.alram@oeaw.ac.at.

2 Renfrew 1972, 68–80.

3 Dousougli 1992; Maran 2000, 179–184.

4 French 1972, 17–18; Renfrew 1972, 68–80.

Calibr. Data		Central and Southern Greece	Cyclades	Thessaly	North Eastern Aegean /Troad	Crete
2200 2500	EH IIB EC IIB/III	Lerna IIIC–D Lefkandi I	Kastri-Group Agia Irini III	Pevkakia-Magula 6–7	Poliochni Giallo	EM IIB
2700	EH IIA EC IIA	Lerna IIIA–B	Keros-Syros Agia Irini II	Pevkakia-Magula 1–5	Poliochni Rosso Poliochni Verde	EM IIA
2900	EH I Late EC I Late	Talioti Eutresis IV Perachora Y–Z Tsepi	Kampos Group Markiani II	Argissa Magula I	Poliochni Azzurro Late	EM IB
3100	EH I EC I	Perachora X Eutresis III Tsepi	Plastiras Group Zas III Pelos Group	Petromagula-Phase	Poliochni Azzurro Early	EM IA
3500	Younger Chalcolithic	Athens N. Slope Franchthi 5b	Zas IIB		Kumtepe B Poliochni Nero	Final Neolithic IV
4300	Chalcolithic	Attica-Kephala-Culture	Attica-Kephala-Culture	Rachmani-Culture		

Fig. 1 Chronological chart.

in Petromagula, Thessaly. The latter contains pottery connecting it with the Pelos Culture in the Cyclades, which is usually interpreted as part of Early Bronze Age I.[5] However, tomb finds in the Cyclades,[6] as well as settlement finds on Crete indicate[7] that the mainland Athens North Slope phase, representing the latest component of the Chalcolithic period should not be equated with the Cycladic Pelos Culture, although both probably overlapped chronologically. Therefore, the phases discussed in this paper will be referred to as an earlier and a later Chalcolithic phase; the latter transitions into the Early Bronze Age of Greece.

These phases are traditionally characterised by pottery, the Attica-Kephala Culture by red ware with pattern burnishing, crusted ware and scoops which often have incised decoration.[8] Contrary to earlier periods of Neolithic Greece, coarse pottery dominates over fine wares. During the later Chalcolithic phase, the dark so-called Heavy Burnished Ware appears; one of its characteristic shapes is the rolled rim bowl.[9]

Stratigraphic evidence for such a development is sparse, most likely due to settlement relocation. In southern Greece sequences are not evidenced from settlements but cave sites, such as the Franchthi Cave in the southern Argolid,[10] the Skoteini Cave near Tharrounia on Euboea,[11] as well as the Zas Cave on Naxos.[12] A similar phenomenon is present in Thessaly where the site of Pevkakia Magula only produced Rachmani strata[13] while cultural layers chronologically

[5] Maran 1998, 135–139.
[6] Rambach 2000b, 103–108, 431, 446, fig. 26.
[7] Nowicki 2002, 53–54; Papadatos 2008, 260–262.
[8] Alram-Stern 1996, 157–159; Alram-Stern 2007, 2–4; Nazou 2010, 8–9.
[9] Vitelli 1999, 82–83, 98–99; Alram-Stern 2004, 154–155; Phelps 2004, 117–118.
[10] Vitelli 1999, 15–21, 64–95.
[11] Sampson 1993, 21–198.
[12] Zachos 1999, 153–154.
[13] Weißhaar 1989.

	Site	Material	Lab.-no.	^{14}C Age BP	Calibrated Date	Reference
Ch early	Pevkakia Magoula, lower Rachmani layer	charcoal	Pta 1405		3680 + 50 uncal	Weißhaar 1989, 139
	Pevkakia Magoula, middle Rachmani layer	charcoal, carbonized fruit	Pta 465		3560 + 65 uncal	Weißhaar 1989, 139
	Pevkakia Magoula, upper Rachmani layer	wood, bone	Pta 436		3570 + 80 uncal	Weißhaar 1989, 139
	Pevkakia Magoula, upper Rachmani layer	charcoal	Pta 435		3820 + 70 uncal	Weißhaar 1989, 139
	Spilaio Limnon, Kastria III	charcoal	DEM-270	5446+29	4348–4239	Phakorellis – Maniatis 1997, 530
	Spilaio Limnon, Kastria III	charcoal	DEM-271	5484+34	4446–4247	Phakorellis – Maniatis 1997, 530
	Spilaio Limnon, Kastria III	charcoal	DEM-344	5438+45	4355–4160	Phakorellis – Maniatis 1997, 530
	Spilaio Limnon, Kastria III	charcoal	DEM-550	5311+29	4234–4005	Phakorellis – Maniatis 1997, 530
	Spilaio Limnon, Kastria III	charcoal	DEM-549	5395+27	4333–4151	Phakorellis – Maniatis 1997, 530
	Spilaio Limnon, Kastria III	charcoal	DEM-394	5444+105	4466–4002	Phakorellis – Maniatis 1997, 530
	Spilaio Limnon, Kastria III	charcoal	DEM-395	5657+32	4545–4400	Phakorellis – Maniatis 1997, 530
	Alepotrypa Cave		DEM D94-3	5540+30	4456–4338	Zouridakis – Papathanassopoulos 1995, 18
	Alepotrypa Cave		DEM D94-4	5465+30	4354–4248	Zouridakis – Papathanassopoulos 1995, 18
	Alepotrypa Cave		DEM D94-9	5500+30	4440–4264	Zouridakis – Papathanassopoulos 1995, 18
	Agios Dimitrios Phase I	charcoal	HD-10020	5400+35	4338–4053	Zachos 1987, 305
	Agios Dimitrios Phase I	charcoal	HD-10163	5330+75	4330–3990	Zachos 1987, 305
	Franchthi Phase 5.1	charcoal	P-1660	5261+64	4310–3970	Vitelli 1999, 138
	Franchthi Phase 5.1		P-1659	5163+78	4230–3790	Vitelli 1999, 138
Ch late	Mikrothives		Dimokritos		3670-3380	Adrimi-Sismani 2007, 74
	Halieis	shell	P-1397	5102±72	4040–3710 3909–3367 (korr.)	Pullen 2000, 184
	Kephala / Keos	seeds	P-1280	4826±56	3710–3380	Coleman 1977, 110
	Tsoungiza	charcoal	AA-10827	4499±53	3326-3102	Pullen 2011, 51
	Zas Cave IIb	shell	OxA-7470	4345±40	3100-2900	Manning 2008
	Skoteini-Höhle, Tharrounia 3	charcoal	DEM 93-104	4811±42	3675–3528	Sampson 1993, 285
EH I	Eutresis III–IV	charcoal	P-307	4442±64	3340–2920	Caskey – Caskey 1960, 164
	Eutresis III–IV	charcoal	P-306	4446±75	3340–2920	Caskey – Caskey 1960, 164
	Aghia Triada / Chalkis	shell	AAR-9668	4781±42	3080-2930	Heinemeier 2006
	Alepotrypa Cave		DEM D94-1	4180±30	2882–2620	Zouridakis – Papathanssopoulos 1995, 18
	Alepotrypa Cave		DEM D94-2	4280±30	2918–2787	Zouridakis – Papathanssopoulos 1995, 18
EC I	Zas Cave III	wood	OxA-7471	4425±40	3300-2900	Manning 2008
EC I late	Amorgos	bone	OxA-4003	4390±65	3100-2910	Renfrew – Housley – Manning 2006, 73f.
	Amorgos	bone	OxA-3297	4380±100	3110-2880	Renfrew – Housley – Manning 2006, 73f.
	Amorgos	bone	OxA-4004	4160±65	2820-2660	Renfrew – Housley – Manning 2006, 73f.

Fig. 2 Radiocarbon dates of the Chalcolithic and Early Bronze I from the area of Greece.

succeeding the Rachmani phase were observed at the single-phase sites of Petromagula[14] and Mikrothiva.[15] However, this picture may change with the publication of the results from sites like

14 Chatziangelakis 1984.
15 Adrymi-Sismani 2007.

Fig. 3 Important Chalcolithic settlement and cave sites.

Palioskala in Thessaly,[16] Spata in Attica[17] and Strofilas on Andros,[18] which appear to have more than one settlement phase (Fig. 3).

Concerning absolute chronology, ^{14}C dates are sparse. There are a number of dates for the Rachmani and Attica-Kephala cultures while dates for the subsequent phase are extremely rare. Nevertheless, the radiocarbon dates indicate that the Attica-Kephala Culture may commence at around 4300 BC (Fig. 3).[19] On the other hand, the beginning of the Athens-North Slope phase and its northern equivalent are quite insecure. However, they must have developed before the middle of the 4th millennium, perhaps as early as 3800 BC or a little later (Fig. 2). Settlements like Palioskala and Strofilas possibly date to the onset of the later part of the Chalcolithic; unfortunately, these contexts are yet to be published. However, data from Zas Cave IIb and the

16 Toufexis 2009.
17 Steinhauer 2001; Steinhauer 2009, 216–218.
18 Televantou 2008, 43–46.
19 Coleman 1992, figs. 2, 4–5; Johnson 1999; Alram-Stern 2007, 2–4, 7–9, tab. 1.

Alepotrypa Cave are comparably young although their finds correspond with the Athens-North Slope phase. Additionally, the ^{14}C date of Zas Cave III which is attributed to the Pelos Culture clearly overlaps Zas Cave IIb. Therefore, it is likely that the Athens North Slope phase as well as the Pelos Culture are part of a longer cultural sequence commencing before 3500 BC, perhaps as early as 3700 BC and continuing until 2900 BC. These dates also fit with a ^{14}C date for the end of Cretan Final Neolithic and the start of EM I between 3360 and 3020 BC.[20]

Settlement Evidence in Central and Southern Greece

Settlement evidence for the 4th millennium has always been described as meagre. However, according to our present knowledge I would argue to the contrary. If we look at the Peloponnese, a large number of sites are known. The same is true for the region of Attica.[21] Most of the Peloponnesian sites are known from surveys, and their assignment to a phase is uncertain. However, from excavations we see that sites do not necessarily belong to the Attica-Kephala Culture, but many of them actually date to the later part of the Chalcolithic period. In any case, this frequency of sites is probably due to the relocation of settlements which is also observed at the excavated sites.[22] Another interesting fact is the visibility of such often quite eroded sites in surveys.

Based on the distribution of Chalcolithic sites it becomes clear that a large number of sites are known from regions not favourable to agriculture and not settled in earlier periods. Therefore, the southern Argolid survey team argues[23] that such sites may be connected with a new agricultural system, which favours fruit requiring comparably little rainfall. This new system also included herding of sheep and goats. Although archaeozoological and archaeobotanical investigations to prove this assumption do not exist to date, an increase in wool production may be argued by the sudden increase of spindle whorls. This occurrence could also be due to other technological changes.[24]

Architectural remains are presently known from the entire Chalcolithic sequence. Since many sites are only preliminarily published, it is difficult to assign them to a certain period. All in all, we may argue that settlements were often surrounded by circular walls which are at least partly to be interpreted as fortifications. They are known for the earlier phase in Attica at Kiapha Thiti;[25] perimeter walls probably dating to the later phase are found in Spata and Choumeza in Attica,[26] in Palioskala in Thessaly and at Strophilas on Andros. While the walls of Palioskala consist of an inner and outer perimeter,[27] the fortification of Strophilas is characterised by a bastion.[28] In any case, perimeter walls, as well as ditches are already known for Late Neolithic sites in Thessaly and Macedonia, and the Chalcolithic fortifications seem to be a tradition continuing from this time onwards.[29]

Wells are known from the later part of the Chalcolithic period in the settlements of Spata and at Loutsa in Attica.[30] They remind us of the fact that Chalcolithic wells have already been argued

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20 Tomkins 2007, 44.
21 Alram-Stern 2001; Alram-Stern 2003.
22 Johnson 1996; Cavanagh 1999, 54–56; Alram-Stern 2003.
23 Jameson et al. 1994, 347–352.
24 Vitelli 1999, 105–110.
25 Rozaki 1982.
26 Steinhauer 2001; Kakavogianni – Douni 2009, 384; Steinhauer 2009, 216–218.
27 Toufexis 2009, 56–57.
28 Televantou 2008, 43–46.
29 Aslanis 1990; Aslanis 2010, 48–49.
30 Efstratiou et al. 2009, 221–223.

for in Athens.[31] Therefore, we can be sure that wells within settlements were common during the Chalcolithic period. Since fortifications and wells are interpreted as communal works characteristic for a proto-urban society, these architectural features point to a start of such a development in the Aegean during the 4th millennium.

House remains were mainly found in Thessaly in Rachmani itself, in Pevkakia, Palioskala, Mikrothiva and Petromagula,[32] in Strofilas on Andros as well as in Attica in Merenta Markopoulou, Spata-Zagani[33] and Choumeza. Thessaly and Attica remain the best investigated areas for this period (Fig. 3).[34] The longhouse, with rectangular or apsidal plan, traditionally separated from other longhouses by alleys, is a characteristic house type of this period. For the Rachmani period, longhouses are known from Pevkakia[35] and an apsidal house was documented at Rachmani.[36] An apsidal house was also found in Strophilas on Andros.[37] For the later Chalcolithic period, a house with an oval layout has been reported for Choumeza in Attica.[38] Mikrothiva also exhibits longhouses, one of them with three rooms.[39] Free-standing, single-room houses have been discovered in the centre of Palioskala[40] and at Lambrika/Koropi.[41] Subterranean rooms cut into the earth are only reported from Attica at Merenta Markopoulou as well as from the health centre excavations at Koropi.[42]

Cemeteries

The Chalcolithic period seems to be the starting point of peripheral cemeteries consisting of built tombs with individual burials in southern Greece and the Cyclades. The best known examples date to the Attica-Kephala Culture from Kephala on Kea[43] and another, possibly synchronous cemetery in Tharrounia on Euboea.[44] The later Chalcolithic phase seems to introduce similar cemeteries in Attica, present at Tsepi near Marathon,[45] but also in the Peloponnese in Delpriza/Kranidi[46] and ancient Elis.[47] Moreover, these tombs may already be synchronous with the earliest tombs of the Pelos phase (Fig. 4).[48]

These tombs also trace the emergence of the tradition of incorporating certain grave goods, like pyxides and small jars. Furthermore, by this time the deposition of jewellery, as well as objects related to the processing and use of pigments, including palettes and pestles for grinding pigments appear.[49] These objects suggest the beginning of body adornment during this period, a custom that seems to have been prevalent throughout the entire Aegean.

31 Sapouna-Sakellaraki 1985.
32 Chatziangelakis 1984, 76–78.
33 Steinhauer 2001; Kakavogianni – Douni 2009, 384; Steinhauer 2009, 216–218.
34 Aslanis 2010.
35 Weißhaar 1989, 11–12.
36 Wace – Thompson 1912, 37–40.
37 Televantou 2008, 45–46.
38 Kakavogianni – Douni 2009, 384.
39 Adrymi-Sismani 2007, 73–74.
40 Toufexis 2009.
41 Kakavogianni 2009, 239–241.
42 Kakavogianni et al. 2009, 161–169.
43 Coleman 1977, 44–97.
44 Sampson 1993, 233–240.
45 Pantelidou Gofa 2005, 324–326.
46 Kossyva 2010.
47 Rambach 2007.
48 Doumas 1977, 49–53.
49 Cyclades: Rambach 2000a, 107–108; Tsepi: Pantelidou Gofa 2005, 320–323; Elis: Rambach 2007, 66–68.

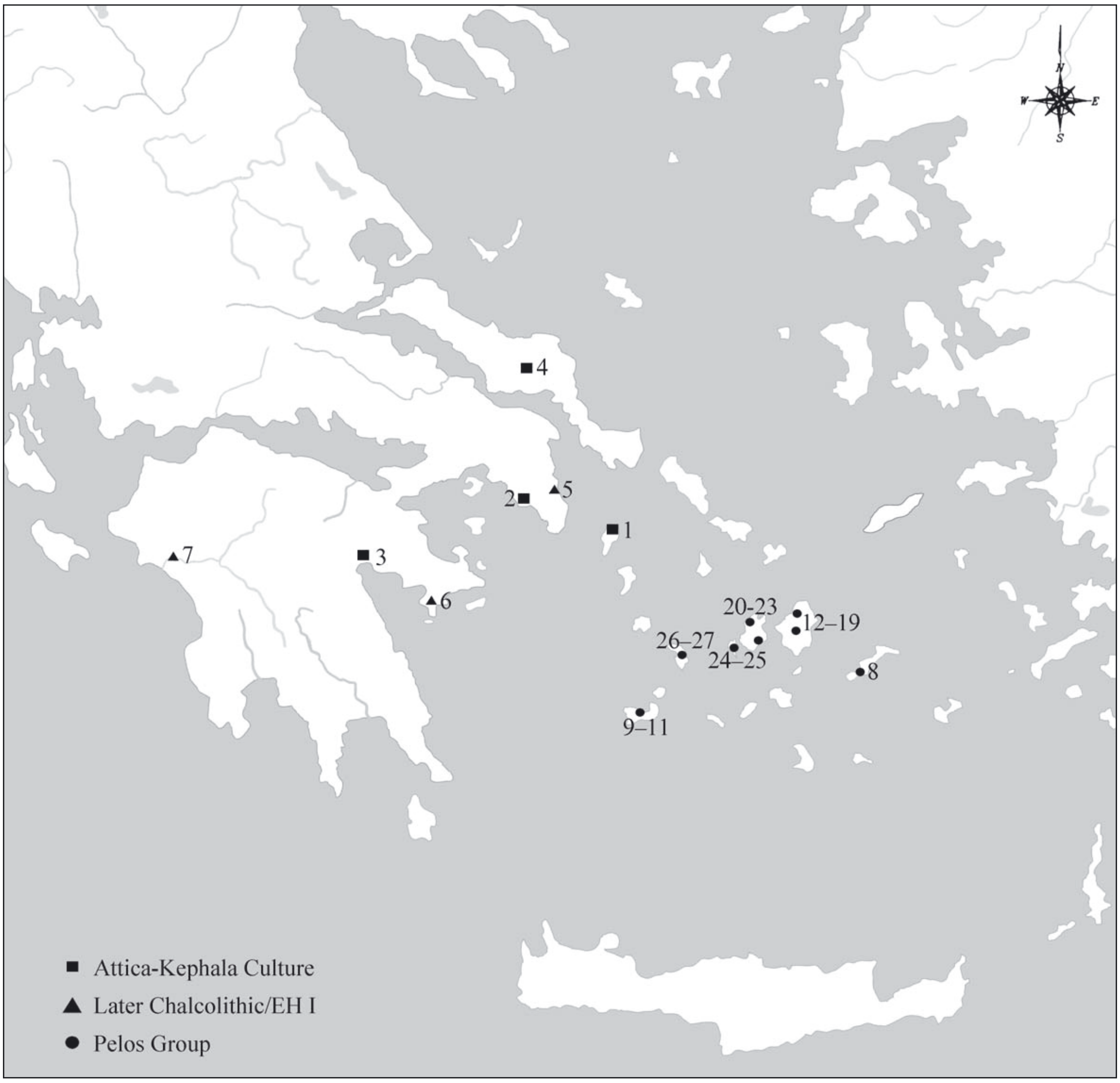

Fig. 4 Cemeteries of the Attica-Kephala Culture, the Late Chalcolithic period and the Pelos Culture.

Figurines

Human stone and clay figurines are known from the earlier phase of the Chalcolithic period from settlement contexts or ritual depositions in settlement areas and in burial grounds,[50] but they are not recovered directly from the graves. Furthermore, there is no evidence for figurines in later Chalcolithic contexts, although they appear again during Early Bronze I.[51]

Pottery

As aforementioned, the ceramic data indicate two distinguishable phases for the Chalcolithic. During the earlier phase, decorated pottery is characterised by crusted decoration mainly found on bowls. This trait occurs abundantly in Thessaly as well as southern Greece.[52] Pattern burnish-

[50] E.g. Kephala on Kea: Coleman 1977, 8–9; Kolonna on Aegina: Felten – Hiller 1996, 67.

[51] Przytula-Wojczyk 2010.

[52] E.g. Pevkakia: Weißhaar 1989, 21–22; Franchthi: Vitelli 1999, 68–70, 73–74; Ayios Dimitrios: Zachos 2008, 17; Lerna: Vitelli 2007, 354–355, fig. 85.

Fig. 5 Pattern burnished pottery of the Attica-Kephala Culture.

ing covering the entire vessel frequently appears in central and southern Greece and the Aegean,[53] but is uncommon in Thessaly. Typically, this decoration is mainly restricted to bowls that quite often display so-called elephant lugs. Pattern burnishing is also known from the eastern Aegean, but differs in style (Fig. 5).[54] Scoops with perforated and incised basket handles – high-swung perforated strap handles, quite often also decorated with incised lines – and incised decoration are typical for this period and may have been used for ritual purposes. They are known from Thessaly to southern Greece and the Aegean islands. The shape of the scoop shows a longer development going back to the Late Neolithic period.[55]

As has been mentioned above, on the Greek mainland as well as in the Aegean, the later Chalcolithic period is characterised by the so-called Heavy Burnished Ware. Shapes of this phase from

53 Coleman 1977, 11–12; Zachos 1987, 699, fig. 9; Mari 1993, 136–152, figs. 135–149; Zachos 2008, 17.

54 Alram-Stern 1996, 147–148.

55 Misch 1992, 27–28; e.g. Sesklo: Papathanassopoulos 1996, 263–264, fig. 116; Kephala: Coleman 1977, 62, 87, pls. 36.173; 36.102.

the Franchthi Cave include collared jars, carinated bowls and collared bowls which often have horizontal tubular lugs.[56] One of the most characteristic shapes is the bowl with a rolled rim. It is abundant at most sites throughout Greece, e.g. at Lerna in the Argolid, Tharrounia on Euboea, in Petromagula in Thessaly, as well as in the Zas Cave on Naxos.[57] Such bowls are also well-known from northwestern Anatolia in Kumtepe B[58] and Poliochni Nero[59] and considered characteristic of this horizon.[60] Their wide distribution is also evidenced by their appearance on Crete. Within this context, rolled rim bowls should be connected with a phase, which Peter Tomkins has defined as Final Neolithic IV.[61] Rolled rim bowls continue to be used on the Cyclades during the EC Pelos phase, as well as throughout the Kampos phase, however, their use ceases with the Keros-Syros Culture (Fig. 6).[62]

Another widely distributed shape that expands into the eastern Balkans to Macedonia and to the Peloponnese is a small jar with with fluted (channelled) decoration on the body.[63] This shape has clear connections to the horizon of Cernavoda III – Boleraz and should, therefore, help to synchronise our Late Chalcolithic period with the earliest Balkan Early Bronze Age.[64]

A shallow, rounded bottom bowl with an incised central motif, often of spiralled design, also connects the Balkans and even central Europe with the Aegean. Joseph Maran who was the first to observe this feature has called it bowl of type Bratislava.[65] It has a distribution pattern that extends from central Europe to northern Greece, Thessaly and Attica. The large number of pieces from Mikrothiva demonstrates that this shape was quite common in certain places and must have been part of an eating and drinking set which was used from the northern Balkans to central Greece.[66] Moreover, in Mikrothiva and Petromagula, this shape was used in addition to rolled rim bowls.[67]

A bowl on a high conical stand is another form to be mentioned. This shape does not seem to be common during the earlier part of the Chalcolithic period. The earliest examples were recovered from a pit in the cemetery of Tsepi, from a pit in Kolonna/Egina as well as from a cemetery at Delpritza.[68] As such, this shape seems to be highly connected with some sort of ritual, mainly taking place in cemeteries. Interestingly, good parallels for chalices of this period come from Poliochni Nero and point to certain relations to the eastern Aegean.[69] Therefore, we see that shape and decoration of eating and drinking sets of the earlier Chalcolithic period are confined to the Aegean while eating and drinking vessels of the later Chalcolithic period show connections to the Balkans and to northwestern Anatolia.

Far reaching connections are also demonstrated by the presence of coarse wares. A very characteristic shape of the Chalcolithic period is the so-called 'cheese pot'. This name is used to describe vessels with a row of perforations under the rim. Most unique are low rim pans with a coarse outer side and burnished interior. The function of this shape is uncertain. In fact, these ves-

56 Vitelli 1999, 82–83, 98–99.

57 Chatziangelakis 1984, 80, fig. 3.13–14; Zachos 1987, 699, fig. 10; Sampson 1993, 161–162, fig. 121.9–12; Vitelli 2007, 350–351, fig. 83; Zachos 2008, 35, 120, fig. 34; Papathanassopoulos 2011, 177–178, no. 124; Koukounaries: Katsarou-Tzeveleki – Schilardi 2008, 69–70; Poros-Katsambas: Wilson et al. 2008, 263, fig. 26.2.

58 Gabriel 2000.

59 Manning 1995, 74–76.

60 Alram-Stern 2007, 5.

61 Nowicki 2002, 53–54; Papadatos 2008, 260–262.

62 Karantzali 1996, 120; Rambach 2000b, 417–418.

63 Sitagroi: Sherratt 1986a, 434–435; Eutresis: Caskey – Caskey 1960, pl. 47.III, 10; Lerna: Vitelli 2007, 342–345, figs. 79e–f, h; 80e, g–h; Alepotrypa Cave: Papathanassopoulos 2011, 169–170, no. 117.

64 Alram-Stern 2001.

65 Maran 1998, 40–41, 344–346, tabs. I–IV; Coleman 2011; Zachos – Douzougli forthcoming.

66 Adrymi-Sismani 2007, 76.

67 Chatziangelakis 1984, 81; Adrymi-Sismani 2007, 76.

68 Tsepi: Pantelidou Gofa 2008, 284–285, fig. 28.11, 13; Kolonna: Felten et al. 2011; Delpriza: Kossyva 2010.

69 Tinè 1997, 37–38.

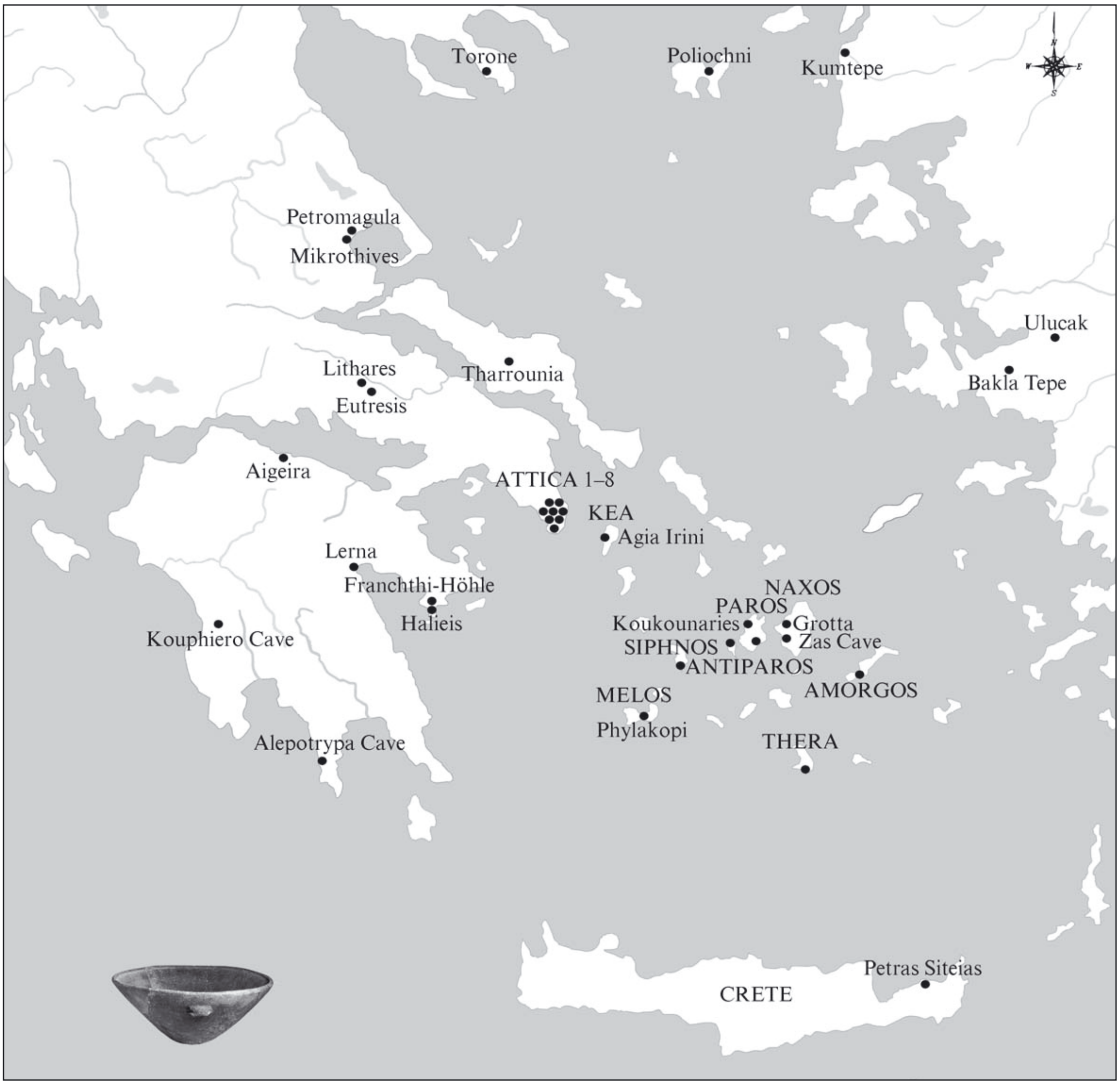

Fig. 6 Rolled rim bowls and their distribution during the Late Chalcolithic period (1–8: Athens, Kitsos Cave, Koropi Health Centre, Laurion, Leontari Cave/Hymettos, Merenda Markopoulou, Tsepi, Zagani) according to selected published finds (Alram-Stern 2004 with additions; see also this volume).

sels could have been used to process milk,[70] but it is also possible that they were used for cooking. This idea is supported by the coarse clay, which is especially resistant to heat. The production of cheese pots may have taken place during the 5th millennium, but their widest distribution dates to the later Chalcolithic period.[71] During this period, they were used in the Cyclades, on the Greek mainland, but also in the southeastern Aegean and in coastal settlements of Crete. Therefore, these forms document an intensive interaction sphere within the entire Aegean including its northern as well as its southern region, i.e. the Dodecanese and Crete (Fig. 7).

[70] Cavanagh 2007, 116.

[71] 5th millennium: Ftelia: Sampson 2002, 61–70; 4th millennium: Tharrounia: Sampson 1993, 182–183, figs. 187–188; Katsarou-Tzeveleki – Schilardi 2008, 70; Crete: Nowicki 2002, 54, 59, 62–63, figs. 32–33; Dodecanese: Sampson 1987, 89–90.

Fig. 7 So called cheese pots, distribution according to published finds (after Nowicki 2002; Alram-Stern 2004, for further additions see this volume).

Coarse fabrics are also used for storage vessels, which are produced in the entire Aegean in large quantities from the Late Neolithic period onwards.[72] The production of large vessels can be viewed as a technical achievement. Furthermore, storage vessels may have been favoured over other storage facilities. In any case, the storage of food was of eminent importance to people living in areas with unstable crop yields.

72 E.g. Lerna: Vitelli 2007, 358–367 figs. 87–90; Alepotrypa Cave: Papathanassopoulos 2011, 157–163, nos. 104–110.

Fig. 8 Chalcolithic copper finds in Greece and the Aegean (after Zachos 2010, figs. 6–4).

Metallurgy

Finally, one of the most important fields of study of the Chalcolithic period is metallurgy. However, in this paper it is only possible to provide a brief outline of the most recent research results.[73] In Greece, it is during the Chalcolithic that we see evidence for the earliest local extraction and production of metal objects (Fig. 8).[74]

73 See the two latest conferences on metallurgy: Day – Doonan 2007; Tsachili 2008.

74 Zachos 2007.

Fig. 9 Ring pendants and straps of gold, ring pendants of silver and other material (after Zachos 2010, figs. 6–4).

According to lead isotope analysis, objects from Sitagroi in Macedonia and an axe from Dimini probably were made of copper from the Black Sea area. Conversely, Aegean sources on the islands of Kythnos and Seriphos and in Laurion/Attica were probably exploited during the late 5th and early 4th millennia. Analyses show that the copper axe from Sesklo and an axe from Alepotrypa Cave had lead isotopes similar to Laurion. In any case, copper was melted in Plakari, in Kephala/Kea and on Phtelia/Mykonos.[75] Additionally, new research from northern Greece points

75 McGeehan-Liritzis – Gale 1988, 207, 211–213; McGeehan-Liritzis 1996; Stos-Gale – Gale 2003, 87–88; Gale – Stos-Gale 2008, 399–400, tab. 37.7; Gale et al. 2008, 102.

to the possibility that copper was produced from the ores on Thasos and the Chalcidice peninsula.[76]

Recent evidence for mining and smelting of copper dating to the Late Chalcolithic comes from Attica. Copper slags from a salvage excavation were recovered in the area of the Health Centre of Koropi.[77] The slags indicate that copper was mined in the area around Lavrio during this time. Furthermore, smelting in crucibles is also present at the same site.[78]

Copper weapons found in the Aegean are confined to axes and daggers. Their use provides evidence from the time of the earlier Chalcolithic period onwards to the later Chalcolithic. In contrast to the Balkans, the use of daggers never ceased, but continued throughout the Early Bronze Age and became one of the status symbols of the Early Bronze Age Aegean.[79]

Apart from copper, gold and silver were used for the production of objects such as jewellery. Gold is found in rivers of northern Greece[80] but is absent in the entire Aegean. Therefore, gold was most likely imported to the Aegean and its presence should be associated with middle to far distance exchange systems. Moreover, these gold objects, gold sheets and so-called ring idols, which are now distributed in the Aegean, can be connected with the Balkans.[81] Most gold objects from closed contexts were connected with Early Chalcolithic contexts,[82] but gold straps were also found in a grave of the Late Chalcolithic cemetery of Tsepi at Marathon.[83]

These ring pendants seem to be a symbolic marker, as can be seen by their representation on Thessalian and southern Greek pottery and in a rock carving in Strophilas on Andros.[84] Ring pendants were also produced from other materials, e.g. stone or silver.[85] Most of these artifacts come from settlement contexts, but they are also found in caves.

This brings us to the exploitation of Aegean silver sources during the Chalcolithic period in the area of Laurion and at Siphnos. The exploitation of Siphnos during the period of the Attica-Kephala Culture is confirmed by pottery finds in the mines.[86] In the meantime, research in the small galleries of Laurion has provided evidence for mining during this period.[87] For the later part of the Chalcolithic period, the cupellation of silver is also acknowledged by the recovery of a bowl-shaped litharge at the site of Merenda Markopoulou.[88] The presence of litharge is indicative of cupellation in bowl-shaped hollows and is also observed in Late Chalcolithic contexts in Lambrika in Attica. Such finds also exist in Limenaria on Thasos[89] and Habuba Kabira in Syria.[90] Two silver ring pendants can be dated to the 5th millennium by their contexts;[91] all the other finds were out of context. The ring pendant from Alepotrypa Cave, which was produced from Laurion

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76 Papadopoulos 2008, 66; Morris 2009/2010, 5–8.

77 Kakavogianni et al. 2008.

78 Amzallag 2009.

79 Zachos-Douzougli 1999, 966–967; Adrymi-Sismani 2007, 77; Zachos 2007, 173; Zachos 2010, 87. For the evidence of the later Early Bronze Age I on Crete and in the Cyclades see Sherratt 2007, 249–250. For a new find of an axe at Palioskala: Toufexis 2009, 59, fig. 11.

80 For Chalkidike: Morris 2009/2010, fig. 6.

81 Zachos 2010, 80–84.

82 Distribution of objects of gold in Greece: Zachos 2010, 82–83, figs. 6–4; for ring pendants of gold see Demakopoulou 1998, 51–58, 62–63, nos. 3–35, 56–58.

83 Pantelidou Gofa 2005, 91–97, 319.

84 Representation on pottery: Demakopoulou 1998, 68, figs. 75–76; Vitelli 1999, fig. 64; Strophilas: Televantou 2008, 49–50, figs. 6, 10; Nazou 2010, 9.

85 Ring pendants of stone: Demakopoulou 1998, 66–67, nos. 67–74; ring pendants of silver: Demakopoulou 1998, 64–65, nos. 62–64 (Salamis, Amnisos Cave, Alepotrypa Cave).

86 Gropengiesser 1987.

87 Gale et al. 2008.

88 Kakavogianni et al. 2008, 49–50.

89 Papadopoulos 2008, 64–65.

90 Kakavogianni et al. 2008, 47–48.

91 Zachos 2010, 88.

Fig. 10 Extraction and objects of silver of the Chalcolithic period.

silver, has unfortunately been published without context.[92] However, Chalcolithic pottery from Alepotrypa Cave points to the later phase of the Chalcolithic period. A silver bead necklace was recovered from the same cave and compares with necklaces of later Early Bronze I from Louros on Naxos and Gournes on Crete. Such associations could, therefore, point to a later Chalcolithic date.[93] Grave 12 of Tsepi also contained silver decorations, which can be dated to the Late Chalcolithic.[94]

92 Maran 2000, 187; Papathanassopoulos 2011, 216, 163.
93 Rambach 2000b, 217; Galanaki 2006, 229–232.
94 Pantelidou Gofa 2005, 91–97, 319.

Conclusion

Early Chalcolithic traditions incorporate Late Neolithic traditions often influenced by the Balkan, for example, fortifications from Thessaly, metallurgy, metal tools (e.g. daggers and axes) and ring idols. However, pottery indicates that an Aegean network, which connected raw material sources like silver and copper mines and obsidian outcrops with the mainland, was already established. Moreover, this network distributed prestige objects such as daggers and ring idols. Such a network could be responsible for the spread of fortifications in the Aegean.

During the Late Chalcolithic, new influences are seen in pottery forms and in the disappearance of symbolic items, such as ring pendants and human figurines. However, in settlement architecture fortifications and wells are present, which suggests an expansion in social organisation. This social continuity is also seen in the continual use of daggers as weapons. It seems as if the use of local metal sources intensified. This development ultimately points to the increasing importance of the Aegean during the Early Bronze Age.

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The Emergence of Trade and the Integration of Crete into the Wider Aegean in the Late 4th Millennium: New Evidence and Implications

Yiannis Papadatos,[1] *Peter Tomkins*[2]

Abstract: Ever since the definition of a Bronze Age in the Aegean, more than a century ago, explanations for its origins have been sought in an intensification of external contacts, traditionally placed in EB I. However, the precise nature and timing of these contacts and the social contexts in which they developed have long remained unclear due to insufficient data. While recent decades have seen an upsurge in detailed investigations of late EB I–II coastal sites, coastal sites of the 4th millennium BC (and earlier) have not been similarly treated. Consequently we have had no means of exploring when, how or why Crete's relations with the Aegean first intensified. Drawing on the results of recent excavations at the FN IV–EM IA coastal site of Kephala Petras in east Crete, a picture is sketched of an early trading community of the late 4th millennium BC, which, thanks to its off-island connections enjoyed preferential access to valued raw materials, to the technologies for their transformation and to finished objects. This monopoly over the resource of distance was in turn exploited locally and regionally in east Crete, as a social strategy, to construct advantageous relationships with other communities. As such Kephala Petras appears to represent the earliest of a series of such gateway communities, which are known to have operated along the north coast of Crete in later periods. The implications of this are also discussed in the light of additional evidence from neighbouring regions, as part of an effort to understand the dynamics of the long-distance trading networks that emerge in this period in the Aegean.

Keywords: Aegean, Crete, Kephala Petras, Final Neolithic, Early Bronze Age, trade, gateway communities, coastal sites

The late 4th millennium in Crete, which in relative terms corresponds to the Final Neolithic (hereafter FN) III and IV phases and the very beginning of the Early Bronze Age (hereafter EB), is becoming more widely accepted as a pivotal phase in Cretan prehistory.[3] Evidence for important changes, spanning FN III to EB IA, include new patterns and types of settlement, population mobility and expansion,[4] significant changes in pottery styles,[5] the development of metallurgy[6] and the emergence of formal cemeteries.[7] However, there are still many problems and gaps in our knowledge of these phases.

First, there are problems of definition and relative chronology, mostly due to the lack of excavations with complete stratigraphic sequences.[8] In the two multi-period sites of Knossos and Phaistos it is only very recently that stratified FN–EB I deposits have been located and subject to detailed study.[9] This work has resulted in a more tightly resolved FN sequence for Crete consisting of five sub-phases (FN IA, FN IB, FN II, FN III, FN IV), initially defined at Knossos and subsequently

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1 Yiannis Papadatos: National and Kapodistrian University of Athens, Department of Archaeology and History of Art, email: ypapadatos@yahoo.gr.

2 Peter Tomkins: SCAA Research Associate in Aegean Prehistory, Department of Archaeology, University of Sheffield, United Kingdom, email: pdtomkins@yahoo.co.uk.

3 Vagnetti – Belli 1978; Hood 1990; Vagnetti 1996; Nowicki 2002; Hayden 2003; Tomkins 2008; Tomkins 2010.

4 Watrous 1994, 701; Branigan 1998, 80–84; Vokotopoulos 2000; Nowicki 2002; Hayden 2003.

5 Hood 1990; Betancourt 1999; Nowicki 2002.

6 Muhly 2004; Papadatos 2007; Catapotis et al. 2011.

7 Vagnetti – Belli 1978, 150–151; Betancourt 1999, 36–37; Tomkins 2008; Tomkins 2010; Tomkins this volume 345–364.

8 For a detailed discussion see Nowicki 2002, 11–15; Tomkins 2007; Papadatos 2008, 261–263.

9 Tomkins 2007; Todaro – Di Tonto 2008; Tomkins 2008.

extended to FN III–IV Phaistos. For the rest of Crete, the available evidence is typically in the form of either single-phase assemblages from open-air sites (e.g. Monastiraki Katalimata, Gortyna Mitropolis, Kaloi Limenes, Nerokourou, Kastelli Phournis), or unstratified, often disturbed, funerary and cave assemblages (e.g. Partira, Ayios Nikolaos Palaikastro, Amnisos Eileithyia, Trapeza and Lebena). Historically, these single-phase, poorly stratified or mixed assemblages have been variously considered to date to FN, early EB I or somewhere in between ('sub-Neolithic'). Finally, in several cases, especially surface surveys, the catch-all term 'FN/EM I' is used.[10]

Second, the historical conditions and the social processes associated with these changes are very poorly known due to the fragmentary archaeological record. While scholars agree on the radical character of these late FN–EB IA changes, there is no consensus concerning their interpretation. For some, they are the result of major population movements into Crete from other external regions.[11] However, amongst those who hold this view there is disagreement on the chronology of these movements, variously dated to FN or EM I, and on the origin of the newcomers, variously located in the Dodecanese and southwestern Anatolia, the Troad and northeastern Aegean, Cilicia or the coast of Syro-Palestine. Others argue that the changes marking the beginning of EB in Crete constituted a long, gradual and mostly internal process, which could involve external influences, but not major migration episodes.[12] Both interpretations, however, converge at one point; that, regardless of the associated mechanisms (population movements or internal development), Crete, after millennia of relative isolation, "enters the wider Aegean world"[13] and from this period onwards becomes a more closely integrated part of the Aegean.

It is important to note that, although both approaches emphasise the more connected character of Crete in the late 4th millennium, neither considers trading as a significant factor in the increase in integration and cultural or social change that seem to occur at this time.[14] One reason is surely the fact that the excavated record for FN III–EB IA is patchy, poor and restricted mainly to inland sites (e.g. Knossos, Phaistos, Monastiraki, Gortyna, Kastelli Phournis, Partira, Ayios Nikolaos, Trapeza, etc.). Among the few coastal sites that have been excavated, Lebena and Kaloi Limenes are late in date (EB IA) and lie on the south coast and are thus less likely to have played any major role in maritime trade with the Aegean. Along the north coast few excavations have taken place of FN III–EB IA sites, with those at Nerokourou (west Crete) and, more recently, Kephala Petras (east Crete) revealing the most promising evidence for off-island connectivity.

A second reason is methodological. While morphological study of late FN–EB IA ceramic assemblages can identify indications of influence by or connectivity with external regions, it cannot isolate the different technologies, raw materials and provenances within such assemblages and thus cannot provide the precise, quantified data necessary to identify specific exchange behaviours in general and trading in particular.[15] In other words, unless such assemblages are subjected to more comprehensive, integrated and fully analytically-supported characterisation programmes, we simply lack the data to discern trading from gift exchange or indeed local importation from local reproduction of 'foreign' forms and practices.

A third reason is conceptual and concerns the belief, still widespread, that trading and the competitive acquisition of prestige goods are an entirely new and defining characteristic of Bronze Age societies, differentiating them from those of the Neolithic, which were characterised by simple gift exchange.[16] According to Renfrew trade and traders emerged around the EB II phase (c. 2600–2400 BC) to satisfy a new desire for specific commodities, mainly metals, but also other categories of raw materials and finished artefacts, such as midrib daggers, sauceboats, stone figu-

10 Haggis 2005, 47.
11 Warren 1974, 41–43; Hood 1990; Nowicki 1999; Nowicki 2002; Hayden 2003, 395.
12 Evans 1921; Branigan 1970, 201; Evans 1974, 19–21; Vagnetti 1996, 39.
13 Vagnetti 1996.
14 Papadatos – Tomkins 2013, 353–356.
15 Papadatos – Tomkins 2013, 355–356.
16 Renfrew 1972, 44, 468–472.

rines and vessels. The distribution of these items in EB II, within a broad area encompassing the islands and the littoral Aegean, was regarded as evidence for a greater intensity of interaction than previously proposed and the fostering of an 'international spirit', i.e. a common culture of artefacts, ideas and practices.[17] Thus, trade was traditionally associated with two important technological innovations of the EBA: (a) the rapid development of metallurgy, a *Metallschock*, which transformed metals into a commodity worth trading, and (b) the invention of the longboat, which enabled swifter, more directed and more long-range sea voyaging.

In more recent decades, two important alterations were made to Renfrew's model. First, it was shown that EB II trading was not a widely accessible venture but was controlled by groups or individuals located in a few large trading communities.[18] As a result, the motive behind this phenomenon was not only the desire for metals but also the desire for social distinction through participation in long-distance networks of maritime interaction and exchange. Second, on the basis of recent archaeological evidence, it has been suggested that intensive interaction and trade of Cycladic commodities started slightly earlier than EB II, in the late EB I (c. 2700 BC), on the basis of evidence for gateway communities operating along the north Cretan coast, such as at Ayia Photia and Poros Katsambas.[19] Thus, long-distance trade, longboats, gateway communities, and the beginning of a *Metallschock* were considered closely connected phenomena, which emerged more-or-less simultaneously in the Aegean sometime around 2800/2700 BC, in the transition from EB I to EB II.

In a recent paper, we have taken issue with this orthodoxy and have argued instead that such phenomena have a deeper history going back at least as far as the late FN. This new interpretation is based on the results of recent detailed, integrated characterisation (morphology, technology, raw materials) of FN IV and EB IA artefactual assemblages from the recently excavated coastal settlement of Kephala Petras, in east Crete. Here we summarise the argumentation and evidence presented in this paper and further argue that trading, rather than migrations, was the main mechanism behind the increased degree of cultural integration between Crete and the rest of the Aegean in the latter part of the 4th millennium BC.

Kephala Petras

The settlement lies on the Kephala hill, which in the prehistoric period had the form of a coastal promontory, 200m northeast of the later Minoan town and palace of Petras (Fig. 1).[20] The Kephala hill enjoys a strategic location with visual control over an extensive area of land- and seascape. Although the excavations covered a relatively small area, the settlement was much larger as indicated by dense pottery scatters on the surface. The excavated building remains belong to at least three architectural phases. On the basis of the associated ceramic assemblages, the earliest architectural phase is dated to the FN IV (c. 3300–3100/3000 BC), and the two subsequent to the earliest phase of the Bronze Age, the Early Minoan IA (c. 3100/3000–2900/2800 BC) (hereafter EM IA).

Pottery

Ceramic study took the form of an integrated macroscopic and petrographic characterisation of technological and typological variation. On this basis the pottery was sorted into fabric groups and wares.[21]

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17 Renfrew 1972, 444, 451.
18 Broodbank 1989; Broodbank 1993; Broodbank 2000, 256–258.
19 Carter 1998; Day et al. 1998; Broodbank 2000, 247–256, 300–304; Davaras – Betancourt 2004; Wilson et al. 2008.
20 Papadatos 2008; Papadatos 2012.
21 For a more detailed presentation see Papadatos – Tomkins 2013, 356–365; Papadatos et al. forthcoming.

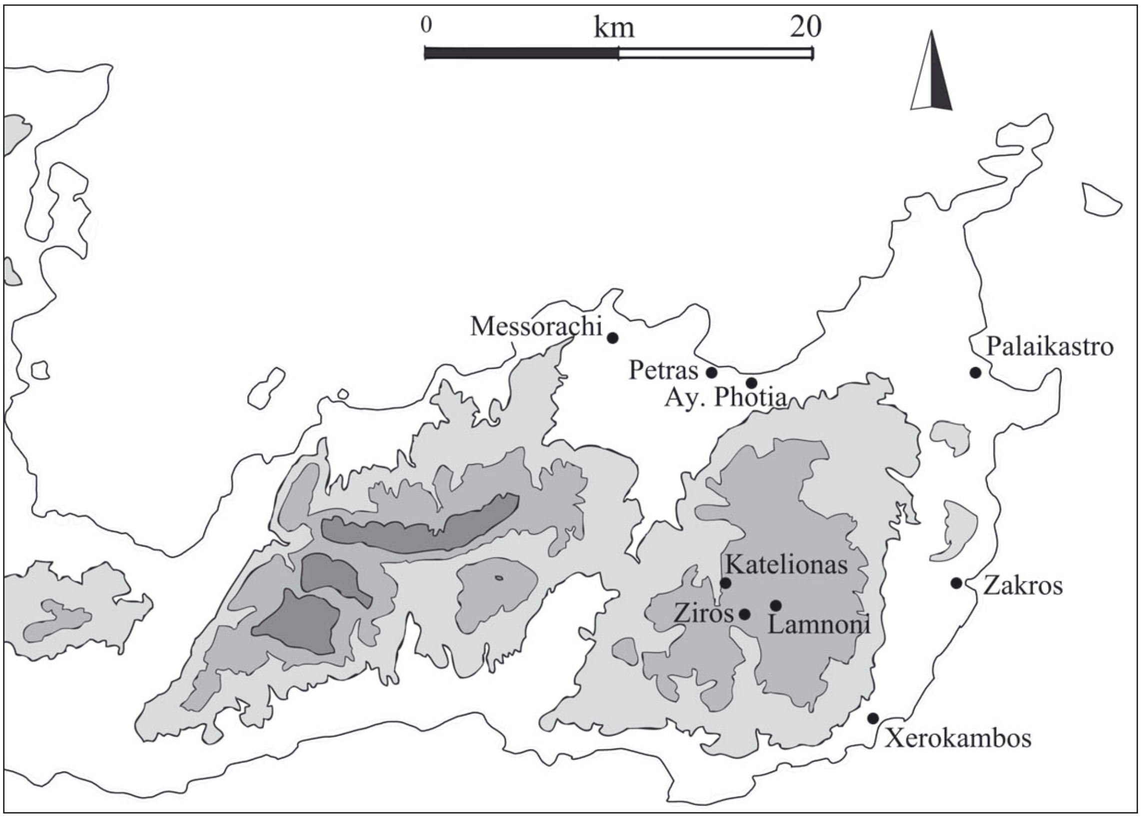

Fig 1 Map of the Siteia region.

(a) Final Neolithic IV Pottery

The pottery fabrics of the FN IV phase could be classified into three principal groups: Local Grog, Cretan Imported and Off-Island Imported.

Local Grog Fabric Group: The majority, almost 80%, of the FN IV pottery belongs to a single fabric group, characterised by a non-calcareous clay matrix tempered with fragments of crushed pottery, or grog.[22] The mineralogy of this fabric and its high frequency strongly suggest that it represents local, most probable on-site, ceramic production. The pottery includes bowl and jar forms with close parallels in contemporary FN assemblages from inland sites in east and central Crete, such as Knossos, Phaistos and Kastelli Phournis,[23] indicating a community following existing Cretan ceramic traditions. It is important, however, to recognise also the occurrence, usually rare, of ceramic types that do not find close parallels in Crete. These types include the 'cheese pot', the biconical jar with horned and/or grooved handle, the hole-mouthed jar with crescentic lug or vertically-pierced tubular lug, the bowl with horizontally pierced tubular lug (with or without low pedestal) and some types of plastic decoration, namely pellets and cordons (Fig. 2A).

Cretan Imported Group: The remainder (20%) of the FN IV assemblage comprise a series of distinctly different and rare fabrics imported to Kephala. About 10% seem to derive from other pottery-producing communities located elsewhere in Crete.

Off-Cretan Imported Group: The other 10% comprise a series of fabrics containing white mica-schist.[24] These fabrics occur in vessels with off-island typological parallels, and, from a mineralogical point of view, are compatible with the schist dominated geology of the Hellenic

22 Nodarou 2012, 82–83.
23 Vagnetti 1973; Manteli 1992; Tomkins 2007.
24 Nodarou 2012, 83–83.

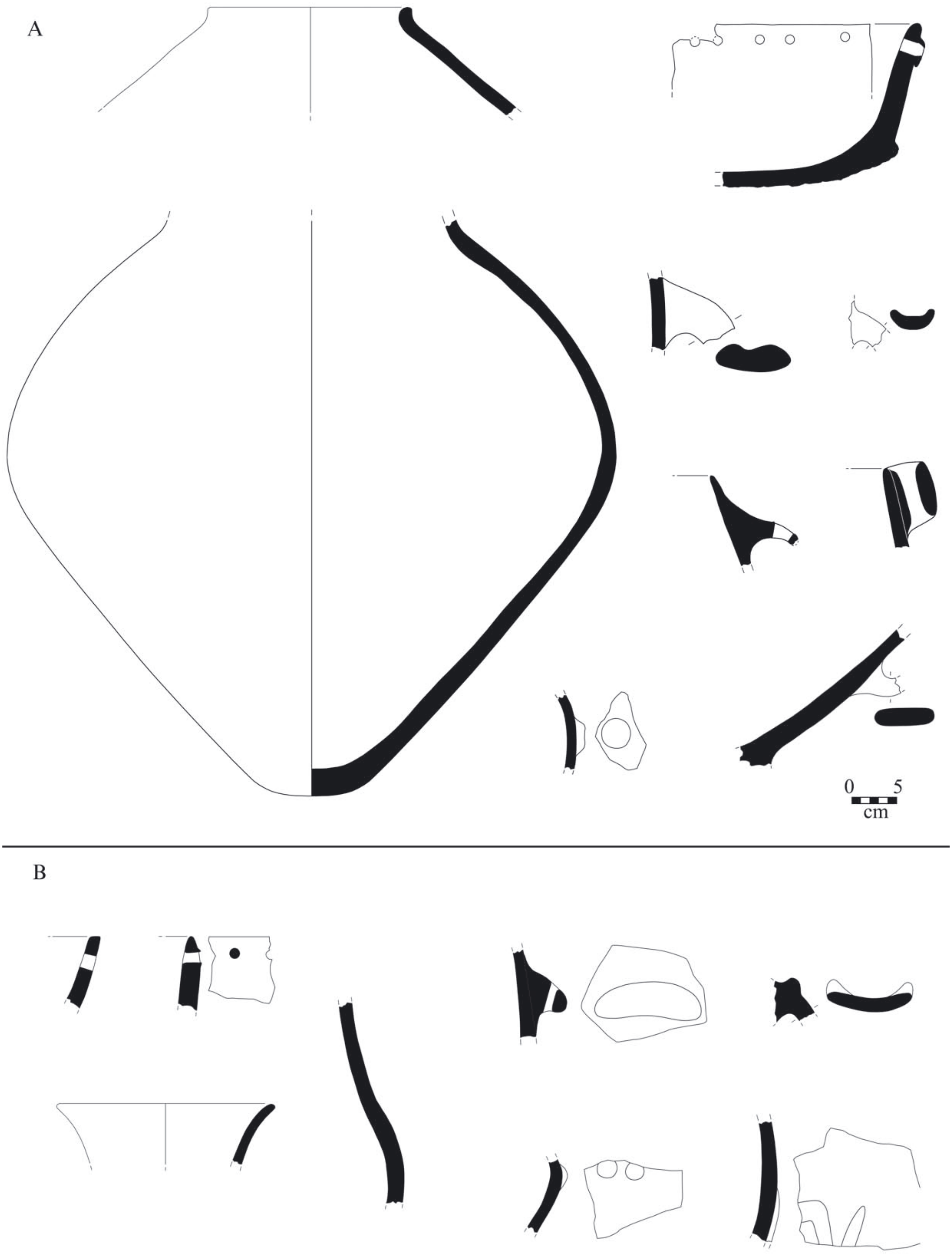

Fig. 2 A. FN IV off-Cretan vessels made in the Local Grog fabric group; B. FN IV off-Cretan vessels made in the imported White Mica-Schist fabric group.

Arc. Analogous mica-schist fabrics occur in FN and EB ceramic assemblages from Attica and the Cycladic islands of Kea, Thera, Melos, Amorgos and Keros. Regarding typology, some of the ceramic forms have parallels from the Dodecanese, but the closest parallels are with latest FN assemblages from Attica, Euboia and the northwest Cyclades, such as Kephala and Ayia Irini I on Kea.[25] The types included are the cheese pot, the biconical jar with grooved handle, the hole-mouthed jar with crescentic lug, the collared jar with narrow body and plastic decoration with pellets and cordons (Fig. 2B). It should be stressed that these non-Cretan vessel types also occur rarely (with the exception of the ubiquitous cheese pot) in the Local Grog fabric group. The typological similarity between vessels of the two fabric groups suggests that imported vessels of the White Mica-Schist Fabric group were the source of inspiration for local experimentation with and selective adoption of these new foreign forms.

(b) Early Minoan IA Pottery

The EM IA pottery from Kephala Petras could also be divided into three main groups: Local Grog, Cretan Imported and Cycladic/Cycladicising.

Local Grog Fabric: Almost the entire EM IA assemblage (98%) is locally made in essentially the same grog-tempered fabric as in FN IV.[26] A wide range of ceramic forms were produced, from small cups and high-pedestaled chalices, to cooking jars and baking plates, or large storage pithoi. The evidence from the local pottery does not indicate a clear break between FN IV and EM IA, but rather evolution in technology and typology that is characterised by both continuity and change. It is interesting to note that some new EM forms can be linked back to FN IV types, which are considered as non-Cretan in inspiration: e.g. the EM IA baking plate with holes beneath the rim echoes the FN cheese pot; the EM IA hole-mouthed jar with crescentic projections echoes rare FN IV hole-mouthed jars with actual crescentic lugs. Finally, there are entirely new forms, such as the fenestrated chalice and the pithos with rich relief decoration, which although produced in the Local Grog Fabric, have close parallels from Akrotiri on Thera, in both FN and EC I contexts.[27]

Cretan Imported Group: The imported pottery is more limited than that of the FN IV and can be classified into two broad groups. A small number of vessels, about 0.5%, finds close morphological parallels in other EM IA assemblages in Crete and is mineralogically compatible with a provenance on the island.

Cycladic/Cycladicising Group: The second imported group, about 1.5% of the total, is characterised by vessels in calcite-tempered fabrics which typologically find their closest parallels in Cycladic assemblages of the EB I period.[28] The forms include the deep bowl with vertical tubular lug(s), the serving plate and the shallow bowl with incurved rim, the hole-mouthed jar with strap handles, the jar with horizontal non-perforated crescentic lug and collared neck jar (Fig. 3). All have close parallels in early and late EB I contexts from islands in the southern Cyclades, such as Naxos, Amorgos and Thera.[29] The rarity of these vessels suggests that they were imported to Kephala Petras. A Cycladic source seems a strong candidate, although we cannot exclude that some or all were produced on Crete, as has been argued for other Cretan EB I coastal sites.[30] In general, despite the decline in the percentage of off-Cretan imported or influenced pottery in EM IA, the evidence indicates continued familiarity with and influence from off-island regions, in particular the southern Cyclades.

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[25] Coleman 1977; Wilson 1999.
[26] Nodarou 2012, 82–83.
[27] Kariotis 2003; Kariotis forthcoming.
[28] Nodarou 2012, 84–85.
[29] Karantzali 2006; Wilson et al. 2008.
[30] Wilson et al. 2008 ; Day et al. 2012.

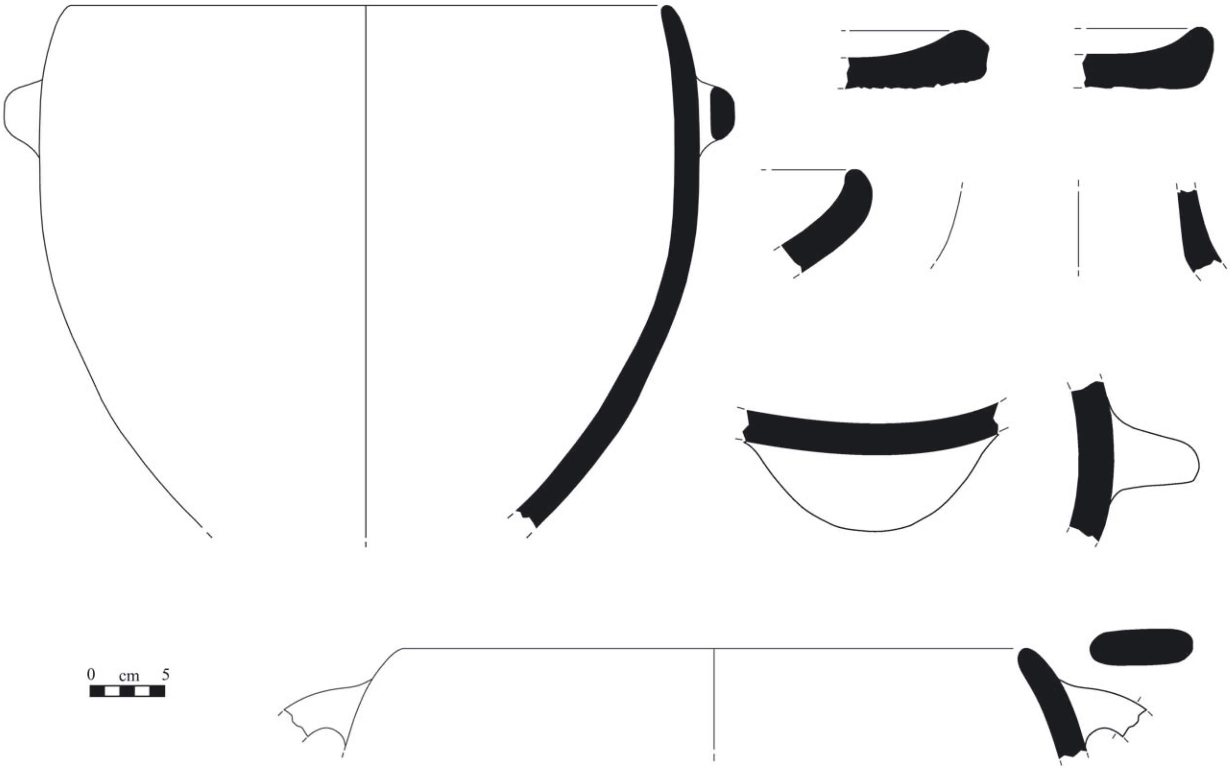

Fig. 3 EM IA off-Cretan vessels made in the Cycladic/Cycladicising Calcite-tempered fabric group.

Raw materials

Beyond pottery, there is evidence for the importation of non-Cretan raw materials, namely obsidian and copper.

(a) Obsidian

All the chipped stone tools are made from Melian obsidian.[31] Although the presence of obsidian cannot be used to differentiate Kephala Petras from other Neolithic sites in Crete, at which Melian obsidian is typically present as a major or minor component, what is unusual is the size, forms and technological characteristics of the Kephala Petras assemblage. First, the percentage of obsidian is encountered in significantly higher proportions than at any other FN site, including Knossos. The fact that no other local or imported stone sources were used suggests that the supply of obsidian was sufficient to meet requirements. Second, the obsidian arrived at Kephala Petras in the form of raw nodules and not as prepared cores or finished tools, as at other contemporary sites. This implies that the Kephala Petras community enjoyed special, seemingly restricted access not only to obsidian in its raw nodule form, but also to the necessary technical knowledge for the transformation of the raw nodules into finished tools. Indeed, the characteristics of the Kephala Petras knapping technology, namely pressure flaking, blade production, burin technology and utilisation of flakes situates it more closely with Cycladic sites[32] than with other contemporary Cretan communities.[33]

[31] D'Annibale 2008.
[32] Carter 2008, 228–229.
[33] Branigan 1998, 47–50.

(b) Metals

Fragments of copper ore and slags, and deformed clay fragments, probably from refractory material used in the metallurgical process, testify to metallurgical activity at Kephala Petras, albeit limited in scale and output.[34] This activity, which seems to begin in FN IV, involved the smelting of oxidised ores for the production of metallic copper.[35] Currently, there is no clear evidence for metallurgy anywhere else on Crete during this period. Thus, it seems that Kephala Petras is more closely linked with late FN sites outside Crete, such as Kephala and Paoura on Kea and Yiali near Nisyros, where small-scale copper smelting was practised before the end of the Neolithic.[36] The origin of the copper remains unknown, but the most probable sources are located in the western Cyclades (Kythnos, Seriphos and Siphnos) and Lavrion. Further evidence for the connection of Kephala Petras with Aegean metallurgy may be seen in the skeuomorphism of some EM IA ceramics, which indicates knowledge of sheet metal vessels. The biconical fenestrated chalices bear several skeuomorphic features that recall sheet metal technology, such as the thin walls, the fenestrated 'pedestal', the plastic knobs and rivets, and the shiny, dark grey burnished surface.[37] The source of the metal prototypes and their technology of production remain unknown, but considering the scarce evidence for Cretan metallurgy during FN IV–EM IA, it seems reasonable to conclude that they too are an off-Cretan element.

Finished products

Apart from pottery and raw materials, Kephala Petras also provided evidence for the importation of finished products, namely spindle whorls and body ornaments.[38] Most spindle whorls were locally made, but at least one FN IV whorl was made in an imported White Mica-Schist fabric, and one EM IA whorl was made in the Cycladic or Cycladicising Calcite-tempered fabric. It seems, therefore, that the Kephala Petras community acquired spindle whorls from the same off-island sources as the imported pottery in both FN IV and EM IA phases. Finally, a small FN IV cache of phallic pendants (Fig. 4A) include examples made in White Mica-Schist fabrics, which must have been imported to Kephala Petras, and two in spondylus shell (Fig. 4B), a material rare in Crete but more commonly used for body ornaments in the rest of the Aegean.[39]

Discussion

From the above evidence, it appears that during FN IV the Kephala Petras community had developed close, direct relationships with communities beyond the island. The ceramic parallels and the origin of the raw materials (obsidian and copper) suggest that these communities were probably located in the Attica-Kephala cultural region (Fig. 5). These relationships involved the exchange of finished objects, such as pottery, spindle whorls and pendants, as well as raw materials, such as obsidian and metal. Furthermore, it also clearly included a wide-ranging exchange of ideas and practices, such as technologies of production (e.g. obsidian, metallurgy), cultures of consumption (e.g. local adoption of off-Cretan ceramic forms, such as the cheese pot) and identities/concepts of the body (e.g. phallic pendants). It seems, therefore, that Kephala Petras currently represents our earliest clear case of an outward-looking coastal Cretan community, which enjoyed

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[34] Papadatos 2007.
[35] Catapotis et al. 2011.
[36] Sampson 1988; Nakou 1995, 3–8; Muhly 2002, 77.
[37] Papadatos – Tomkins 2013, 365, fig. 9.
[38] Papadatos – Tomkins 2013, 367–368.
[39] Theodoropoulou 2011.

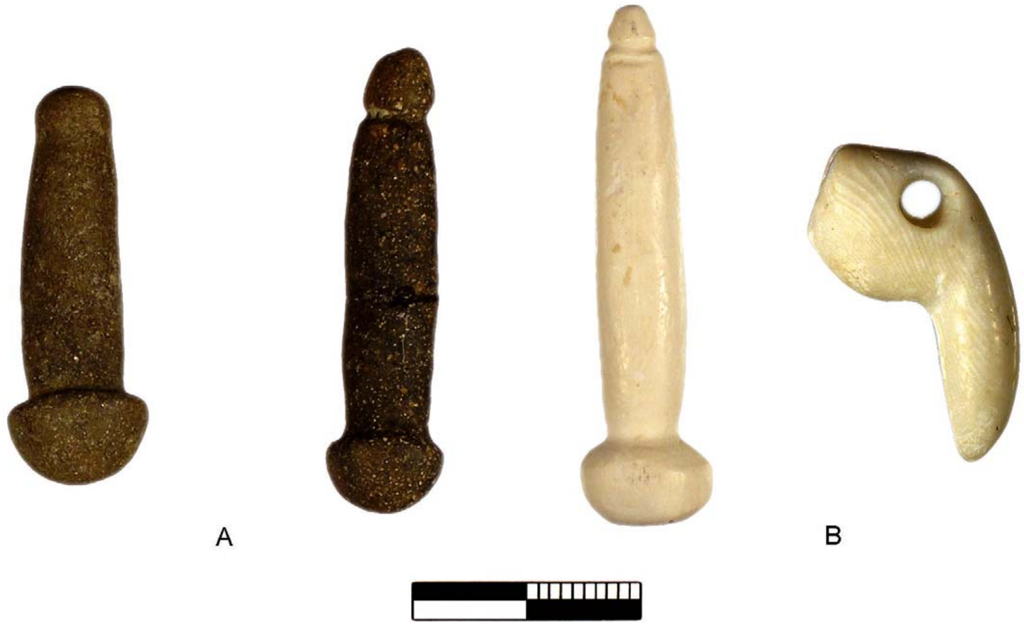

Fig. 4 A. FN IV pendants made in the imported White Mica-Schist fabric group; B. FN IV pendants made in imported spondylus shell.

close, direct contact with off-island areas, imported goods and raw materials from overseas, and adopted and/or adapted foreign ideas and practices.

It should be noted that these off-island relations are characterised by both distance and specificity. The comprehensive nature of the ceramic characterisation work means that we can conclusively rule out any connectivity with more proximate regions of the Aegean, such as the southern Dodecanese. Rather specific connection seems to have been sought with the more distant Attica-Kephala cultural region. Sustaining this specific, distant link required increased navigational capabilities and the use of boats that were capable not only of swiftly covering longer distances, but also of bypassing islands that previously had functioned as stepping stones. We therefore believe it likely that vessels with the navigational capabilities of longboats, which are traditionally considered as an EB II invention, were built and used as early as the FN IV period. Indeed, not only was the construction of such boats technically possible at the end of the Neolithic,[40] but also petroglyphs recently found at Strophilas on Andros[41] clearly suggest that a craft similar in form to the EB II longboat was already known at the end of FN in the islands.

The operation of longboats at the end of the FN enabled Kephala Petras to gain privileged access to the important mineral resources of Lavrion and the western Cyclades (metal, obsidian), as well as to the metallurgical and knapping techniques for the transformation of these raw materials into finished objects. However, in order for this activity to qualify as trading, it is important to provide evidence that Kephala Petras operated as a gateway community, controlling local access to off-island raw materials and technological knowledge. The late FN–EM I sites located by surveys in the Ziros uplands (Fig. 1)[42] and in neighbouring areas[43] take the form of small hamlets or isolated farmsteads, much smaller than the settlement at Kephala Petras. The ceramic material from these sites shows no obvious off-Cretan fabrics, and evidence for the adoption of foreign ceramic forms is very limited or absent. Of the off-Cretan forms observed at Kephala Petras only

40 Broodbank 2000, 97.
41 Televantou 2008; Liritzis 2010.
42 Branigan 1998.
43 Tsipopoulou 1989; Tsipopoulou 1990; Whitley et al. 1999; Vokotopoulos 2000; Schlager 2001; Greco et al. 2002; Nowicki 2002; Papadatos – Sofianou 2013.

Fig. 5 Map of the Aegean with sites and areas mentioned in the text.

cheese pots occur at a small number of other coastal/near-coastal sites in the Siteia region and are almost entirely absent from sites in the Ziros uplands.[44] Furthermore, obsidian is rare or absent from FN IV–EB I sites in the Ziros uplands,[45] which typically exploit local chert sources. The obsidian at these inland sites arrived in the form of finished tools, suggesting that the procurement, reduction, consumption and secondary exchange of obsidian was primarily mediated through and controlled by communities on the Cretan coast,[46] with Kephala Petras being the most obvious candidate. Notably, these inland sites lack a pressure-flaked industry in local chert,[47] suggesting that they were not only excluded from accessing obsidian in raw material form, but also from the technology for its transformation into pressure-flaked blades. The same applies to metal objects, which are extremely rare at inland sites, and most probably were procured through coastal sites, such as Kephala Petras.[48] Taken together, the above evidence suggests that FN IV–EM IA Kephala Petras was very different from other contemporary sites of the Siteia region concerning access to off-island objects, raw materials and associated technical knowledge for their transformation into finished products.

Conclusions

To conclude, the FN IV–EM IA coastal site of Kephala Petras constituted an early trading community which, thanks to its close off-island connections enjoyed preferential access to valued raw materials, to the technologies for their transformation and to finished objects. The motive behind

[44] Papadatos – Tomkins 2013, 372.
[45] Branigan 1998, 48–50.
[46] Branigan 1998, 49.
[47] Branigan 1998, 48–50.
[48] Papadatos – Tomkins 2013, 373–374.

trading with off-Cretan areas was not simply the acquisition of valuable goods for internal consumption, but also the accumulation of symbolic and political capital at a regional level. Preferential access to Cycladic goods allowed Kephala Petras to develop advantageous relationships with other communities in the region, by controlling the distribution of sought-after off-island products and raw materials and perhaps even by manipulating local demand. From this point of view, FN IV–EB IA Kephala Petras appears to represent the earliest of a series of gateway communities, such as Ayia Photia, Mochlos and Poros Katsambas, which operated along the north coast of Crete during the EBA.[49]

On this basis, the origins of phenomena traditionally associated with the EBA, such as the emergence of trading, the use of longboats, the establishment of distant maritime networks for the movement of people, goods and ideas and the flourishing of gateway communities, should now be pushed at least as far back as FN IV. Moreover, we believe that Kephala Petras was not the only trading site in Crete or the rest of the Aegean. Extensive, important, fortified FN sites, have been recently excavated on the Greek mainland and in the Cyclades, namely Zagani in Attica[50] and Strophilas on Andros.[51] These may have played a similar role in early trading and long-range maritime activity as is apparent at Kephala Petras. The depictions of longboats on the fortification wall of Strophilas reinforce the connection of this prosperous settlement with maritime interaction. A similar suggestion could be also made for Akrotiri on Thera, at least on the basis of the deep and rich FN deposits excavated beneath the Middle and Late Bronze Age town.[52]

The above evidence also presents important implications for theories on the historical conditions of the FN–EB transition and the possibility of population movements in Crete. Kephala Petras, a coastal site with a large number of off-island cultural elements could be regarded as one of the best candidates for a newcomers' settlement. However, the evidence clearly suggests that the vast majority of the pottery was locally manufactured, and belongs to ceramic forms similar to other typical Cretan FN assemblages such as Knossos, Phaistos and Kastelli Phournis.[53] This picture does not provide evidence for major population movements to Crete in the FN IV, although it does depict the existence of a trading network within which people could and almost certainly did move and re-locate between regions in multiple directions. Moreover, comparison of the pottery of the FN IV and EM IA phases shows a significant degree of continuity (technological, morphological), rather than the clear break that one could associate with a cultural shift and the arrival of newcomers during the FN IV–EM IA transition.[54] Small scale population movements cannot be excluded, as some imported finished artefacts, such as the spindle whorls and the body ornaments, may have travelled to Crete together with their owners, e.g. perhaps marriage partners. However, in the light of the above discussion it is suggested that the cultural integration of Crete in the Aegean world could not be the result of the major migration episodes or large-scale colonisation and replacement envisaged by earlier researchers. The evidence from Kephala Petras reinforces the idea that in the late FN period Crete enters the wider Aegean world,[55] and demonstrates that this was primarily achieved through interregional trade and more intensive maritime activity facilitated by long-range boats, which allowed people, goods and ideas to travel further and more frequently across the Aegean well before the beginning of the EBA.

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49 Branigan 1991; Day et al. 1998; Wilson et al. 2008.
50 Georgopoulos et al. 1999.
51 Televantou 2008.
52 Kariotis 2003; Kariotis forthcoming.
53 Papadatos 2012; Papadatos – Tomkins 2013; Papadatos et al. forthcoming.
54 Papadatos 2012, 72–75.
55 Vagnetti 1996.

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Tracing Complexity in 'the Missing Millennium': An Overview of Recent Research into the Final Neolithic Period on Crete

Peter Tomkins[1]

Abstract: Traditionally the Neolithic period on Crete has played no part in narratives of the origins of civilisation except perhaps rhetorically as a contrastive device employed to focus attention on the beginning of the Bronze Age as the phase when something new, more complex and more reassuringly 'modern' first emerged. However, during the last decade or so clarification of Neolithic chronology and thereby of the nature and timing of change, combined with detailed contextual study at key sites, most notably at Knossos and Phaistos, has revealed something of the complexities of social life in Cretan Neolithic communities and how it changed over time. The 4th millennium BC, corresponding to the latter part of the Final Neolithic phase, is emerging as a key period in the evolution from 'Neolithic' communities, constructed around communality and subjugated to the interests of the many, to 'Bronze Age' communities, constructed around inequality and driven by the interests of the few. This work has isolated the late Final Neolithic (FN) in particular as the real beginning of the Bronze Age, during which new identities and livelihoods, new cultures of acquisition and accumulation and new and more permanent forms of social difference and inequality first emerge. This paper will provide an overview of this emerging new picture and of new developments in how the 4th and early 3rd millennia on Crete are being theorised and explained. Given the focus of this volume, the paper will clarify the timing and nature of the changes that take place in Crete during this period up to the emergence of central buildings late in Early Bronze Age I (EB I) and urbanism in EB II.

Keywords: Greece, Crete, Minoan, Final Neolithic, Early Bronze Age, chronology, social evolution, initial urbanism

It is now more than four decades since C. Renfrew first drew attention to a 'fault line' separating 'historically-dated' chronologies, such as those sharing material linkages with Dynastic Egypt, from chronologies that relied solely on radiocarbon dating.[2] In the Aegean this fault-line divides off the 3rd millennium BC, a period known universally as the Early Bronze Age (EB), from the 4th millennium BC, a period known by different names in different regions (e.g. Late Chalcolithic, Late Neolithic, Final Neolithic, Late Aegean Neolithic, etc.). Research conducted either side of this 'fault line' has developed along radically different lines. Viewed as a pivotal period in the emergence of civilisation in Europe, the Early Bronze Age of the Aegean has attracted intense research activity over the course of the 20th century and is relatively well-defined and understood.[3] In contrast, just across the fault line, the period of the 4th millennium and earlier, has tended to be viewed as irrelevant to narratives of the emergence of greater social complexity or what has been termed 'civilisation'.[4] Consequently, it remained under-investigated and poorly understood; so much so, in fact, that as recently as 2001 it was still possible to speak of a 'missing millennium', symbolised by a "radiocarbon 'gap' in the 4th millennium BC across much of central and southern Europe, the Aegean and Anatolia".[5]

In this paper I will explore how and what we have learnt about the 'missing millennium' on Crete over the last decade or so. In the first part I will outline some general historiographical

1 SCAA Research Associate in Aegean Prehistory, Department of Archaeology, University of Sheffield, United Kingdom, email: pdtomkins@yahoo.co.uk.
2 Renfrew 1970; 1989.
3 E.g. for recent reviews of EBA Crete see Wilson 2008; Tomkins – Schoep 2010; Tomkins, submitted b.
4 E.g. Childe 1958; Branigan 1970; Renfrew 1972; see Schoop 2011; Tomkins, submitted b.
5 Manning 2001, 168.

theoretical, methodological, empirical issues that have been faced and some solutions that were found. I do so in the belief that these are more widespread problems, shared with researchers working on the 4th millennium in other regions of the Aegean, and therefore in the hope that the solutions adopted for Crete might also be relevant to those working elsewhere. In the second part of the paper, I will outline some of the patterns to emerge from this recent work. What do the societies of the 4th millennium BC on Crete look like? What changes in complexity occur during this period, when and where? How has our new knowledge affected or transformed traditional views about the nature and timing of social evolution on the island, specifically the so-called 'emergence of Minoan civilisation'? Is there a sudden transformation in complexity at the beginning of the EBA, as convention holds, or is EB I an *artificial* 'fault line', created by the ways in which our forebears chose to frame and explain the past; that is, just a phase in a longer period of reconfiguration that began earlier in the 4th millennium BC. Finally, since the Vienna workshop also addressed the question of 'proto-urbanisation', the paper briefly touches upon the origins of urbanism in Crete, a task that takes it across the 'fault line' and into the 3rd millennium BC.

Tracing Complexity in the 4th Millennium BC Aegean: Some Considerations

Historiographical Considerations

In order to understand the current state of knowledge on the 4th millennium it is useful to reflect upon how the early historiography of Aegean prehistory has directed investigation and shaped interpretation. In the decades either side of the turn of the twentieth century Aegean prehistory was framed and explained by an elite group of influential and predominantly northwestern European scholars, whose agenda was to establish the prehistoric origins (racial, ethnic, historical) and geographies of national and European identities and to explain the cultural stages by which modern European civilisation emerged and evolved.[6] This Eurocentric, cultural-evolutionist project led them to seek out the earliest instances of key modern phenomena (e.g. farming, metallurgy, trade, monarchy, palaces, writing, etc.) and to focus their enquiries on 'top-end' complexity, the clearest examples of which were the 'palace civilisations' of Bronze Age Crete and Greece. Early influential interpreters, such as Arthur Evans and Gordon Childe, instinctively felt able to theorise this higher level complexity by drawing on their own understanding of modern western society and its history since the Renaissance. However, this personal experience was of little use for understanding earlier, less complex periods of existence, such as the Neolithic or indeed the Early Bronze Age. Instead these earlier periods tended to be defined and understood in opposition to what was called civilisation. They were thus understood *rhetorically*[7] according to their place in a grand narrative of the emergence of European civilisation, rather than *empirically*, that is in their own terms.[8] When prehistories are rhetorical rather than empirical the interpretation of data is significantly more fluid, such that it is perfectly possible for two opposing narratives to be sustained simultaneously from the same 'evidence'. Thus, for example, in the case of Crete, the same set of data was interpreted by Arthur Evans as indicating a rapid, revolutionary emergence of civilisation at the beginning of the Early Bronze Age, and by V. G. Childe as evidencing a much later, but similarly revolutionary, emergence of civilisation at the beginning of the Middle Bronze Age.[9]

One of the great achievements of Cretan Bronze Age studies of the last forty years has been to move understanding of the Early Bronze Age from a rhetorical to an empirical footing.[10] This task

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6 Bintliff 1984; Thomas 2000, 14–18; Hamilakis 2002; Hamilakis – Momigliano 2006; Schoep 2010; Tomkins, submitted b.

7 Fotiadis 2006.

8 Tomkins 2004; 2010.

9 Tomkins, submitted b.

10 Branigan 1970; Renfrew 1972; Tomkins, submitted b for a review of the 'Early Minoan Project'.

was achieved through detailed chronological work, which transformed the resolution at which actual continuity and change could be measured and compared, through intensive and extensive investigation in the field and through integrated characterisation of artefactual and ecofactual datasets. While ultimately this empirical engagement has been extremely successful, it unfortunately had an upper chronological limit, defined by the earliest ceramic phase of the 'Early Bronze Age' on Crete. While it was obvious to some that this was an artificial limit – one effectively invented by A. Evans when he first drew the 'fault line' between Neolithic and Bronze Age in the deep stratigraphy he encountered at Knossos in 1900–1904 – it was generally believed that this conceptual boundary nevertheless enclosed the actual limit of variation relevant to study of the evolution of social complexity: i.e. to understand the emergence of civilisation one needed only to investigate the Bronze Age.

This sustained a 'Catch 22' where the (later) Neolithic of Crete continued to be perceived as irrelevant and so was not systematically investigated; but where this supposed irrelevance would remain rhetorical assertion rather than empirical fact until such systematic investigation took place. In this way the 4th millennium BC on Crete was under-investigated and under-theorised, isolated by Evans' chronological, conceptual and investigative fault line and inevitably ignored by narratives of social evolution. This story – of how our own artificial, inherited categories have constrained our engagement with certain periods of the past – is one that I suspect will be familiar to others working on the 'wrong' side of the 'fault line' elsewhere in the prehistoric Aegean.

Theoretical Considerations

A second factor complicating investigation of social complexity during the 4th millennium BC is theoretical. How can we move from a rhetorical understanding of past small-scale societies, in which our own assumptions and preconceptions drive our narratives, to an *actual* understanding of past social lives, which accords more closely with how the social was actually lived and experienced? One approach, successfully pursued for the Greek Neolithic since the early 1980s, has been to take cross-culturally defined anthropological concepts (e.g. household, community, production, exchange, consumption), and use them to think through our data.[11] In this way by considering how small-scale societies of the recent past organised themselves and operated we gain not only a better understanding of the constraints and possibilities of existence in such societies, but also an alternate perspective from which to critically assess the specificities of our own experiences of the social.

Central to this work has been the concept of the household as a socioeconomic unit[12] and its seemingly close applicability to the Neolithic data. Neolithic sites throughout the Aegean are composed of multiple architectural sub-units that seem to mark the existence of multiple, co-residing groups that were active in the domains of production, consumption and exchange. By mapping variation in how Aegean households operated and cooperated during different periods of the Neolithic researchers have sketched a general evolution in the nature and complexity of societies during the Neolithic and into the Bronze Age. The nature of this long-term evolution is rendered clearest by comparing and contrasting communities of the 7th millennium with those of the 3rd millennium BC. In this way one can trace an evolution from the communal societies of the earlier Neolithic, where the interests of specific groups were subordinate to those of the many, to the unequal societies of the EBA, where the interests of the many are subordinate to and driven by the interests of a few.[13] But between these two extremes, the nature and timing of the subtle shifts that occurred along the way are often unclear. Thus far the focus has fallen on what appears

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[11] E.g. Halstead 1981a; Halstead 1981b; Halstead 1999; Kotsakis 1999; Tomkins 2004; Tomkins 2007a; Tomkins 2010.

[12] E.g. Sahlins 1974.

[13] Halstead 1995; Tomkins 2010.

to be a progressive isolation of the household as an independent social, economic, and political unit and its progressive appropriation of communal rights, controls, and obligations.[14] Framed in such terms it has been possible to develop a narrative of social evolution that emphasises two particularly notable phases of realignment within the Greek Neolithic, the first around the mid-6th millennium BC, the second during the mid to late 4th millennium BC.[15]

However, while the use of cross-cultural anthropological concepts has transformed our engagement with the Neolithic data, their deployment is not without certain risks and limitations. These are, after all, concepts that we have developed to understand societies of the recent past and thus their relevance to the societies of the Aegean Neolithic, and the conditions in which they operated, cannot simply be assumed but must be established. Unless we can observe the specific ways in which these idealised concepts are actualised and articulated in the Neolithic data, we run the risk once more of imposing our own ideals and assumptions on the data and creating our own rhetorical prehistories of the Neolithic. While the recasting of social relations during the Neolithic as an interplay of household and communal agencies has helped us to develop more sophisticated social narratives, we need to ask ourselves how well grounded these agents are in the Neolithic data. How well linked are our current narratives of social evolution to the actual data? Do they float above or flow from the empirical realities of existence? Can the social during the Neolithic be adequately summed in idealised terms of households and communities or do we need to work harder to do full justice to the complexity of existence during the Neolithic?

These are difficult questions, which we can only address by broadening and deepening our engagement with Neolithic materiality and thereby what is often termed social production. Since the 1980s detailed, contextual studies of various Neolithic technologies of production and consumption (e.g. farming, lithics, pottery, ornaments) have provided our most important insights into Neolithic social production, especially when married with a theoretical approach that explicitly or implicitly frames past human engagement with the material world in terms of *practice.*[16] A practice-based approach views continuity and change in material and social production as occurring through the interactions of people and things. Human practices take different forms and articulate different materialities in timespace. Typically the archaeological record presents a palimpsestic mixture of these different materialities and thus a practice-based approach offers a means of unpacking the residues of the archaeological record into more meaningful people-thing associations. Crucially, a practice-based approach places the (now absent) people alongside their (still present) materials, and thus provides a necessary corrective to the object-oriented gaze of modernist archaeologies.[17] Past applications of practice theory to European prehistory have demonstrated that practice provides a more sensitive and appropriate framework for understanding change in small-scale Neolithic societies than culture history or systems theory; one that allows the people of the past to inform us of their lives and have a greater say in our narratives of their history.[18]

Methodological Considerations

However, while our epistemologies and frameworks are now sufficient to offer the prospect of a Neolithic 'in its own terms', applying them successfully necessarily requires datasets amenable to such a detailed, relational approach. That is, we need datasets that allow us to situate our gaze at the highest possible temporal and spatial resolution and comprehensively trace out the entanglements of people and things and thus how the social was variously enacted. It is only by deepening and slowing down our engagement in this way, by focusing down on the specific and maximizing

[14] Halstead 1995; Tomkins 2004; Tomkins 2010.
[15] Halstead 1995; Tomkins 2010.
[16] E.g. Bourdieu 1977; Dobres 2000.
[17] E.g. Tomkins, submitted a.
[18] E.g. Thomas 1990; Barrett 1994; Edmonds 1999; Tomkins 2004.

the detail, that we can have any hope of giving full voice to the diversity and contingencies of the data,[19] and thus of glimpsing actual identities and of tracing how the social was stabilised and experienced during the Neolithic.

However, if we adopt such an approach, we are forced to confront a major methodological issue and, in turn, to reflect critically on the efficacy of current techniques and traditions of archaeological characterisation.[20] Just how well do our traditions of archaeological practice, which were developed more than a century ago amid different circumstances and answering to different agendas for and conceptions of the past, answer to present aims and conceptions? To what extent do the datasets produced by these traditions resist the social narratives we now seek to trace? How might we modify our methodologies of characterisation to enable a more relational understanding of Neolithic social production? Thus, for example, in the case of ceramic characterisation it may be argued that traditional object-oriented, typology-led characterisation is not the most sensitive indicator of meaningful variation in Neolithic ceramics and, moreover, that a different, more integrated and more comprehensive practice-led approach can produce datasets better suited to the highly detailed, relational approach to Neolithic social production advocated above.[21]

Empirical Realities: Discovering the 'Missing Millennium' on Crete

When commenting on the scarcity of radiocarbon dates from 4th millennium BC contexts Manning sensibly drew attention to a potential variety of factors and to variability in their articulation in different regions of the Aegean.[22] While for some sites, even whole regions, it is apparent that there was actual hiatus in habitation, in other cases the 'missing millennium' seems more likely to result from under-investigation (i.e. insufficient radiocarbon sampling of likely 4th millennium BC contexts). In the case of Crete, after a decade or so of investigation it is apparent that under-investigation, site abandonment and empty regions are all relevant for different cases at different times.

Resolving Basic Chronological Problems

The biggest single factor restricting our understanding a decade ago was under-investigation. Although investigation of pre-Bronze Age contexts on Crete had mainly been serendipitous rather than planned, more than a century of this had still produced a large body of (mainly unstudied) data. While several pioneering site-studies had been made, most notably by J. Evans at Knossos and L. Vagnetti at Phaistos and Nerokourou, the relations between sites and regions generally remained unclear, if not confused, largely because of ongoing chronological uncertainty about ceramic phasing during the Final Neolithic and at the beginning of the Early Bronze Age.[23] While Knossos presented a clear and seemingly continuous sequence from the very beginning of the Neolithic down to the end of the 5th millennium BC, its uppermost Neolithic levels were seen as more problematic. Indeed a form of consensus had developed that the strata covering most, if not all of the 4th millennium BC were missing, either because the site contracted or was abandoned before reoccupation during EM I[24] or because these strata, together with almost all EBA remains from the top of the hill, had been cleared in a major leveling episode that preceded the construction of the First Palace,[25] traditionally placed at the beginning of the MBA.[26] In contrast to

[19] See Latour 2005.
[20] Tomkins, submitted a for a discussion.
[21] Tomkins, submitted a.
[22] Manning 2001, 168–169.
[23] See Tomkins 2007b, 13–18, 32–48; Tomkins 2008, 36–40.
[24] Broodbank 1992, 42.
[25] Evans 1968, 276; Evans 1971, 114.
[26] Evans 1921, 127–131, 134, 165.

Knossos, most known Neolithic sites elsewhere in Crete seemed to be of much shorter duration, typically comprising no more than one or two phases of occupation. Moreover, these generally presented styles of pottery that appeared to date later than Knossos, but earlier than classic EM I.

And so a decade ago it was already clear that there were sites of general 4th millennium BC date on Crete, however an absence of radiocarbon samples and uncertainty regarding relative phasing meant that there was no more precise means of dating them and thus no way of exploring continuity and change *within* the 4th millennium. Moreover, as one got close to the Neolithic-EBA transition, there was also considerable confusion with regard to what precisely was or was not characteristic of the beginning of EM I, leading to the same pottery groups being termed Neolithic or EM I by different scholars.

Such chronological problems, specifically a lack of resolution *within* the long Final Neolithic (FN) phase and uncertainty or disagreement regarding the precise nature of the ceramic phases that lie either side of the latest FN and earliest EB I divide, were by no means limited to Crete. Indeed to a greater or lesser extent they still afflict other regions of the southern Aegean as well as those further afield. Resolving them is of paramount importance because enhanced chronological control and resolution is the critical first step to a deeper understanding of the nature and development of social complexity in the Aegean during the 4th millennium BC. In view of this, some discussion of how these chronological problems came to be resolved for Crete over the last decade may be of wider interest.

To a large extent, recent advances in Cretan FN chronology are the product of hard work studying previously excavated data from sites where multiple phases of FN are preserved. In this way Comprehensive reviews of Neolithic stratigraphy and ceramic phasing at Knossos[27] and Phaistos[28] have clarified the sequence for the 4th millennium and have resolved longstanding questions regarding the chronological relationship between the two sites. At Knossos, which is the only site to preserve a complete FN sequence, the 4th millennium proved to be present in its entirety and thus only 'missing' in the sense that it lacks radiocarbon dates. It has also become apparent that stratigraphies spanning the end of the Neolithic and the beginning of EBA[29] are by no means rare or lacking on Crete[30] and, moreover, would have long been available had detailed characterisation work been carried out immediately after their excavation.

In addition, further clarity has been brought by refinement in the basic methods of chronology building, specifically a move away from an idealised 'stratum-based' approach to a more specifically contextual approach to the definition of ceramic chronological 'control' groups. Simply put, in the case of complex, multi-phase stratigraphies such as Knossos and Phaistos, the stratum, when deployed as the total depth of archaeological deposit assignable to a single ceramic phase, is too blunt an instrument to capture ceramic development accurately and reliably, primarily because it seeks to combine deposits with potentially very different depositional and compositional characteristics. Preferable is an approach that isolates specific, closed, stratified groups of pottery, that can be shown to correspond to discrete, and ideally primary, episodes of deposition. Such pottery groups provide a more secure basis for the definition of relative site phases, the sequence of which at a site is made clear by their stratigraphic relationships. The aim with this is to exclude mixed deposits from the primary chronology-building process, even when those deposits comprise the most complete examples of specific vessel types, such as is the case with the numerous cave and collective burial sites that span the FN–EM I transition in Crete. Previous chronological work on Crete that attempted to define phases using mixed deposits[31] succeeded only in generating considerable confusion regarding what constituted latest FN and earliest EB I.[32]

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27 Tomkins 2007b; Tomkins 2008.
28 Todaro – Di Tonto 2008; Todaro 2012.
29 E.g. Knossos, Phaistos, Kephala Petras.
30 Contra Manning 2001, 41–42.
31 E.g. Renfrew 1964; Vagnetti – Belli 1978.
32 Tomkins 2007b, 13–18 for a discussion.

An essential tool in the comparative investigation of complexity in different regions of the Aegean is chronological transparency, that is the development of a common understanding of chronological phasing that is shared between researchers working in different regions and within different modern regional archaeological traditions. Ideally, greatest transparency would be achieved if all researchers related their regional sequences to a single, shared standardised chronological scheme for the Neolithic Aegean, as is the case for the Bronze Age. In reality, however, we seem, if anything, to be moving further away from this ideal thanks to the current proliferation of alternative chronological schemes, fed by recent expansion in investigation into this period in different Aegean regions. Greater clarity and integration between Greek and Turkish schemata is particularly crucial for our understanding of the relations between the islands of the East Aegean and the Aegean regions of Turkey, where the two systems most clearly overlap.

The difficulty, of course, lies in achieving a common, transparent Aegean chronological framework for the 7th–4th millennia BC. Researchers first need to be willing to adopt new chronological terminology (not easy when one has grown up in a different chronological tradition) and consensus has to be reached on which particular terminology to use. A significant obstacle to the latter is the desire felt by many researchers that a chronological scheme should not simply be a system of reference to refer to blocks or periods of time, but should also convey a place or stage in a system of historical development. The main difficulty with this desire to merge chronological and developmental schemes is that opinions about the nature and timing of development within and between regions vary greatly, not just among researchers in the present-day, but also historically as data increase and understanding deepens. This lack of consensus about development combined with the potential for future empirically-driven shifts in understanding, means that the desire to impose developmental opinions on our chronological architecture is a highly subjective one that is best resisted at all costs. Thus, while all chronological schemes currently in use around the Aegean originate out of a merging of chronological and developmental functionality, and thus imply a developmental meaning, it is essential that we resist the desire to see them as denoting anything more than a relative chronological ordering of time. Indeed it is only by excising all sense of historical development, that we can ever have any hope of harmonizing our fragmented regional chronologies into a single, overarching scheme.

In the case of Crete a decade ago, chronological disharmony with other Aegean regions was extreme. Although it shared the same phase terminology for the Greek mainland (i.e. Aceramic, Early, Middle, Late, Final Neolithic), none of the Cretan phases were remotely equivalent in timing or duration. The extent of the original mismatch is shown by the fact that the old Cretan 'Early Neolithic' covered the entire period of the Greek EN, MN and LN periods, while 'Middle Neolithic' coincided with the beginning of FN. In order to improve chronological transparency, and thereby facilitate the comparison of ideas, models, and data between Crete and more general discourse on the Greek Neolithic, the Greek terminology was reapplied to phases at Knossos that could be shown (by imports, exports, stylistic influence and radiocarbon dates) to be the direct equivalent of their Greek counterparts.[33] The new chronology was also linked, where possible to the chronology used in the Aegean regions of Turkey (NB, an updated version of this correlation of Cretan, Greek and Turkish regional chronologies is shown in Fig. 1). For the Final Neolithic, and more specifically the 4th millennium BC, this process had the added advantage of advertising the exceptionally fine chronological resolution that is available for Crete, in contrast to the Greek mainland, where phasing within the 1500 years of FN is currently not well understood. Regarding the Aegean regions of Turkey, the Cretan FN IB, FN II, FN III and FN IV phases appear to be broadly the equivalent of Late Chalcolithic 1–4 (Fig. 1).

[33] Tomkins 2007b.

<table>
<tr><th>New Cretan Neolithic Phases (Knossos)</th><th>Southern Greek/ Cycladic Neolithic</th><th>Anatolian Neolithic</th><th>Approx. Dates (calibrated BC)</th></tr>
<tr><td>Initial Neolithic
(Stratum X)</td><td>Initial Neolithic
(from c. 6750 BC)</td><td>Aceramic/
Early Neolithic
Ulucak VI</td><td>c.7000 – c.6500/6400</td></tr>
<tr><td>Early Neolithic
(Strata IX-VIII)</td><td>Early Neolithic
Franchthi FCP1</td><td>Late Neolithic
Hacilar IX–VI
Ulucak V
Kuruçay 13–11</td><td>c.6500/6400 – c.6000</td></tr>
<tr><td rowspan="2">Middle Neolithic
(Strata VII–VIB; Stratum P)</td><td rowspan="2">Middle Neolithic
Franchthi FCP2–3</td><td>Early Chalcolithic
Hacilar V–I
Ulucak IV
Kuruçay 10–7</td><td>c.6000 – c.5600</td></tr>
<tr><td rowspan="4">Middle Chalcolithic
Ulucak III
Emporio X?

Emporio IX?
Tigani I

Emporio VIII
Kum Tepe IA
Beşiktepe
Kizilbel/Lower Bagbasi
Tigani II–III</td><td>c.5600 – c.5300</td></tr>
<tr><td>Late Neolithic I
(Strata VIB–V;
Strata N, M, L)</td><td>Late Neolithic I
Saliagos I–II
Franchthi FCP4</td><td>c.5300 – c.4900</td></tr>
<tr><td>Late Neolithic II
(Stratum IV;
Strata K, H, G)</td><td>Late Neolithic II
Saliagos II–III
Ftelia</td><td>c.4900 – c.4500/4400</td></tr>
<tr><td>Final Neolithic IA
(Stratum IIIB;
Strata F, E, D)</td><td rowspan="5">Final Neolithic

Franchthi FCP5

Kephala (early)

Ayia Irini I
Kephala (late)</td><td>c.4500/4400 – c.4200</td></tr>
<tr><td>Final Neolithic IB
(Stratum IIIA;
Strata C, B)</td><td>Late Chalcolithic 1
Beycesultan
XL–XXXV
Aphrodisias Pekmez VIIIB</td><td>c.4200 – c.3900</td></tr>
<tr><td>Final Neolithic II
(Stratum IIB)</td><td>Late Chalcolithic 2
Beycesultan
XXXIV–XXIX</td><td>c.3900 – c.3600</td></tr>
<tr><td>Final Neolithic III
(Stratum IIA)</td><td>Late Chalcolithic 3
Beycesultan
XXVIII-XXV
Kuruçay 6A</td><td>c.3600 – c.3300</td></tr>
<tr><td>Final Neolithic IV
(Stratum IC)

Kephala Petras (Neolithic Building)</td><td>Late Chalcolithic 4
Beycesultan
XXIV–XX
Kuruçay 3
Kum Tepe IB
Emporio VII/VI
Tigani IV</td><td>c.3300 – c.3000</td></tr>
</table>

Fig. 1 The relationship between Cretan, Greek and Anatolian phase.

Identifying Investigation Biases: Visibility, Serendipity and Blind-Spots

Resolution of these basic chronological issues on Crete in turn provided a more secure and resolved perspective from which to evaluate Neolithic data collected over more than a century of archaeological investigation. By clarifying the relative chronology of sites beyond Knossos it has proved possible to identify several new patterns in site-use and settlement.[34] But such work has also served to demonstrate that the current Neolithic data are seriously affected by issues of taphonomic and research bias. But, by acknowledging the full extent of this bias, we place ourselves in a better position to appreciate not only the data that we do have, and thus where we have been afforded precious windows on the past, but also the areas where we have serious gaps, and thus where we need to tread carefully and direct future research.

Beyond Knossos, the representation of phases in the new Cretan Neolithic chronology varies considerably. Most phases down to the mid-4th millennium (i.e. IN–FN II) seem to be strikingly under-represented or absent outside Knossos, while the late FN, particularly FN IV, account for the large majority of known 'Neolithic' sites. Previously this scarcity had been explained as reflecting a real absence of settlement outside Knossos. However, petrographic study of EN–FN pottery from Knossos has demonstrated a consistent presence of imported pottery originating from different regions within Crete and beyond.[35] If pottery was being produced at various locations beyond Knossos, using distinct sets of raw materials and in distinct technological traditions, it seems reasonable to presume that such locations correspond to settled communities.[36] This strongly suggests that settlement (in)visibility in fertile, lowland fluvial zones, whether due to subsequent burial or insufficient investigation, remains a major distorting factor in the data. That this invisibility issue also applies to the better represented late FN phases of settlement is suggested by the fact that the majority of known late FN sites are small, single-phase sites in locations of high archaeological visibility in the uplands of Crete (i.e. thin soils, hills, ridges), while the most fertile lowland locations remain almost as under-represented in the late FN as they are in earlier phases of the Neolithic.[37]

Compounding issues of visibility is the problem of research bias. While some serendipitous discoveries have been well studied and published,[38] most have received little or no further attention. One consequence of this is that we still do not really know the extent of what we have found, with a considerable amount of potentially valuable data, especially from caves, currently languishing unstudied in store-rooms. A second consequence of serendipitous investigation has been that our sample of the places where Neolithic activity took place is heavily biased towards locations where Bronze Age or later activity occurred. Thus caves remain a heavily over-represented Neolithic site type, as they do elsewhere in the Aegean,[39] while in the sample of open-sites the late FN is slightly better represented in part because it is the period when occupation at some Bronze Age sites first begins and thus is more frequently revealed in excavations targeted at Bronze Age remains. In contrast, locations *only* occupied during the (Final) Neolithic, especially in the lowlands, are under-represented to an unknown degree.

Worlds in Transition: The Rise of Defensibility and Marginality in the 4th Millennium BC

And so, while many gaps remain, the settlement data are sufficient, in some cases, to provide glimpses of patterns and development *within* the long FN period.[40] For the millennia prior to FN

[34] Tomkins 2008; Tomkins 2013.
[35] Tomkins – Day 2001; Tomkins et al. 2004.
[36] Tomkins 2008, 27–33.
[37] Tomkins 2008, 38–39.
[38] E.g. Vagnetti et al. 1989; Haggis et al. 2007.
[39] Tomkins 2009.
[40] See Tomkins 2008, 35–40; Tomkins 2013.

the settlement data are consistent with the conclusion, drawn from detailed petrographic study of EN–FN pottery fabrics from Knossos, that there was widespread occupation of prime, lowland agricultural locations in eastern, central and western areas of Crete, not just at Knossos.[41] For the early FN (i.e. late 5th millennium BC) the settlement data remain frustratingly sparse, but provide further hints in this direction. The first change to this picture of significant settlement invisibility in the lowlands of Crete occurs during FN II–III (c. 3900–3300 BC) when some lowland regions (e.g. Isthmus of Ierapetra, Mesara) see a marked increase in the archaeological visibility of settlement, while others (e.g. the Herakleion Basin around Knossos) do not. This pattern appears to be caused by a shift in site preference (in some regions) to higher-lying, more 'defensible' locations (hilltops, upper slopes) overlooking prime agricultural land.

While the near-invisibility of earlier phases of settlement in these regions currently restricts the extent to which this can be *demonstrated* to be a local evolution in site choice, there are nevertheless some indications in this direction. For example, Mitropolis, the earliest known settlement in the Mesara (FN I–II),[42] is located directly on the plain next to a tributary of the Ieropotamos River. During FN II (c. 3900–3600 BC) occupation ceases at Mitropolis and is initiated at a number of higher-lying, more 'defensible' locations (ridges, hill-tops) in the general vicinity (e.g. Phaistos). Although a direct causal link between the two phenomena cannot be demonstrated, the timing is at least suggestive of a wider local shift in preference for site location. The reasons for this increased interest in defensibility (and inter-visibility) remain unclear, but it seems plausible to infer increased insecurity and friction between local settled communities. Why there should be increased social conflict at this time remains unclear. One possible contributory factor could be increased climatic uncertainty (i.e. greater aridity and interannual variation in precipitation), and the pressure this could place on productivity and thus social stability in an agricultural economy.[43] However, considerably more research is required to produce a more resolved and local picture of climatic variation in Crete and to relate it convincingly to the timing of shifts in human behaviour, before the validity of this hypothesis, and particularly why it would affect only certain lowland regions, can be assessed.

During FN IV a second, significant development in settlement is marked by the first appearance of a dense spread of small sites located in agriculturally more marginal regions (e.g. Siteia uplands of East Crete), which previously had not been favoured for Neolithic settlement.[44] Such regions are termed marginal because they lie away from the (mainly lowland) areas of prime agricultural land and because stands of cultivable land tend to be less extensive and more dispersed through the landscape. Short-term marginal colonisation recurs as a settlement strategy, in different forms and at different times, throughout the Cretan Bronze Age and historic past. In order to exploit such regions in the Neolithic a new, more distributed form of community needed to be developed, one where households and dwellings were distributed through the landscape rather than clustered together in large nucleated villages. While some regions of Crete were settled in this way during FN IV (e.g. Siteia uplands), in others (e.g. Asterousia hills of south-central Crete) marginal colonisation is only apparent from EB I. In contrast to Neolithic settlement in the lowlands of Crete and elsewhere in the Aegean, marginal settlement appears to have been a considerably more unstable strategy. FN IV and EB I sites in more marginal locations are typically occupied for no more than one or two ceramic phases, which need equate to no more than a few centuries at most. There remains much to learn about the nature of these episodes of marginal colonisation and about the factors pushing/pulling certain groups of people away from the Cretan lowlands at certain times. However, in the case of FN IV marginal colonisation, it has been suggested that social changes taking place in lowland villages during the late FN may have played a significant role.[45]

41 Tomkins et al. 2004.
42 Tomkins 2007b, 35–36.
43 Tomkins 2008, 38; Tomkins 2010, 42–43.
44 Halstead 2008; Tomkins 2008, 38–40; Tomkins 2010, 39–40.
45 Tomkins 2010, 39–42.

Continuity and Change in Village Life during the 4th Millennium BC

Early FN Continuities: The Later Neolithic Village

In addition, to these dots on maps, there are a number of excavated sites, mainly of late FN date, where a more detailed window on people, materials and practices can be gained. Chief among these is Knossos, which after more than a century of excavation and study represents one of the more comprehensively sampled Neolithic settlements in the Aegean. While its importance for our understanding of Neolithic Crete has been appreciated for more than a century,[46] over the last decade or so appreciation of the nature of its significance has changed. Previously Knossos tended to be treated as unusual in almost every respect: it was widely believed that it grew rapidly in isolation into a Neolithic 'super-site' which became the mother community for a very late colonisation of the rest of the island in the 4th millennium BC.[47] More recently, however, this idea has been entirely rejected thanks to the recognition of the probable existence of other communities beyond Knossos from as early as the 7th millennium BC[48] and by detailed re-evaluation of the growth of Neolithic Knossos.[49] Far from growing quickly into a large, demographically self-sufficient community early in the Neolithic, as previously supposed,[50] Knossos remained very small (c. <0.5ha), and thus demographically unviable for the 1st millennium of its existence (i.e. c. 7000–6000 BC), and only developed into a large village (c. 1.0–2.5ha), that was at least technically self-sufficient demographically, during LN (c. 5300–4500 BC). Contrary to previous estimates, which assumed continual growth throughout FN,[51] careful study of all available deposits, exploiting the resolution provided by the new FN I–IV chronology, indicates that at no point during FN did Knossos grow any larger, remaining instead within the size threshold observed for other large villages on Crete[52] and in other regions of the Aegean.[53]

And so, rather than providing us with a window on a highly unusual form of Neolithic social complexity that has little comparative value, Knossos in fact appears to be typical of other large village sites of the Aegean Neolithic and thus gives us our best glimpse of social life and how it may have evolved at other such villages on Crete. From the first emergence of a more independent household unit during the late 6th millennium BC[54] down to the turn of the 4th millennium BC a picture of the later Neolithic Knossos community emerges that is household-based, communally-oriented and seemingly highly stable. From LN I houses are not only larger, more complex and more carefully constructed, but also for the first time become architecturally discrete and ideologically represented (house models). That this change in the visibility of the household coincides with changes in household rights and obligations in other domains of practice is suggested by the adoption of a series of new technologies of production (e.g. weaving, flax, increased wild olive cultivation) and consumption (e.g. pouring shapes) during the 5th millennium. The possibility for such changes suggests that households now enjoyed greater control over the destination of their productive output, while the motivation for such changes seems to lie in the competitive social advantage afforded by increasing the quantity, quality and value of household productive output.

Clearly, however, household competition had its limits. Elsewhere[55] I have suggested that the LN-early FN household be seen as 'emergent' in the sense that it had become a more discrete social, economic, and political unit, but one whose independence continued to be curtailed by

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46 E.g. Evans 1902; Tomkins 2000.
47 E.g. Broodbank 1992.
48 Tomkins – Day 2001; Tomkins et al. 2004; Tomkins 2008.
49 See Tomkins 2008, 27–36.
50 E.g. Broodbank 1992.
51 Evans 1971; Broodbank 1992, 44–45.
52 E.g. late FN Phaistos 2–3ha; Whitelaw 2012, 120–121.
53 Tomkins 2010, 34.
54 Halstead 1995; Tomkins 2004; 2010.
55 Tomkins 2010, 37–39.

a powerful set of communal obligations. There is, as yet, no convincing evidence, from Crete for the emergence of more permanent forms of social inequality during the 5th millennium BC. Rather the evidence indicates that households continued to live in aggregations, preferring the security of communal solidarity to the potential opportunities for personal advancement provided by social fragmentation. Moreover, the failure of LN–FN Knossos (and other Aegean communities) to grow beyond the threshold above which egalitarian communities tend to fission or evolve more complex forms of organisation[56] strongly suggests an absence of permanent institutionalised inequalities, which would otherwise have developed if household competition had been allowed to develop unchecked.[57] In this way the stability of the later Neolithic village on Crete was predicated on the continued maintenance of communal rights and obligations over the general inclination of households to pursue their own self-interest.

The Bronze Age before the Bronze Age? Thinking through Complexity and Change in the Late FN

On present evidence this balance of social rights and obligations appears to continue without significant change for much of the 4th millennium BC. Although the regional shift to more defensible locations during FN II–III may hint at increased social stress within some lowland communities (see above), it is currently only from FN IV that more concrete signs of a rupture to this social contract become apparent.

One such indication is provided by evidence that trading and the longboat, which hitherto had been understood to be phenomena of the EB IB–II Aegean, have a deeper history in the Aegean and on Crete going back at least as far as FN IV.[58] This earlier date is based partly on the discovery of petroglyphs of a craft resembling the longboat and dating to the very end of FN, at the site of Strophilas on Andros,[59] but mainly on detailed, integrated characterisation of ceramic, lithic and metallurgical artefacts from the site of Kephala Petras, located on the Siteia Bay in East Crete.[60] This characterisation work has shown that around half the imported pottery is in White Mica-Schist fabrics compatible with a provenance beyond Crete in the Hellenic Arc (Lavrion-Cyclades) and also shares distinctive typological similarities with FN IV pottery from sites in the same Attic-Kephala region. The general absence of connections with regions that lie between the Attic-Kephala region and East Crete indicates that this was a highly specific, directed link. The presence of notably larger amounts of obsidian at Kephala Petras, exploiting off-island technologies of reduction without a deep history of use on Crete, together with evidence for seemingly the earliest known metallurgy on Crete, strongly suggests that primary motivation for this direct, long-distance connection was not to forge specific social relations *per se* but to secure preferential access to specific, high value *commodities* (i.e. metals, obsidian) and the technologies for their transformation.[61] Comparison with assemblages at other FN IV sites in the Siteia region strongly suggest that Kephala Petras monopolised and restricted access to these off-island commodities and technologies and thus that it acted in an essentially similar way to later EBA gateway communities engaged in trading (e.g. EB IB Ayio Photia, EB IIA Poros-Katsambas, EB IIB Mochlos).

As has long been realised,[62] the emergence of trading and gateway communities is significant because it implies the existence of new cultures of acquisition, commoditisation and consumption. In this way the presence of trading communities by FN IV strongly suggests that communal

56 Ca. 2–3ha or 300–500 people; Whitelaw 1983, 340.
57 Tomkins 2010.
58 Tomkins 2010, 40–42; Papadatos – Tomkins 2013.
59 Televantou 2008.
60 See Papadatos – Tomkins 2013.
61 Papadatos – Tomkins 2013.
62 E.g. Renfrew 1972, 440, 463, 468–472, 496–497.

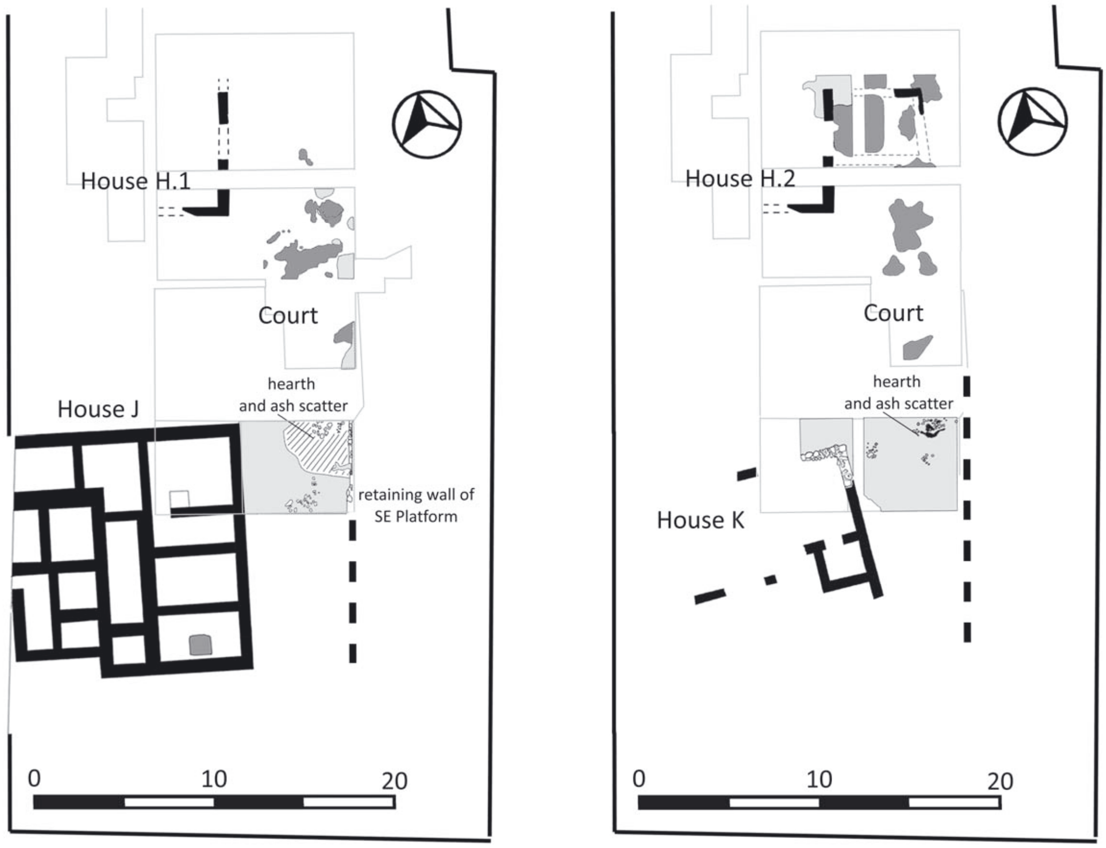

Fig. 2 The Final Neolithic IV–Early Minoan I houses and court below the Central Court at Knossos: left, Stratum IA (FN IV); right, Stratum IB (FN IV–EM IA).

controls over household acquisition and accumulation, which typify later Neolithic village societies, were no longer operating in quite the same way. Indeed we may reason that households were now freer to acquire, accumulate and appropriate in ways that would surely have brought them into more overt, unmediated conflict with each other and their communities and would have led to the emergence of more permanent forms of inequality.

Further hints in the direction of emerging inequality and an appropriation of the communal are provided by changes in ritual practice. Throughout the Neolithic the use of caves on Crete and in the wider Aegean appears to have been communal and essentially ritual in nature, involving the deposition of material culture and, on occasion, human skeletal material.[63] During FN IV there is evidence for a significant increase in the intensity of corporal deposition at certain cave sites on Crete, prefiguring a more widespread funerary use of caves and rock-shelters in EB I and II.[64] The placement of a body in a cave is a highly energetic and visible form of corporal disposal: to do so episodically over millennia at a communal ritual site advertises the status of an important individual or lineage; however, to do so more intensively over a century or so suggests a more competitive environment, where individuals or lineages were not only seeking to make sustained claims to (unequal) status, but were also aiming to cement these claims in greater perpetuity by appropriating the space, both physical and semantic, of communal ritual.

63 Tomkins 2009; Tomkins 2013.
64 Tomkins 2013.

Something similar is suggested by a major spatial reorganisation at Knossos at the beginning of FN IV. This takes the form of large-scale levelling of the top of the Neolithic settlement mound to produce a large, flat area, which was then extended to the south-east by the construction of a terrace wall backed by a large fill of levelling debris. On the eastern edge of this levelled area a long, rectilinear open space or court was laid out (Fig. 2). This court was bounded to the west by two houses, one of which has been sufficiently excavated to show that it was large and unusual in that it contained a copper axe, one of the earliest known metal artefacts from the island. The court surface seems to have been kept clean save for the presence of fixed hearths, the position of which remains constant between different stratigraphic phases (i.e. Strata IC–IB; FN IV–EM IA). On the western edge of the hilltop there is evidence from FN III for a second open area, characterised by the digging and re-digging of large pits with complex, episodic internal sequences of deposition that appear ritual in nature. Perhaps the most significant feature of these eastern and western communal spaces is that a direct line of evolution can now be traced between their initial creation in the late FN and the subsequent development at Knossos of the monumental Bronze Age ceremonial complex conventionally known as the Minoan palace.[65] Similar continuities are also apparent between late FN communal ritual spaces at Phaistos and the Central and West Courts of the later 'palace' complex.[66]

The FN IV spatial reorganisation at Knossos served to create a restricted residential area, sufficient for 4–6 similar-sized dwellings, on the hill-top flanked by open spaces of different character to the west and east, with the rest of the settlement occupying the lower northern slopes of the hill. The establishment of specific ritual foci on the hill-top created the possibility for a new, hierarchy of access to communal ritual space, which previously in the Neolithic had shown no sign of such restriction. These changes thus appear to articulate a new order, where access to communal ritual space is not only more restricted, but also more unequal, with those resident in the restricted hilltop habitation area enjoying priority. Moreover, this new order, once established, continues to develop into EB I–II during which the eastern court and western open space are enlarged, boundaries between hilltop and settlement are further reinforced and access becomes further restricted by the construction of terraces and additional public buildings oriented around the eastern court. In short, at Knossos the history of a specifically Bronze Age tradition of ceremonial practice on the Kephala Hill goes back not to the beginning of the EBA but to the late FN.

And so what might these late FN developments mean more generally for the evolution of social complexity? Elsewhere I have argued that the appearance of marginal colonisation and trading in Crete, together with new arenas for the performance of social difference, new cultures of acquisition, appropriation and accumulation and new forms of identity and inequality are all rooted in a more fundamental shift in social rights and obligations that takes place in the late FN. This shift may be understood in terms of an irreversible change in the balance between the communal good and private self-interest that hitherto had stabilised and sustained later Neolithic village life. Previously communities had effectively managed perceptions of the possible, such that the logical desire of groups to capitalise on periods of advantage (social, productive), by finding ways of stabilizing these short-term inequalities into more permanent inequalities in status and access to resources, was controlled and curtailed. A loosening of these communal controls in the late FN opened the door to the development of alternative and diverging perceptions of the possible, in which private gain was allowed to take precedence over the common good and households were now more free to accumulate and appropriate in ways that encroached upon previously sacrosanct domains of household and communal practice. Elsewhere I have characterised this shift in terms of the emergence of a new form of household, termed 'modular' because households now appear

[65] Tomkins 2012.

[66] Todaro – Di Tonto 2008; Todaro 2012.

to have been more free to operate in isolation as fully separate and separable socioeconomic units that might combine in new and different ways to meet new and different circumstances.[67]

This late FN shift not only opened the door to the development of more permanent forms of inequality, but also increased organisational flexibility. It facilitated the emergence of new forms of identity, more permanent forms of inequality and new forms of livelihood, such as trading and marginality, which enabled communities to exploit a wider range of the resources configured across the land and seascapes of the Aegean. In this way, processes of socioeconomic diversification and integration, which are conventionally viewed as typical of the Bronze Age and later, should be understood to begin in the late FN.

Final Thoughts: The 'Urban Evolution' in Crete

If the late FN on Crete represents the beginning of the process of social and economic reconfiguration that we conventionally term the 'Bronze Age', when in this process do we see the first signs of urbanism? Historically the answer to the first question has depended very much on how urbanism has been defined. One group of researchers, most notably Gordon Childe and Colin Renfrew, chose to place the bar to the attainment of urban status at a high level, viewing only settlements with very large concentrations of population[68] as urban. In the case of Crete this meant that urbanism only first emerges at the end of the 3rd millennium BC during EM III–MM IA. Others, however, have pointed to evidence for significant settlement growth, well beyond the village threshold typical of Neolithic communities, already at certain sites in EB II and have suggested that this represents the beginning of urbanism, albeit at a much smaller scale than later.[69]

Recent work on Crete has contributed to this debate in two ways: first, clarification of spatial and demographic development at Knossos during FN (see *infra*) has demonstrated that the first phase of growth to take it beyond the demographic and organisational threshold of the face-to-face village society (c. 350–450 people) took place, not in FN as had been claimed, but in the early part of EB II (i.e. EM IIA). By the end of EB II Knossos has been estimated to have reached a size of c. 6.5ha,[70] corresponding to a population of at least 1000 people and probably significantly more. Elsewhere in Crete,[71] and indeed the Aegean,[72] EB II is more generally a phase that sees significant, comparable growth in the size of certain communities. As has long been emphasised, growth of this sort implies that some form of social restructuring must have taken place.[73]

Second, integration of late FN–MM I contextual, architectural and stratigraphic data from below the later Minoan palaces at Knossos and Phaistos, drawing on a century's accumulation of excavated materials, has recently opened up a window on a surprisingly complex world of ritual practice, large-scale 'public' construction and spatial re-organisation in the period between the late FN and the end of the EBA.[74] At Knossos, it is apparent that the origins of the building complex that we term the 'palace' dates back, not to MM I, but to late EM I when there is evidence to suggest the construction of one, or more probably two, large buildings, which share the same footprint and orientation as the Central Palace Sanctuary and Throne Room System of the later (MM I–III) 'palace'.[75] This building (or buildings) lay immediately to the west of a very large, rectangular, formal open space or court, which was a successor to the original FN IV–EM I early

67 Tomkins 2010, 39–42.
68 E.g. >5000; Renfrew 1972, 7; cf. Childe 1950.
69 Branigan 1970, 42, 118, 120; Warren 1975, 2, 36; Tomkins 2012, 69–75; Tomkins, submitted b.
70 Whitelaw 2012.
71 E.g. Phaistos, Malia; Whitelaw 2012.
72 Halstead 1981b, 196–200; Hägg – Konsola 1986.
73 Cf. Whitelaw 1983.
74 See Todaro 2012; Tomkins 2012.
75 See Tomkins 2012.

courts, but significantly enlarged in EM I late. During EB II there is good evidence to suggest that this 'central building' saw further significant expansion through the addition of further peripheral buildings, the walls of which share the same orientation as the late EM I building with court and, moreover, appear in some cases to have also formed part of the fabric of the later palace.

Irrespective of its precise function, which is difficult to establish owing to the fragmentary nature of the evidence, the timing of the construction of this 'central building' is significant because it predates the first initial expansion of the settlement in EB IIA. It implies a notable change in scale, both in the expenditure of resources on a communal project and in the size of the gatherings that could be accommodated in the court. Such changes are suggestive of a modification or even restructuring of social relations and imply that expansion in the community was either already taking place or was foreseen. It may thus be proposed that the subsequent expansion of the Knossos community during EB II, and the concomitant further expansion of the 'central building', was facilitated by social changes that took place slightly earlier, in the late EB I period. It may therefore be more appropriate to speak, not of an urban revolution and a pivotal, unilineal moment of transformation,[76] but of an *urban evolution*, characterised by a more complex and multilineal unfolding of social relations between the late FN and EB II, which in time and at certain places created the conditions in which what might be termed *initial urbanism* ultimately evolved.[77]

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Environment, Economy and Technologies

Agricultural Patterns in the Aegean in the 4th Millennium BC – An Explanatory Model

Simone Riehl,[1] *Konstantin Pustovoytov,*[2] *Hussein Othmanli*[2]

Abstract: Palaeoclimate proxies indicate orbitally induced changes in insolation for the sequence of the mid to the end of the 4th millennium BC. These changes led to polar cooling and advancing glaciers, and have been correlated with Bond event no. 4 or the 5200 BP event, which is considered responsible by some for droughts in wider Mesopotamia, Arabia and Africa. Palynological data from eastern Mediterranean sea-sediment cores suggest relatively arid conditions throughout the whole 4th millennium BC. At other locations like Lake Acigöl in Turkey the second half of this period has been reconstructed as increasingly arid climate. In the Trojan bay a descending sea level for the end of this period has been determined. A settlement hiatus at the archaeological site of Kumtepe (Troad) until roughly 3500 BC supports the argument of unfavourable living conditions. From c. 3300 BC onwards, human impact becomes clearly visible in the charcoal record of the Troad, supporting alternating impact of climate and humans. As a general characteristic of palaeoclimate proxies they often cannot tell in detail how climate change affected ancient societies. Resilience and adaptation, two important aspects in human societies, often cannot be satisfactorily linked with observations of climatic and reconstructed environmental change, because the intermediate agents, such as subsistence behaviour and economy are insufficiently integrated. This contribution aims to provide more insights into these aspects by considering the combined archaeobotanical and stable carbon isotope record as an indication of ancient growing conditions and soil moisture availability for crop plants as the agricultural basis of ancient societies.

Keywords: Mediterranean, climate change, mid-Holocene, archaeobotany, stable carbon isotopes, agricultural modelling

Established agricultural systems of the Final Neolithic or Chalcolithic period are generally considered advanced in terms of technology and the organisation of labour. Disruptive factors in these systems mainly derive from climate and environmental change and/or are closely related to socio-economic developments and/or societal constraints. There are surely more factors, but equally important is the seemingly infinite number of effects they may have. All these factors and multiple effects are interwoven and nearly impossible to be disentangled; therefore transformations of agricultural systems are difficult to explain in a deterministic way.[3]

As archaeologists, we may be able to determine single effects through investigating the material record. At the best we may be aware of certain human actions, but interpretations of the original factors may be relatively biased. This depends on which step in the chain of effects and actions is reflected in the archaeological record.

With this contribution, we aim to improve the understanding of late Neolithic/Chalcolithic agricultural patterns in the Aegean region by considering potentially disruptive factors in agricultural systems (Fig. 1). A short review of the climatic and environmental data available for the 4th millennium BC is followed by a discussion on the archaeobotanical evidence and the regional agricultural potential as indicated by agronomic models.

1 Universität Tübingen, Institut für Naturwissenschaftliche Archäologie und Senckenberg Zentrum für Menschliche Evolution und Paläoumwelt, email: simone.riehl@uni-tuebingen.de.

2 Universität Hohenheim, Institut für Bodenkunde und Standortslehre, email: knpustov@uni-hohenheim.de; husseinothmanli@hotmail.com.

3 Riehl 2009.

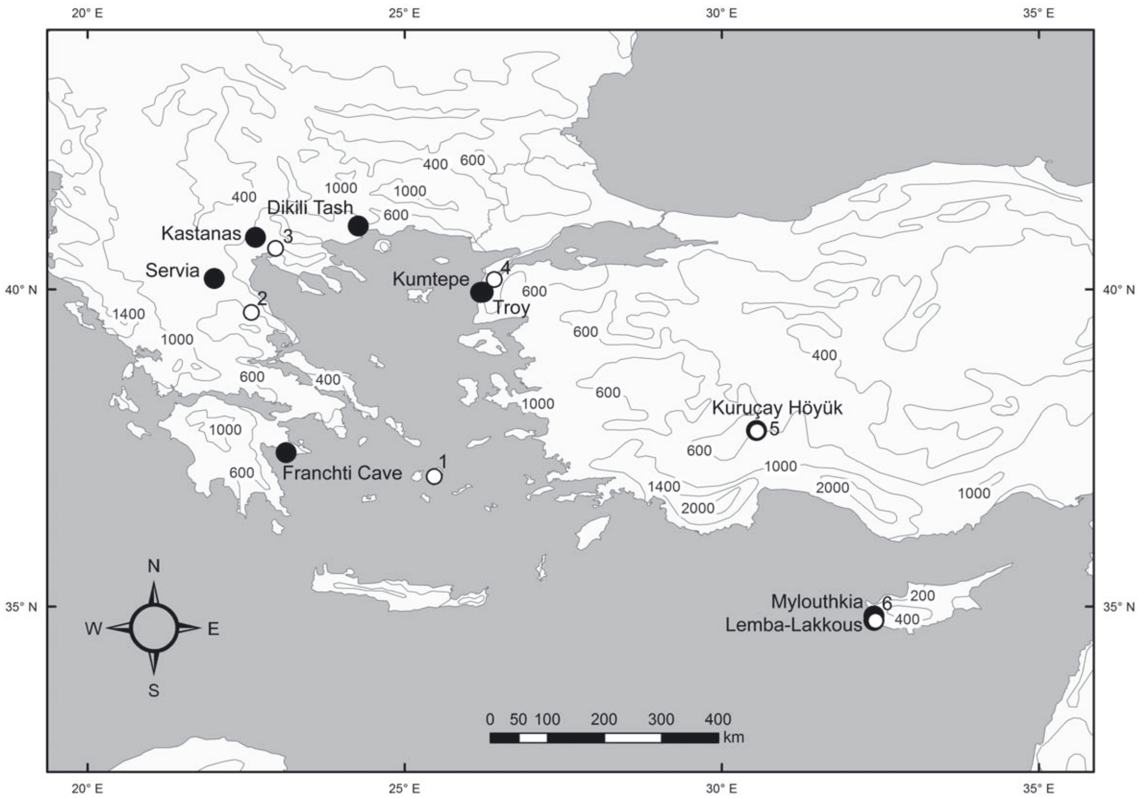

Fig. 1 Map of archaeological sites (black dots) and climate stations (white dots) discussed in the text; Climate stations: 1. Naxos; 2. Larissa; 3. Thessaloniki; 4. Çanakkale; 5. Isparta; 6. Paphos (illustration: S. Riehl).

The Mid-Holocene Palaeoclimate Record

Orbital and solar forcing and the ocean circulation linked to it represent the main parameters of climate change. Evidence suggests moister conditions for the Mediterranean region during the first half of the Holocene,[4] which has also been used as an argument to explain high lake levels in the area.[5] A drying trend followed from the mid-Holocene (around 6000 calBP) on.[6]

The reasons for this development are portended in a marine pollen record from the northern Aegean Sea indicating changes in the coupling to different climate systems throughout the Holocene in this geographic region. The terrestrial climate dynamics in the northern Aegean Sea were largely decoupled from the influence of the Siberian High and probably affected by the monsoon-influenced climate system of the lower latitudes during the early Holocene (9500–7000 calBP). However, after 7000 calBP the winter temperatures correlate with the GISP2 ice core.[7] From the mid-Holocene on, the intensity of the Siberian High exerted strong control on winter climate in the Aegean region.[8] Subsequent research has restated this argument in relation to a multi-centennial winter SST (sea surface temperature) decrease, between 6200–5000 calBP in particular.[9] The interval between 6000–2000 calBP has been described to characterise climatic instability.[10]

4 Bar-Matthews et al. 1997; Davis et al. 2003.
5 Harrison – Digerfeldt 1993.
6 Roberts et al. 2008.
7 Rohling et al. 2002.
8 Kotthoff et al. 2008, 843.
9 Marino et al. 2009.
10 Geraga et al. 2010.

Heavy stable oxygen isotopes are enriched at around 5000 and 3000 calBP and, in combination with the micropalaeontological record, support lower sea surface temperatures in the Mediterranean.[11] Temporal reductions in deciduous tree pollen suggest lower terrestrial temperatures and/or stronger aridity.

Non-cyclic events have only been discussed randomly, including evidence for tsunami impact on southwestern Crete at 5660 BP.[12] In contrast, cyclical events, mostly cited in relation to work by Bond et al.,[13] have been analysed more intensively. The 5200 calBP episode was documented in the Greenland ice core records, and Geraga[14] interprets its visibility in the Mediterranean palaeoclimate proxy records with a reduction in the SST records of about 1–2 °C as an overall Mediterranean climatic response to the high-latitude climate system variation. At the same time, east African records document increased aridity around 5200 calBP, which has been associated with a weakening of the monsoonal system through variability in solar activity, changing global circulation patterns, and a teleconnection between high and low latitudes,[15] which underlines the geographic and temporal dispartment of climate effects in the eastern Mediterranean region.

Cold and dry climatic phases are indicated in the benthic foraminiferae records of the Aegean Sea around 5400 and 4300 calBP.[16] Warm and humid climatic conditions have been interpreted for the southeastern Aegean Sea between 5200 and 4200 calBP.[17]

For the Near Eastern region, some geographers link local palaeoclimate proxies at around 5200 calBP to the collapse of the Late Uruk colonies.[18] They refer to interpretations of reduced precipitation leading to unsustainable agricultural production.[19] However, the extent of possible reduction in precipitation is not known for the Aegean region.

Climate modelling has been applied to the Mediterranean region. Brayshaw et al. model slight precipitation and circulation changes. While in northwestern Greece and coastal western Anatolia there is a slight positive modelled change around 6000 calBP, there are slightly negative modelled changes in Thessaly, central eastern Greece and eastern Anatolia.[20] Compared to modern precipitation, no change has been modelled for central Anatolia. The model shows a likely scenario for 6000 BP, but what seems even more important is the visualisation of the regional variation in climate effects we need to be aware of while generalising the Aegean cultural region and its agricultural economy.

Recent evidence for distinct regional differences in climate effects derives from multiple sources. Ehrmann et al.[21] linked the cycles they found in their sediment cores from the northern and southern Aegean Sea to changes of winter/spring intensity of the Siberian High (GISP2 K+ record) and to worldwide Holocene glacial advances. They concluded that substantial differences in sediment grain size between the northern and southern Aegean Sea were caused by different processes and climate regimes controlling sedimentation in the two regions. In the sediment cores analysed, short-term fluctuations superimposed the long-term trends of clay mineral composition and are likely linked to climate variations in the northern and southern Mediterranean borderlands.[22] This is also supported by additional coring results from the Levantine Sea. The similarity of $\delta^{18}O$ values from benthic foraminifers of the southern Aegean Sea and Levantine Basin sug-

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11 Geraga et al. 2010, 114.
12 Scheffers – Scheffers 2007.
13 Bond et al. 1997; Bond et al. 2001.
14 Geraga et al. 2010, 114.
15 Kiage – Liu 2006.
16 Kuhnt et al. 2007.
17 Triantaphyllou et al. 2009.
18 E.g. Staubwasser – Weiss 2006.
19 Weiss 2003.
20 Brayshaw et al. 2011.
21 Ehrmann et al. 2007.
22 Ehrmann et al. 2007, 51.

gests the influence of isotopically identical deep water masses during the middle and late Holocene. Slightly higher $\delta^{18}O$ values are observed in the northern Aegean Sea, which probably shows lower temperatures of North Aegean deep waters.[23]

Sea level changes, indicative of major environmental change, have been investigated in a number of regions in the Aegean. In northwestern Greece, the highest rates of local sea level rise during the Holocene were found until 5500/5000 calBC (up to 12.3m/ka) and the lowest during 4000–500 calBC (0.2–1.4m/ka),[24] which correlates with the observed sea level decrease in the Troad starting between 4000–3000 calBC.[25]

Palynological data is available from a number of sites in Greece and southern Turkey which, according to a recent study, show a shift in inferred plant functional types from temperate mixed forest to xerophytic woodland scrub between 6000 calBP to present.[26] However, a closer look at the vegetation units for 6000 calBP provided on the NOAA server reveals distinct regional differences. According to these records the coastal parts of the area in particular were covered with xerophytic woodland shrub while the higher elevations and interior regions to the north of Greece comprised of cool-mixed forest and the inland region of western Turkey encompassing warm to cool steppes.[27]

Evidence from the northern Aegean indicates high amounts of deciduous tree pollen between 6000 and 4300 BP.[28] Palynological research at Lake Philippi and Lake Kopais was discussed in the 1970s to indicate distinct vegetation differences between northern and southern Greece.[29] The northern pattern constitutes a thick oak forest that had developed by c. 7000 BC without much pioneer scrub. It persisted without discernible change throughout the Neolithic and the Early Bronze Age. In western Greece, Lake Voulkaria shows a pattern similar to northern Lake Philippi.[30] Vegetation patterns, of Kotihi lagoon in northwestern Peloponnese, also seem to fit these patterns.[31] This is in contrast to evidence from the south that shows that the forest was probably substantially reduced with largely treeless plains by the Bronze Age, and perhaps earlier.[32] These data conform to more recent results from the Peloponnese[33]. Greig interprets this pattern as largely anthropogenic due to a higher population pressure in the south although he also considers climatic difference as a factor, arguing that the moister north enabled faster regeneration of tree cover than possible in the south.[34] Supportive evidence comes from olive cultivation which was earlier and more extended in the south than in the north.

Simultaneously, ecological differences in relation to elevation have to be considered, as has been suggested for two sites in northwest Greece near Ioannina.[35] Gramousti Lake and Rezina marsh are only 20km apart, with the former at an elevation of 285m and the latter at 1800m. In the mountainous, more humid region, dense deciduous woodland was predominant while open woodland occurred in the valley. Around 4000 calBP, depletion of vegetation through anthropogenic disturbance is visible in the pollen diagrams from both sites, leading to a relatively uniform herbaceous flora.[36] A general trend noticeable in both pollen diagrams between 6300–5000 calBP

23 Kuhnt et al. 2008, 111.
24 Vött 2007.
25 Kayan 1992.
26 Roberts et al. 2011.
27 Cheddadi 1997.
28 Kotthoff et al. 2008.
29 Greig – Turner 1974.
30 Jahns 2005.
31 Lazarova et al. 2012.
32 Greig – Turner 1974, 191.
33 Jahns 1993.
34 Greig – Turner 1974.
35 Willis 1992.
36 Willis 1992.

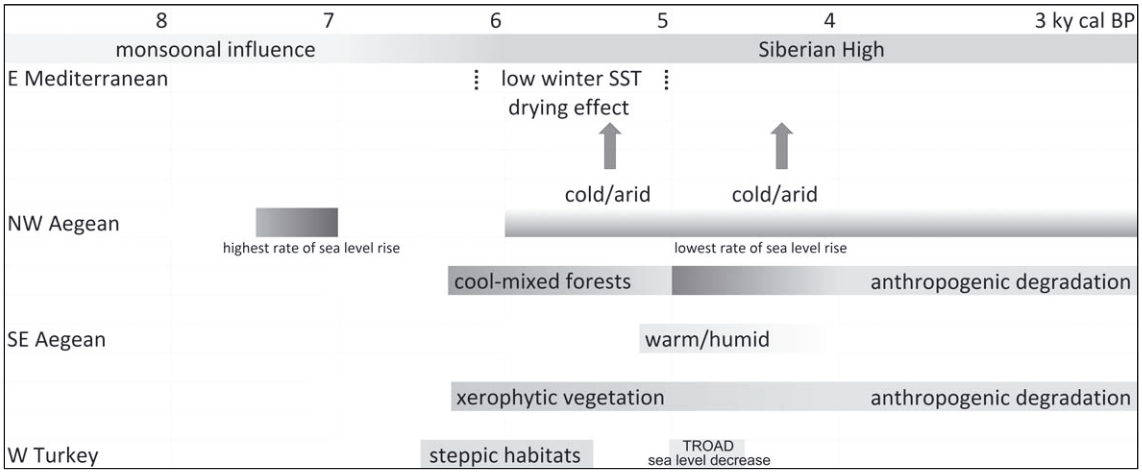

Fig. 2 Climate effects and vegetation development in the Aegean region with focus on the mid-Holocene (illustration: S. Riehl).

is a reduction in tree species, and a re-expansion of woodland after 5000 calBP, which agrees with the cold and arid phases indicated by benthic foraminifera (Fig. 2).

Whether anthropogenic or not, regional differences in vegetation composition were probably linked to the ancient economy in terms of landscape potential and agricultural development.

Greig's interpretation also discusses what was later described as the problem to differentiate between natural and human impact from the mid-Holocene onwards,[37] and subsequently labelled the 'mid-Holocene Mediterranean mélange'.[38] Specific effects of human impact on the environment are to be expected, depending on the settlement density and human economy in the different geographic regions throughout the different periods, as well as on a number of natural response mechanisms, all contributing to a highly complex mosaic of local environments and a high degree of variation in living conditions in the past, almost resistant to any generalisation.

The main goal of this contribution is to consider agricultural patterns against the backdrop of the assumed trend of increasingly arid conditions toward the end of the 4th millennium BC, and the regional differences in climate effects and environmental conditions.

Material and Methods

To achieve the goal stated above, we consider the archaeobotanical evidence from Late Neolithic and Chalcolithic sites in the area, including the stable carbon isotope evidence from Kumtepe and Troy. An agronomic model is used to evaluate potential long-term yields at different locations of the area under investigation.

Archaeobotanical Data

Archaeobotanical research on Late Neolithic/Chalcolithic sites of the Aegean has been published since the 1960s. The regional coverage, however, is very uneven, with most of the sites located in Greece and only few in western Anatolia (Tab. 1).

Certain standards need to be fulfilled in order to use archaeobotanical data for inter-site comparison because they determine the representativeness of each plant assemblage for the site from

37 Wilkinson 1999.
38 Roberts et al. 2011.

which it comes. The criteria applied here are the volume and number of samples along with find density, which usually equals the number of records and number of taxa that provide information on the diversity of the assemblage. High diversity is usually provided by contexts with long-term accumulation of plant remains, while low diversity frequently results from storage contexts.[39] Applying the rigid standards of a requirement of 30 samples per phase[40] would have reduced the comparison to five sites with only three sites from the Late Neolithic/Chalcolithic. Therefore, we used all sites from which more than nine samples were analysed. We excluded sites with very low taxa numbers because of the high probability that only selected species were identified and documented for the original report, limiting comparability. Despite moderate application of archaeobotanical standards, 21 possible data sets were reduced to 10.

In addition to the basic quantitative analysis of the crop assemblages, we applied correspondence analysis to the wild plant taxa to elaborate on possible environmental and/or economic patterns. Correspondence analysis is widely used in archaeobotany and has been applied to a large number of different research questions.[41]

Site	Period	No. of samples	No. of records	< 9 samples, < 500 records < 20 taxa
Dikili Tash	Chalcolithic	224	52375	
Franchthi Cave	Chalcolithic	81	3553	
Kissonerga	Chalcolithic	150	0	X
Kumtepe	Chalcolithic	28	12856	
Kuruçay Höyük	Chalcolithic	47	154445	
Lemba-Lakkous	Chalcolithic	17	1022	
Mylouthkia	Chalcolithic	9	8856	
Pefkakia-Magoula	Chalcolithic	2	0	X
Pyrasos	Chalcolithic	1	585	X
Servia	Chalcolithic	10	9097	
Sesklo	Chalcolithic	2	0	X
Saliagos	Chalcolithic	1	2	X
Argissa-Magoula	Early Bronze Age	4	0	X
Demircihüyük	Early Bronze Age	6	7364	X
Kastanas	Early Bronze Age	40	16782	
Pefkakia-Magoula	Early Bronze Age	3	0	X
Platia Magoula Zarkou	Early Bronze Age	4	1519	X
Sotira Kaminoudhia	Early Bronze Age	53	187	X
Troia II	Early Bronze Age	9	2220	
Troia I	Early Bronze Age	15	3162	
Yenibademli Höyük	Early Bronze Age	15	4,448E+09	X

Tab. 1 Late Neolithic/Chalcolithic and Early Bronze Age sites with archaeobotanical research publications; Zero in the column 'no. of records' marks assemblage with presence/absence of records instead of absolute counts; Shaded sites have been used in the analysis, and 'X' designates those samples that had to be excluded from comparison, because they did not fulfil archaeobotanical standards. Yenibademili Höyük contained large storage contexts and was excluded.

39 Riehl 1999.
40 Jacomet – Kreuz 1999.
41 E.g. Jones 1991; Colledge 1998; Bogaard 2004.

Stable carbon isotope analysis on ancient plant remains provides an independent tool for assessing the potential impact of reduced soil moisture in relation to changing agricultural patterns. The method derives from plant physiology and was developed to explore processes during photosynthesis, including water use efficiency in C3 plants.[42] The heavy ^{13}C becomes enriched with the closing of the stomata in the plant during phases of reduced water availability.

In archaeological contexts, the method has been applied at a number of Near Eastern sites that are well-suited for this kind of study due to the semi-arid to arid conditions.[43] In areas where water availability is not the main stress factor for plants, the principle would not apply. Currently, primary research on stable carbon isotope ratios in cereals under Mediterranean conditions are lacking, but recent results on coastal Syrian and Lebanese Bronze Age sites indicate that the $\delta^{13}C$ signal is not a characteristic stress signal of such environments.[44]

We conducted stable isotope analysis on 44 barley grains from Kumtepe and Troy dating to the Late Neolithic/Chalcolithic period and the Early Bronze Age. Measurements were conducted with a Finnigan MAT252 for stable isotope HCNOS analyses at the Central Laboratory of Geochemistry at the University of Tübingen. We consider the $\delta^{13}C$ values within the whole settlement sequence of Troy for understanding the chronological development, and compare the values to other Near Eastern sites to assess the significance of the signals.

The Agronomic Model

Agronomic models inform about potential long-term yield of individual crop species at specific locations and enable the farmer to choose the optimal strategy in crop production. They also help to understand the influence of different factors, natural and anthropogenic, on particular crops.

An agronomic simulation is a simplified model of crop plant growth based on multiple physiological equations and empirical data.[45] An array of agronomic models has been proposed over the last three decades. Some of the models are crop-specific and designed for a single crop plant[46] while others can be applied to a number of different crops.[47]

For this study, we used EPIC (Environmental Policy Integrated Climate), an agro-ecological model that enables the simulation of crop plant growth as a function of environmental factors and agricultural management.[48] Originally, EPIC was developed to calculate the impact of erosion on yields for different periods of time,[49] but it turned out that its principles can be effectively applied to a broader spectrum of assignments.[50] Test studies in different parts of the world demonstrated the robustness of EPIC, usually showing no significant differences between predicted and harvested yields at the 95% confidence level.[51] EPIC operates with a daily time step and involves a series of sub-models:[52] climate and weather, hydrology, erosion, nutrients turnover, soil temperature, tillage, plant growth, crop plant management and economics. One of the advantages of the model is the availability of seven options for water erosion and five options for simulation of evapotranspiration.[53] With these features, EPIC provides the possibility to simulate yields over relatively long periods of time, centuries or even millennia.[54]

42 Farquhar et al. 1989.
43 Araus et al. 1998; Ferrio et al. 2005; Fiorentino et al. 2008; Riehl et al. 2008; Flohr et al. 2011.
44 Marinova et al. 2012; Riehl et al., in print.
45 Haan 2002.
46 Ritchie – Otter 1985; Jones et al. 1986.
47 Van Keulen et al. 1982; Sharpley – Williams 1990.
48 Williams 1990.
49 Williams et al. 1983.
50 Williams et al. 1989.
51 Bernardos et al. 2001; Liu et al. 2008; Van der Velde et al. 2009; Srivastava – Geiser 2010.
52 Williams et al. 1984.
53 Gassman et al. 2005.
54 Williams 1995.

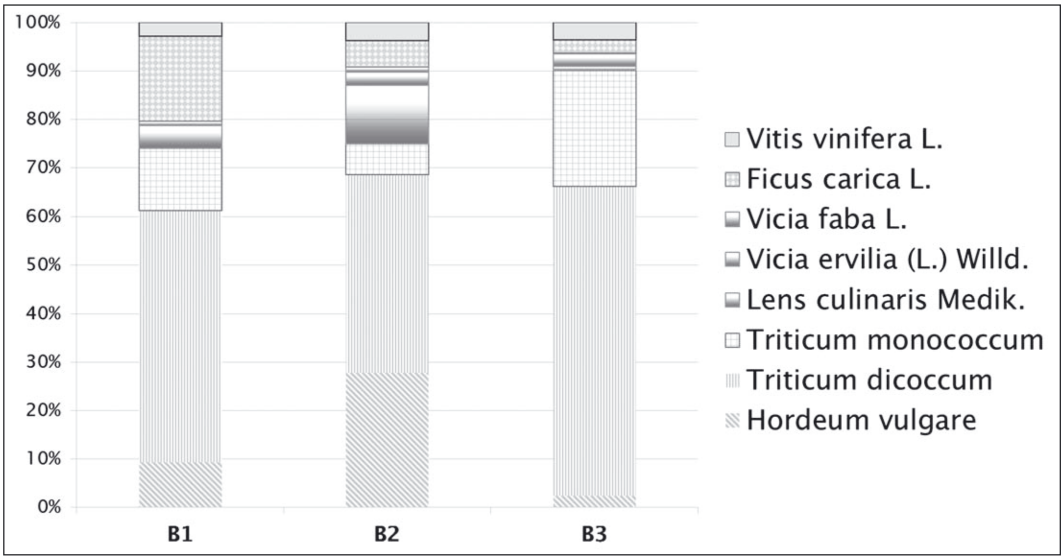

Fig. 3 Crop proportions of the Kumtepe B sequence. Note the higher proportions of pulse crops in Kumtepe B2 and the increase of hulled wheat in Kumtepe B3 (illustration: S. Riehl).

For the EPIC application, we created a data set for locations near the archaeological settlements considered in this study in Access format. These include climate stations at Çanakkale, Isparta, Thessaloniki, Paphos, Naxos and Larissa (http://www.tutiempo.net/en/Climate). For each climate station, two sets of monthly weather parameters were chosen from the past 30 years of continuous meteorological records: the year with minimum sum precipitation and that with maximum sum precipitation. Thereafter these are referred to as a 'bad year' (BY) and 'good year' (GY) respectively. Soil properties were taken from the harmonised world soil database,[55] and from local sources.[56] The simulations were run for two crops, barley and lentil yields for the duration of 100 and seven years and differing starting precipitation values.

Results

Archaeobotanical Patterns

A combined analysis of charcoal and seed remains from Kumtepe and Troy was conducted to answer the question regarding the role of human impact on the mid-Holocene vegetation development in the Troad.[57]

While the site of Kumtepe was not inhabited between 4600 and 3500 calBC and Troy did not yet exist, the dominant species around 3500 calBC belonged to a mixed woodland-type dominated by oak and pine, probably resembling a vegetation type similar to that attested for northern Greece. Human impact became strongly prominent at around 3300 calBC with an increase in sclerophyllous species in Kumtepe B2. These results correlate with palynological results from the northwestern Aegean region as outlined above, and find support in a descending sea level as documented for the Trojan Bay at the end of Kumtepe B[58] (see also Fig. 2). Aridification to an

55 Batjes 1995.
56 Zinke et al. 1986; Boysan – Çimrin 2006; Bilen 2008.
57 Riehl – Marinova 2008.
58 Kayan 1992.

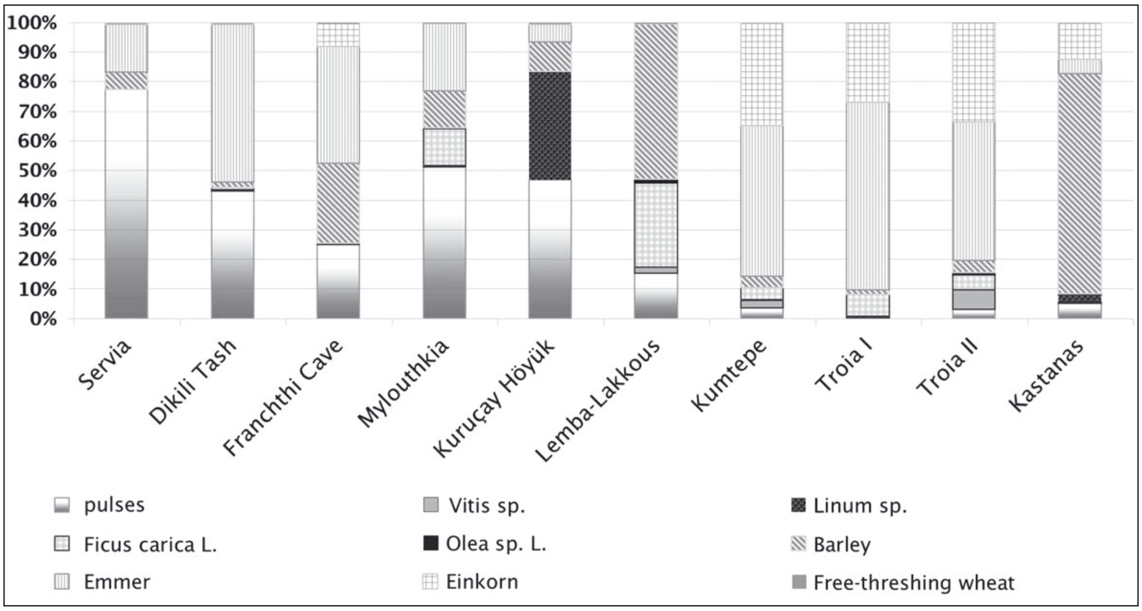

Fig. 4 Crop proportions at Late Neolithic/Chalcolithic and Early Bronze Age sites in the Aegean. The sites appear in relative chronological order with Servia, Dikili Tash and Franchthi Cave starting circa 4500 BC, Mylouthkia and Kuruçay Höyük dating at around 3700 BC, and Lemba-Lakkous and Kumtepe B with the earliest dates at 3500 BC. Troy and Kastanas are Early Bronze Age settlements (illustration: S. Riehl).

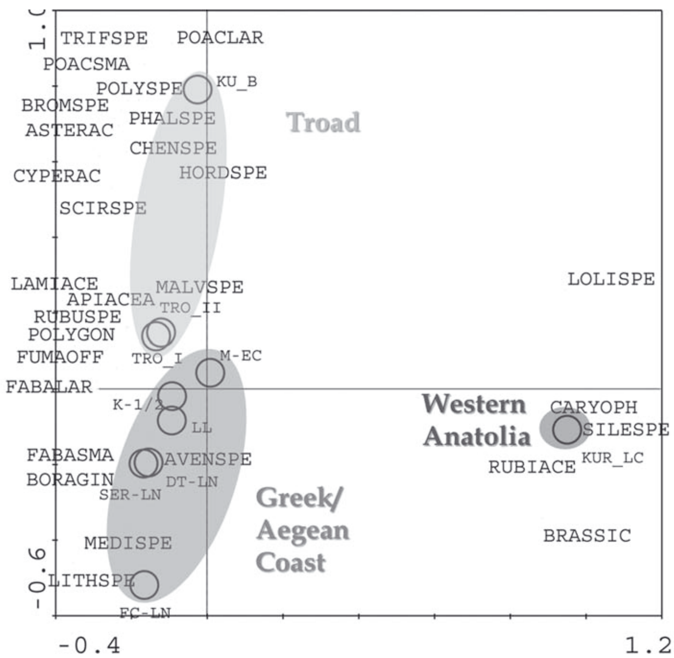

Fig. 5 Correspondence plot of the wild plant assemblages of the ten sites listed in Tab. 1, showing clusters of geographic units (illustration: S. Riehl).

unknown degree may have intensified the anthropogenic impact on the vegetation at the end of the 4th millennium BC.

A distinct pattern becomes obvious when considering crop data of the Kumtepe B sequence. The whole assemblage is dominated by cereals and pulses while lentil is particularly well repre-

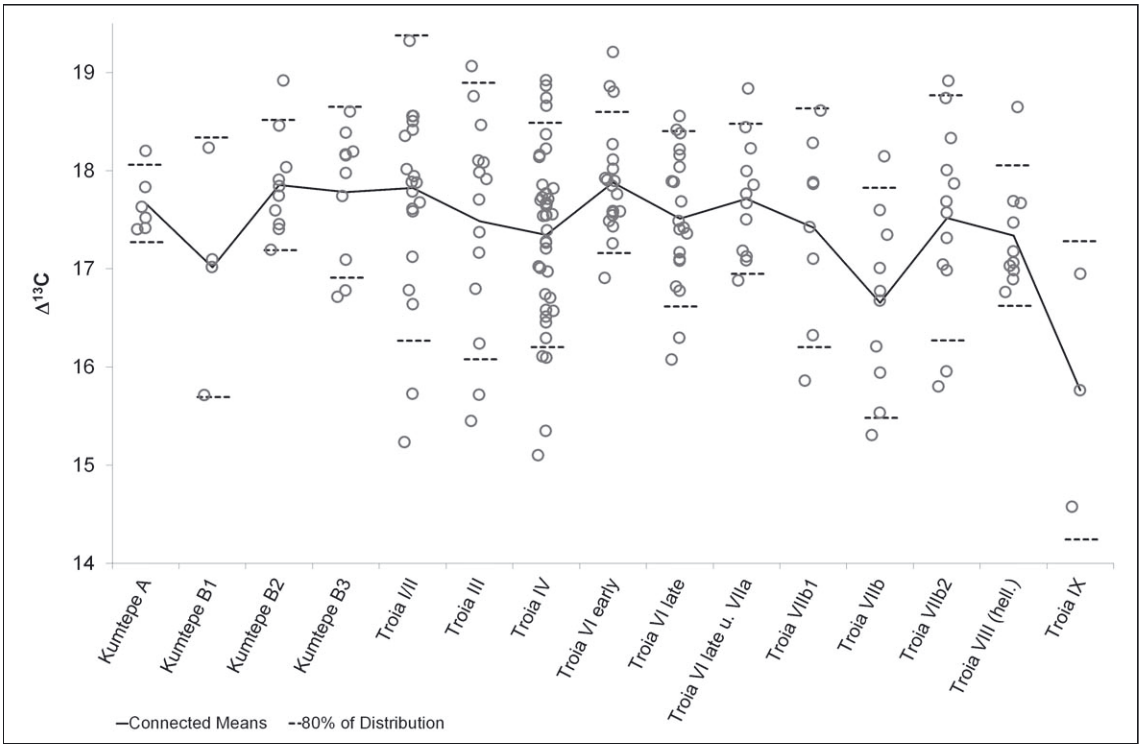

Fig. 6 Stable carbon isotope data of barley grains from different periods at Troy (illustration: S. Riehl).

sented in Kumtepe B2, and hulled cereals increase in Kumtepe B3 and remain in this dominant composition during the Early Bronze Age as recognised at Troy and Kastanas (Figs. 3, 4).

A consideration of ten Aegean archaeobotanical assemblages that fulfil the standards, outlined in the material and methods section, reveals the same pattern as in the Kumtepe B2 assemblage (Figs. 3, 4). Pulse crops are present in high percentages in most of the Chalcolithic sites while hulled cereals such as emmer, einkorn and barley have higher proportions in the two Early Bronze Age sites, but also at Kumtepe B3. The chronological correlation of this development with the proposed palaeoclimate change outlined above raises the question of whether climate change may have been involved in this shift from major components of pulse crops to a cereal-dominated economy.

Correspondence analysis of the wild plant assemblages from these sites displays a geographic pattern rather than a chronological one (Fig. 5). Although the geographic clustering into settlements of the Greek Aegean coast, Kurucay Höyük, and the sites of the Troad indicates environmental diversity of the geographic areas, an environmental change throughout time that would require a clustering of the Late Neolithic/Chalcolithic sites separated from the Early Bronze Age sites is hardly visible which may be alternatively related to the reduced number of Early Bronze Age sites.

Stable Carbon Isotope Data

Stable carbon isotope data on cereal remains may be more informative in relation to increased aridity, because they may provide a direct signal of drought stress in the crop species themselves.

Referring to earlier studies on $\delta^{13}C$ signals at Near Eastern sites, drought stress can be assumed for ^{13}C values below 16‰ that were found at a number of Syrian sites at the transition from the Early to the Middle Bronze Age.[59] Applying this relatively rigid limit to the mean values found at Troy, we may state definite drought stress only during the Roman period (Troia IX). Looking

[59] Riehl et al. 2008; Riehl et al. 2014.

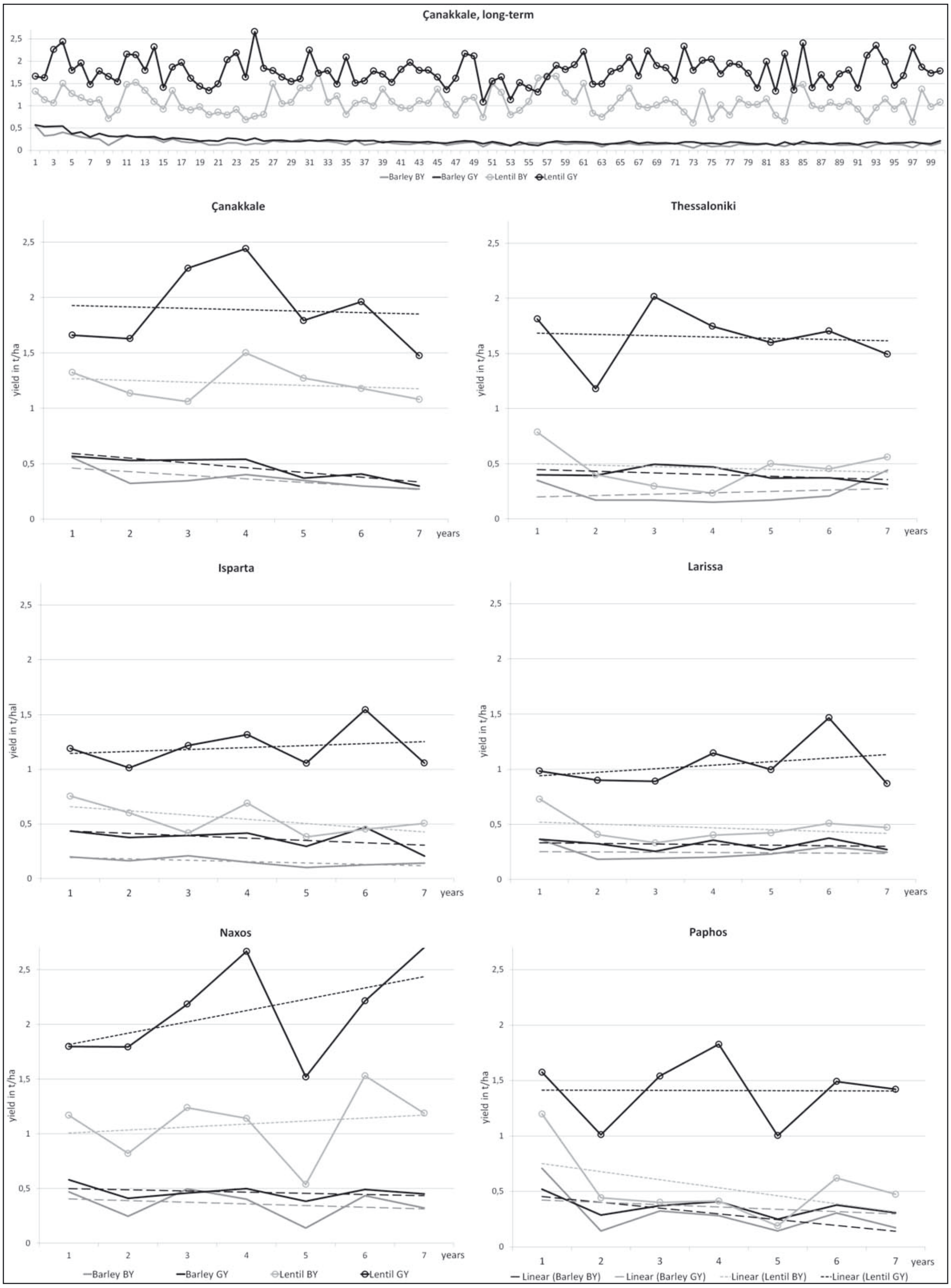

Fig. 7 Yield structure of barley and lentil with different precipitation parameters in the first year, modelled for different climate locations; BY: 'bad year' with minimum sum precipitation, GY: 'good year' with maximum sum precipitation, linear: linear regression (illustration: S. Riehl).

at individual values from the different phases and periods in the Troad, there is, however, a trend of an increasing number of stress signalising values in Kumtepe B3 until Troy IV, although definite stress-indicating values are only present from Troy I/II onward. Kumtepe B1 values cannot be considered, because of too few measurements. A strong drought stress signal during the time considered here is not evident in barley grains from the Troad (Fig. 6).

Agricultural Models

The archaeobotanical and stable carbon isotope evidence alone is not distinctly showing a possible climate impact on the agricultural economy. The modelling of potential yields at different geographic locations may help clarify the local conditions necessary for sufficient crop yield.

Long-term modelling of yields over 100 years shows a general pattern of slightly decreasing yields in all climate stations, depicted here for Çanakkale (Fig. 7, top). While yields of lentil are considerably higher than those of barley, they show strong inter-annual fluctuations and large differences between yields in drier and moister years, in contrast to barley with only a little inter-annual variation and nearly no differences between dry and moist years.

A detailed consideration of the first seven years of the simulations for different locations documents some obvious patterns related to local climate conditions. While regional differences in barley yields are moderate, modelled yields of lentil are considerably higher in coastal areas (Çanakkale, Naxos), and relatively low at locations further inland (Isparta, Larissa).

Considering the linear regressions with reduced precipitation at the beginning of the simulation for seven years (termed as bad year), yields for barley and lentil both decrease, while yields for lentil are generally higher. However, absolute yields for barley and lentil during a bad year are relatively similar from the second year onward at Thessaloniki, Larissa and Paphos while at Çanakkale and Naxos lentil yields with a bad starting year are still higher than barley yields with a good starting year.

The most striking result of the simulation is the strong difference between the high yields of lentil and the relatively low yields of barley with higher precipitation (GY) at the beginning of the simulation. Yields of barley in a good year do not strongly differ from yields in a bad year.

Discussion

The following considerations are based on the assumption that crop plants documented at the different sites are mostly consumed by humans. This also includes the pulses but is in some contrast to the stable isotope data from the Neolithic and Chalcolithic site of Aktopraklık near Bursa in northwestern Anatolia.[60] There, a major component of the diet must have been from C3-plants other than pulses because the $\delta^{15}N$ values are relatively high, suggesting that, aside from the consumption of animal products and meat, the plant component mainly derived from cereals rather than from legumes. With radiocarbon dates between 6400 and 6200 BC, the timing of Aktopraklık is earlier than the periods considered here but also falls into the phase of a RCC event, the 8200 BP event respectively.[61]

Reconsidering our goal as outlined in the introduction, the most striking regional agricultural pattern is the high amounts of pulse crops in the Late Neolithic/Chalcolithic sites that were strongly reduced in favour of barley and hulled wheat during the Early Bronze Age. It is speculated that climate change, i.e., increasing aridity from the mid-Holocene on, may have played a role in this process. The wild plant assemblages do not support this interpretation because they do not indicate a clear chronological clustering, which may be expected if strong climate effects would have affected the composition of the wild plant assemblages.

In general, human impact on vegetation creates similar archaeobotanical results as increasing aridity, making climate impact hardly discernible from human impact in wild plant assemblages.

60 Budd et al. 2013.
61 Weninger et al. 2006.

Such a trend is also visible in the pollen record, and applies to the Troad where human impact on the vegetation occurred at approximately the same time[62] as sea level decrease.[63] The stable carbon isotope evidence from the Troad may correlate with the increasing aridity identified for the palaeoclimate proxy records, but the values do not support a strong drought stress in the plants.

While the archaeobotanical evidence fails to prove a strong link between global climate fluctuations such as the 5200 BP event and agricultural strategies, the incorporation of the agronomic simulations under consideration of a general increase in aridity from the mid-Holocene on helps develop an explanatory model for the observed changes in agricultural patterns.

The extremely high yields of lentil under good moisture conditions in contrast to the modest yields of barley presented the most striking aspect in the model output. As the absolute yields of lentil are higher than those of barley even in bad years, increasing aridity would not explain the shift from pulse crops to cereals observed for the transition from the Chalcolithic/Late Neolithic to the Early Bronze Age. The strong yield differences in lentil between good and bad years, in contrast to barley with relatively similar yields in bad and good years, are more significant because they qualify lentil as a crop with low yield predictability. Agricultural production with a high dependency on lentil would entail the risk of heavy losses in relation to weather fluctuations, while barley yields would be less vulnerable and therefore more predictable. This factor is of high importance under conditions of inter-annual climate variability and increasing aridity, which have been stated for the periods from the mid-Holocene on.[64] Although this climate trend was too weak to produce a strong stress signal in barley, the slight stress increase that is visible may have been enough to cause strong yearly losses in the pulse harvest, leading to a change in the crops preferred for agricultural production.

Such a model of ancient farmers adapting their mode of subsistence or at least their crop spectrum to changing conditions introduces the factor of human perception of the environment, which is unknown for past societies, but undoubtedly a part of the decision making process.[65]

The Aegean crop assemblages presented here suggest a Neolithic tradition of dominating pulse crop cultivation that starts to shift to dominating cereal cultivation from 3500 BC on, probably in relation to increasing aridity, higher variability in mean annual precipitation and a change in environmental perception. This shift probably smoothly progressed, which does not correspond with what we would expect of a RCC (rapid climate change) event as the climate fluctuation around 5200 BP. In terms of diet, this shift can be interpreted as a change from a protein-dominated to a carbohydrate-dominated plant diet. At least in the case of Kumtepe (fallow deer and mussels), hunting and gathering played a major role during the Neolithic while during later periods, including the Early Bronze Age, sheep and goat husbandry increased.[66] Although the earliest date for milk use extends much farther back into the past,[67] decreasing pulse crops at the end of the Chalcolithic period is consistent with Sheratt's classical model[68] of an increased use of secondary products such as milk and cheese to compensate for reduced protein-intake with the shift from pulses to cereals.

Prospective and Conclusions

Because the interrelationship between human societies and landscapes becomes nearly impenetrably complex from the mid-Holocene on, current palaeoclimatological studies considering proxy archives that are not directly associated with archaeological sites can only provide a very rough background

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[62] Riehl – Marinova 2008.
[63] Kayan 1992.
[64] Roberts et al. 2008; Geraga et al. 2010.
[65] Tuan 1990; Ingold, 2011.
[66] Riehl – Marinova 2008.
[67] Evershed et al. 2008.
[68] Sherratt 1981.

pattern of local climate and environmental conditions, regardless how well resolved they are. While immediate reactions to abrupt changes are relatively easy to recognise, long-term processes are much more complicated, involving a large number of natural and cultural variables. Explanatory models of documented changes can become very complicated and regionally specific, particularly, when ancient human perceptions of the environment are involved in the development of economy.

Therefore, each archaeological excavation requires its own environmental archaeology program that cooperates closely with sociocultural anthropology to enable the recognition of concrete, site-specific developmental patterns and an understanding of interdependence of the specific local society within its past natural and cultural landscapes.

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Late Chalcolithic Subsistence Strategies on the Basis of Two Examples: The Çukuriçi Höyük in Western Anatolia and the Barcın Höyük in Northwestern Anatolia

Alfred Galik[1]

Abstract: A Late Chalcolithic agricultural development based on exploitation of livestock is discussed at two sites: Barcın Höyük is located in the Yenişhehir Basin in the eastern part of the Bursa province and Çukuriçi Höyük in the Ephesos region, on the west coast of Anatolia. Both sites revealed similar pattern of cattle- and ovicaprine exploitation but revealed differences in livestock management. Pig was already exploited in the Early Chalcolithic at the Anatolian west coast but keeping pigs did not start earlier than in the Late Chalcolithic in Barcın Höyük and stays absent in the Late Neolithic. Large and small ruminants were mainly kept for meat production and milk to some extent. The archaeozoological remains indicate a form of local husbandry at both settlements but reveal faunal differences between them as well. Cattle and sheep were probably better adapted to the climate of northwest Anatolia while the environment at the western Mediterranean coast was more appropriate for goat. Disparities between both societies are strongly indicated by their cognisance of natural environments and resources. These are not only expressed by varying hunting behaviours but also by the intensity of exploitation in aquatic resources. Freshwater fish and molluscs played a minor role at Barcın Höyük while exploitation of marine resources from the nearby sea shore was probably not only of high nutritive importance for the inhabitants of the Çukuriçi Höyük but may also indicate a component of their daily life and identity.

Keywords: Turkey, western Anatolia, northwestern Anatolia, Barcın Höyük Çukuriçi Höyük, Late Chalcolithic, 4th millennium subsistence, livestock

Late Chalcolithic settlements with reliable stratigraphic sequences and archaeozoological records are scarcely distributed throughout northwest Anatolia.[2] Subsistence strategies shall be discussed for two sites, 'Barcın Höyük' in the northwestern and 'Çukuriçi Höyük' in the western part of Turkey. Archaeozoological remains from these sites provide an opportunity to shed some light on the breeding strategies of the main domesticates and consumption behaviour. Barcın Höyük is situated in the Yenişehir Basin in the eastern part of the Bursa province.[3] The earliest settlement activities started in the Late Neolithic and after a hiatus, over two millennia occupation resumed witnessing Late Chalcolithic activities and continued towards the EBA, the Iron Age, and the Byzantine time.[4] The surroundings of the site provided wetlands, arable farming land and upland environment in the north. The duration of the Late Chalcolithic occupation is assumed to be rather short at about 3800 calBC,[5] the missing later phases were probably destroyed by ploughing and soil removal.

Çukuriçi Höyük is located in the region of the classical town of Ephesos, the ancient metropolis Asiae.[6] The site was originally located rather close to the sea shore, at the delta of the river Küçük Menderes, surrounded by mountainous areas and plains. Similarly to Barcın Höyük, the settling activities started in the Late Neolithic (phase VIII) and proceeded to the EBA probably without continuity in occupation. However, this mound revealed some evidences from the 4th mil-

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1 Inst. Anatomy, Histology and Embryology, Depart. Pathobiology, Veterinary Medicine University, Vienna; alfred.galik@vetmeduni.ac.at.

2 Özbal 2011; Schoop 2005; Schoop 2011.

3 Gerritsen et al. 2010.

4 Gerritsen et al. 2010.

5 Roodenberg et al. 2008.

6 Ladstätter 2012.

lennium as well.[7] Although both sites yielded only little archaeozoological material dating to the 4th millennium according to Anatolian chronology,[8] evidence for farming and subsistence appear to be worth discussing. Therefore, argumentation will be improved by evaluations with material from the Late Neolithic from the Barcın Höyük and Early Chalcolithic (Phase VIII) from the Çukuriçi Höyük.

Herding, Exploitation and Subsistence

The earliest settlers at Barcın Höyük exploited domestic breeds. In the Late Neolithic, the weight of cattle remains and bone fragments of animals of similar size predominate the assemblage while less than a quarter represents ovicaprines (Pl. 1A). Subsequently, breeding strategies changed, and the Late Chalcolithic assemblages exhibit the presence of domestic pig and fewer cattle (Pl. 1B). It seems that ovicaprines, especially sheep became more important. At the Çukuriçi Höyük, a phenomenon contrary to the Barcın Höyük becomes visible. In phase VIII domesticates total up to about 75% while the Late Chalcolithic assemblages indicate a probable change in consumption behaviour and a decrease of mammalian finds to approximately 40% (Fig. 1A–1B). Although exploitation of shellfish played a role from the beginning of the occupation, exploitation of domesticates seems to lose importance and harvesting marine food becomes more significant in Çukuriçi Höyük's Late Chalcolithic. Contrary to Barcın Höyük, pig appears even in the earlier chronological units, and the frequency of ovicaprines increases as well. However, goat seems to be of more importance in the Late Chalcolithic (Pl. 1C–D).

For this paper, postcranial elements are used to characterise demographic distributions of slaughtered domesticates by analysing size and form of neonates and infantiles compared to reference specimens and the stages of epiphyseal fusing (Pls. 2–3).[9] Unfortunately, the Late Chalcolithic deposits from the Çukuriçi Höyük did not reveal enough postcranial material to produce cattle culling profiles. However, the other profiles from both sites appear rather similar (Pl. 2). Besides some culling of milk calves, infants and juveniles, more cattle survived up to approximately 30 months while older individuals were culled at higher frequencies. The Çukuriçi Höyük reveals a slightly different pattern with a higher representation of individuals older than four years (Pl. 2C). The management of keeping and slaughtering ovicaprines is similar between the two sites as well (Pl. 3). Few kids and lambs were slaughtered at early stages and up to half a year, and the major part of the stock survived the first year. Culling started probably with approximately two years while only a small part of the stock became older than three to four years at Barcın- and Çukuriçi Höyük. Although there are some differences in the faunal composition between the sites the culling patterns appear to be somewhat similar and provide several culling ages from newborn/infantile individuals up to adult and sometimes old/senile individuals. Besides the major domesticates, few dog bones cannot be regarded as unusual in the archaeozoological assemblages from both sites. The first evidences of equids did not appear earlier than in the EBA at Barcın Höyük, and these animals remain absent in the Late Chalcolithic at both sites, although equids might be expected as a 'new invention' particularly at this time.

Hunting did not play a substantial role at either site but reveals some importance perhaps beyond nutritive significance. However, when both sites are compared, the Çukuriçi Höyük suggests a higher importance of game. The main species are similar: hare, wild boar and fallow deer. In addition to smaller carnivores like fox, marten, wild cat as well as larger herbivores, like aurochs, roe deer and red deer, are also present. A difference might be expressed by the absence of large carnivores in Barcın Höyük while brown bear and leopard appeared at the Çukuriçi Höyük. The

7 Horejs 2010.
8 Schoop 2005.
9 Habermehl 1975; Zeder 2006.

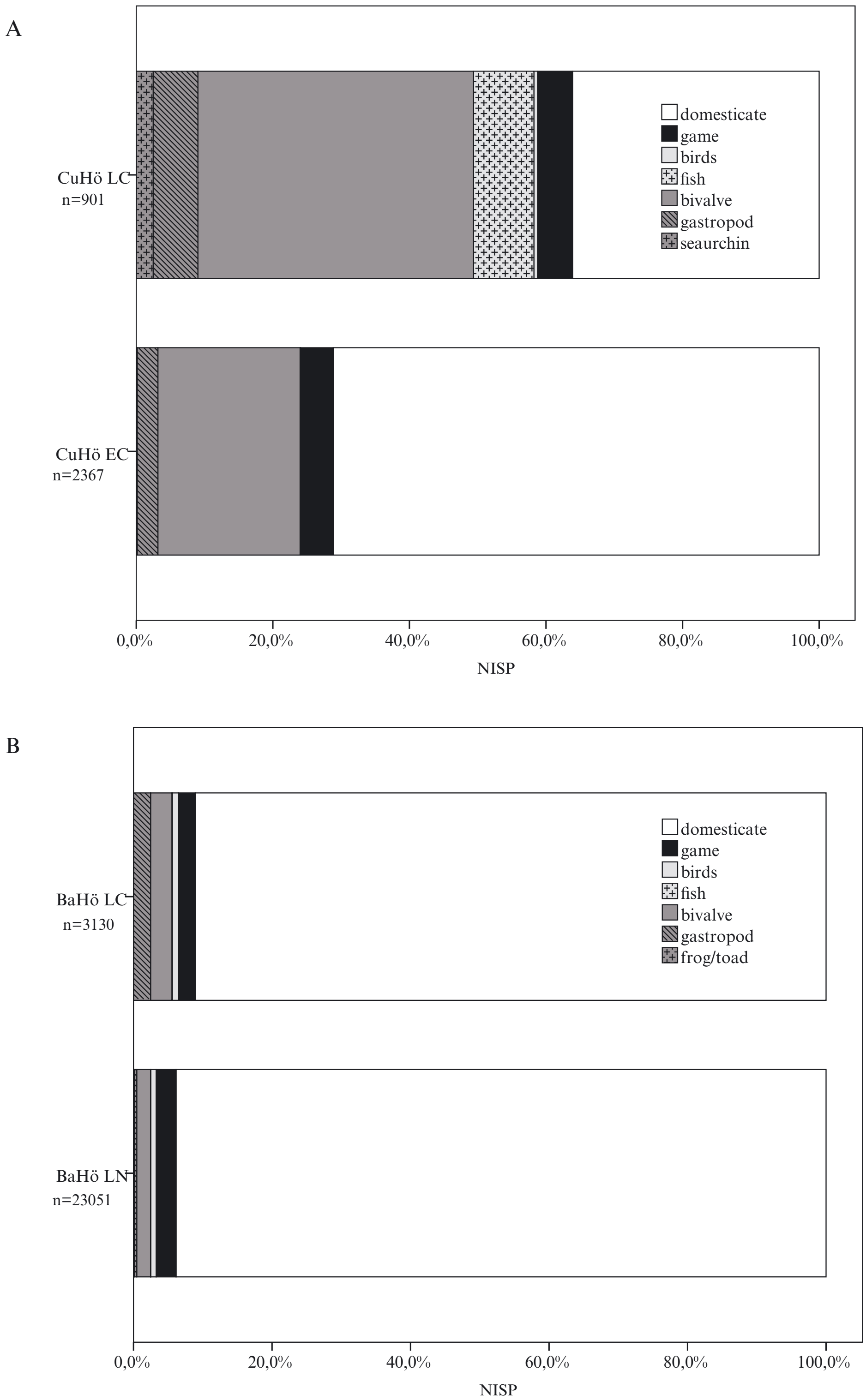
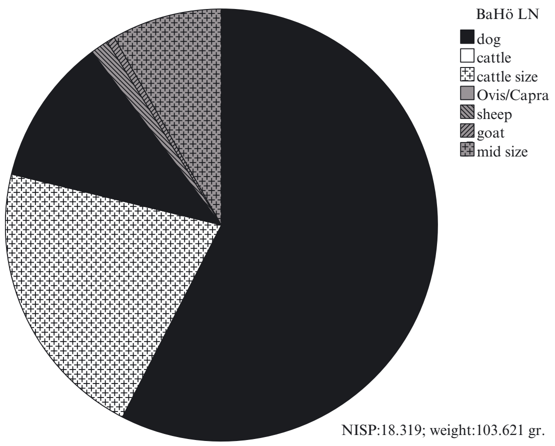


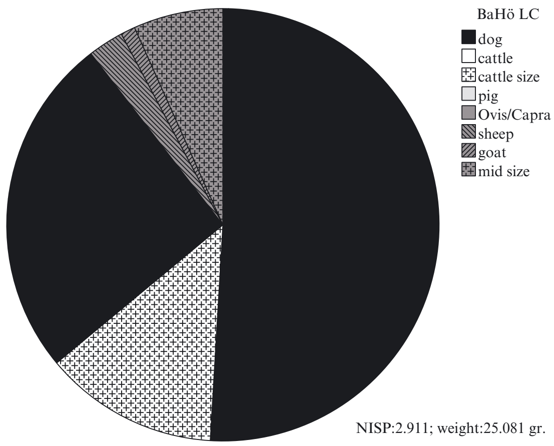
Fig. 1 Distribution of animals. A. Çukuriçi Höyük; B. Barcın Höyük.

latter was discovered in a special context, perhaps ritual (Tab. 4).[10] However, the hunting of birds indicates a different pattern of behaviour between the occupants of both sites. At Barcın Höyük

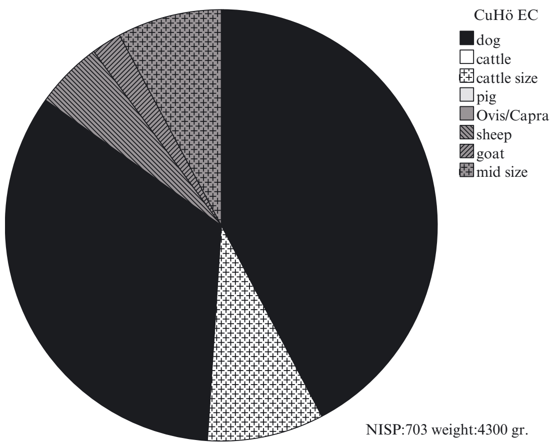
10 Galik et al. 2013.



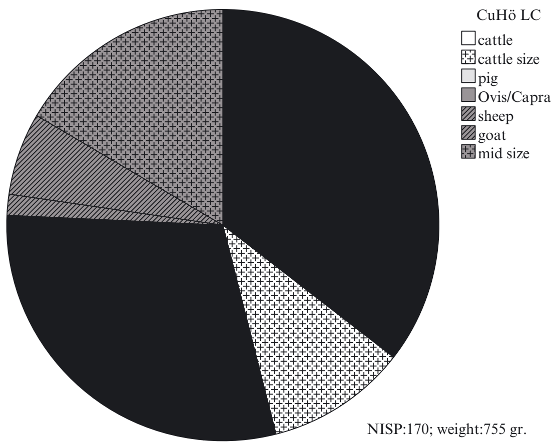
A. Barcın Höyük Late Neolithic



B. Barcın Höyük Late Chalcolithic



C. Çukuriçi Höyük Early Chalcolithic

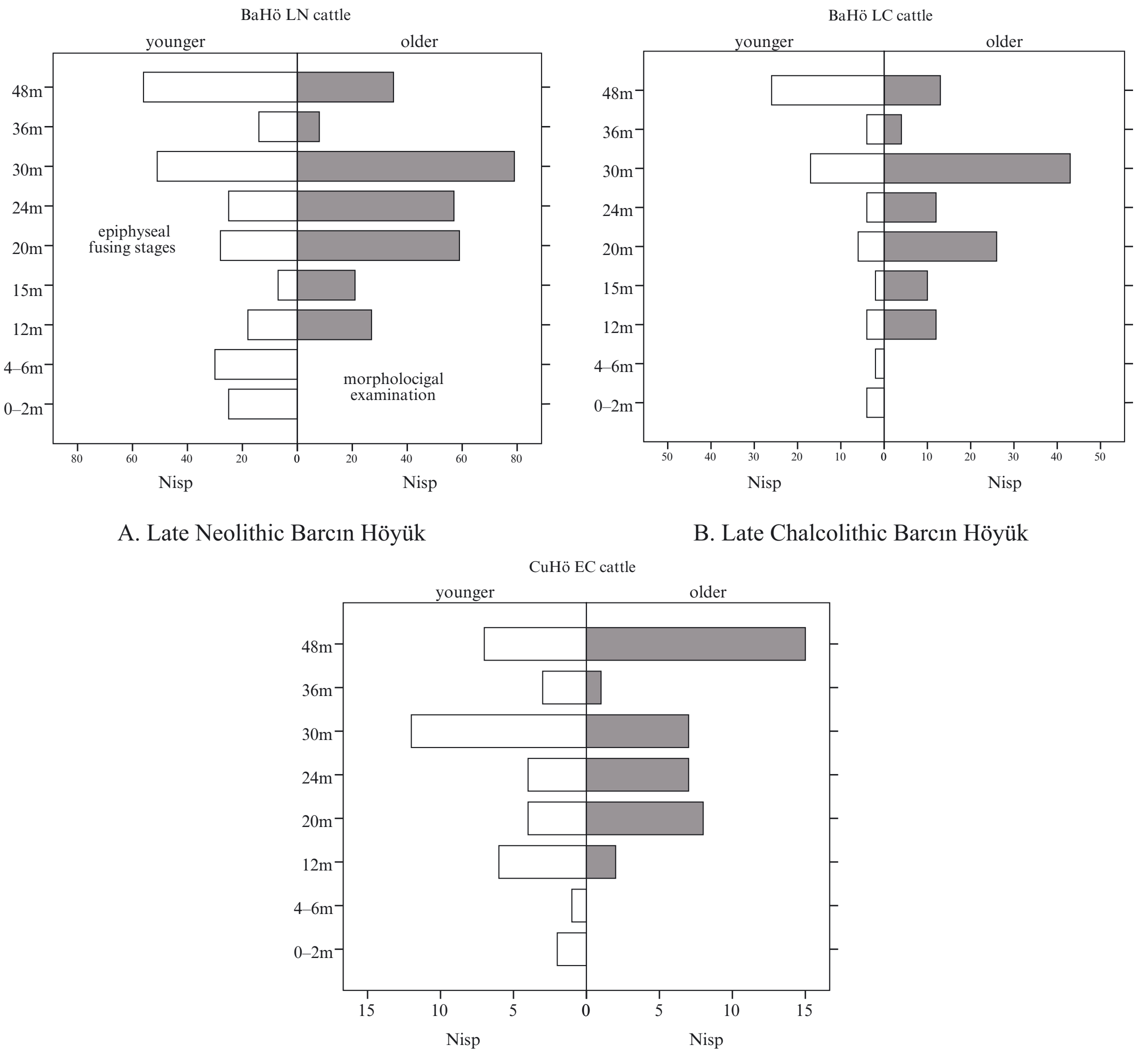


D. Çukuriçi Höyük Late Chalcolithic

Pl. 1 Weight distribution of the most important domesticates

bird hunting was of some importance and the hunters killed raptor birds, open land birds, as well as waterfowl. Although masses of sediment samples were screened at the Çukuriçi Höyük the recovery of a few remains mirrors the irrelevance of birds as a food resource (Tab. 3). A 'dolphin-like' rib fragment relates to the maritime affinity of Çukuriçi Höyük inhabitants.

Besides, herding and hunting the surroundings at both sites encompassed various environments providing additional access to animal protein. For example, the inhabitants of Çukuriçi Höyük obviously used their access to marine resources. Although only a few fish remains were preserved the high diversity of shellfish reflects intense exploitation in the Late Chalcolithic of the Çukuriçi Höyük (Fig.1A, Tab. 1). In the early phase VIII the assemblage is dominated by species settling on hard substrate, like oyster, sometimes rather large spondylus, blue mussel and mainly Noah's ark shell. The Late Chalcolithic composition of bivalve species completely changed to burrowing species predominantly edible cockle, but also venus shell, carpet shell, noble pen shell and wedge shell dominate over the hard substrate populating species (Tab. 1). At the inland settlement Barcın Höyük, such kinds of nutriment were certainly not without value. The inhabitants exploited freshwater resources as well, but this kind of aliment appeared to be of less significance (Tab. 1). Besides, a few fish remains (Tab. 2) from the Late Neolithic and the Late Chalcolithic shells indicate exploitation of large garden snails (Helix sp.), freshwater mussels (Unio sp.) and blue mussels (*Mytilus galloprovincialis*). However, the frequency of both bivalves decreases in the Late Chalcolithic while the large garden snail increases. Although, blue mussel populate even in low brackish



A. Late Neolithic Barcın Höyük

B. Late Chalcolithic Barcın Höyük

C. Early Chalcolithic Çukuriçi Höyük

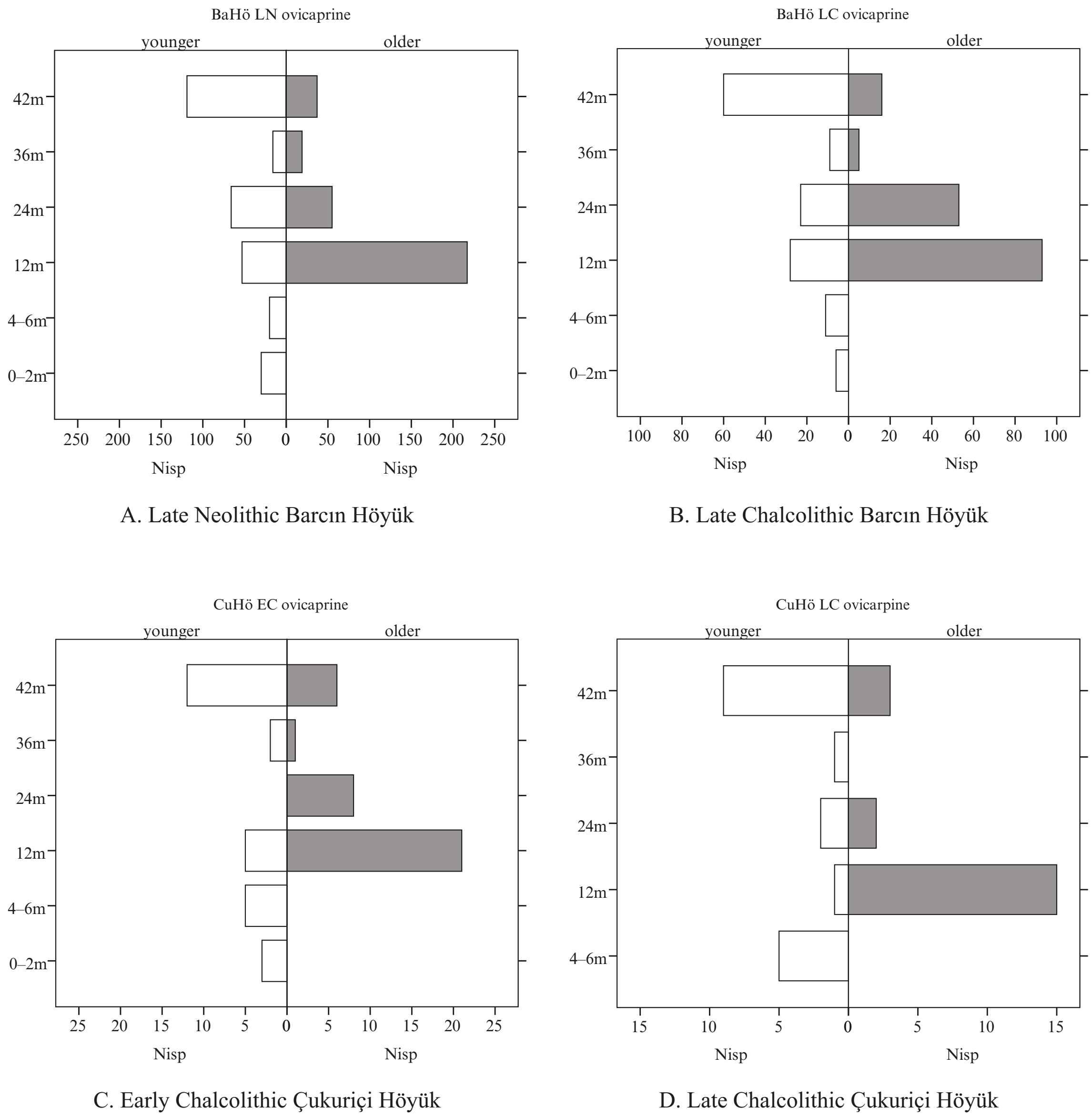
Pl. 2 Demographic distribution of cattle.

waters no habitat can be easily detected in the vicinity of Barcın Höyük today. The mussels were probably collected at the present day freshwater İznik lake north of the mountain ridge to the north of the site. Besides molluscs, other shells like cockle, oyster or a scallop were transported to the settlement as empty and water worn shells probably as raw material for ornaments.

Conclusions

It remains challenging discussing such topics on a wider scale because nearby sites, like Fikirtepe[11] and Ilıpınar[12] or Menteşe[13] in the northwest and Ulucak[14] in the west of Anatolia, were abandoned

[11] Boessneck – von den Driesch 1979.
[12] Buitenhuis 2008.
[13] Gourichon – Helmer 2008.
[14] Çakırlar 2012.



Pl. 3 Demographic distribution of ovicaprines.

before the 4th millennium BC. Concerning cattle and ovicaprines breeding strategies reveal rather similar approaches at both sites, although some changes and differences in keeping and exploitation of livestock became visible. Pig was already utilized in the Late Neolithic and Early Chalcolithic at the west coast of Anatolia,[15] exploitation of 'house swine' started in the Late Chalcolithic at Barcın Höyük and domestic pig remained absent in the Late Neolithic of the nearby settlement Menteşe[16] and central Turkey as well.[17] The culling profiles presented here do not indicate major changes in exploitation of meat and milk to some extent from the Late Neolithic towards Late Chalcolithic. However, despite the anticipated cultural and economic changes in the Late Chalcolithic such patterns might not indicate major transformations in keeping cattle, sheep and

15 Horejs – Galik 2011; Cakirlar 2012.
16 Gourichon – Helmer 2008.
17 Arbuckle 2013.

goat. They resemble the husbandry economy in rural settlements, rather than large scale and wide distance pastoralism that is usually seen in the context of increasing use of wool or fleece as demonstrated for early Chalcolithic to mid Chalcolithic Köşk, mid Chalcolithic Güvercinkayası and Late Chalcolithic Çadır, in combination with vertical transhumance to upland pastures.[18] However, sheep and cattle were probably better adapted to the northwest Anatolian climatic conditions while the western Mediterranean coast perhaps provided suitable conditions for herding goat.

The perception of nature and environmental interaction of the two Late Chalcolithic societies might be enlightened by remains of hunting and gathering activities in their ecosystems. Hunting of large carnivores like brown bear and even leopard is present at the Çukuriçi Höyük, but not at Barcın Höyük, where hunting of diverse bird species was clearly of importance although the surrounding environment at the Çukuriçi Höyük certainly provided habitats for aquatic and other birds as well. The inhabitants of Barcın Höyük probably consisted of a society dependent on farming but supplemented their diet by hunting birds, small and large game. However, they avoided pursuing dangerous and large carnivores. The society living at the Late Chalcolithic Çukuriçi Höyük might be characterised as relying on farming for subsistence as well, but with a large focus, especially, on the exploitation of marine goods like fish and shellfish. Such subsistence practices may express a maritime affinity in their daily life that continues into the Early Bronze Age.[19]

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	BaHö LN	BaHö LCh	ÇuHö ECh	ÇuHö LCh
Gastropoda	1			1
Helicidae		1		
Helix sp.	25	36		
Viviparus sp.		1		
Patella sp.			6	5
Gourmya vulgata			10	21
Hexaplex trunculus			28	6
Bolinus brandaris			1	
Monodonta turbinata				1
Barleeia rubra				2
Theodoxus sp.				1
Bivalvia	4	26		
Unio sp.	66			
Arca noae			136	10
Barbatia barbatia			1	1
Mytilus galloprovincialis	86	21	17	5
Ostrea edulis		1	34	8
Spondylus gaederopus			38	2
Cerastoderma glaucum	2	1	67	177
Donacilla cornea			3	13
Solen sp.				7
Tapes decussatus			4	4
Venus venerupis			9	
Pecten glaber		3		

Tab. 1 Molluscs from Barcın and Çukuriçi Höyük.

	BaHö LN	BaHö LCh	ÇuHö ECh	ÇuHö LCh
Pisces				44
Cyprinidae	3	1		
Mugilidae				1
Sparidae				4
Serranidae				1

Tab. 2 Fish remains from Barcın and Çukuriçi Höyük.

	BaHö LN	BaHö LCh	ÇuHö ECh	ÇuHö LCh
Aves large size	13	5		
Aves mid size	29	3	1	2
Aves small size	4			
Ciconia ciconia	3			
Anserinae	2			
Anser anser	1			
Anatinae	2	2		
Buteo sp.	2	2		
Fulica atra	1			
Corvus corone	1			
Corvus monedula				1
Grus sp.		2		
Otis tarda	3	1		

Tab. 3 Bird remains from Barcın and Çukuriçi Höyük.

	BaHö LN	BaHö LCh	ÇuHö ECh	ÇuHö LCh
Erinaceus concolor	1			
Lepus europaeus	58	9	4	2
Vulpes vulpes	16	2	4	
Martes foina	1			
Felis silvestris			1	
Ursus arctos				1
Panthera pardus			1	
Sus scrofa (?)	102	10	19	8
Bos primigenius	4		4	
Bos primigenius (?)	7			
Capreolus capreolus		2	1	
Cervidae			1	1
Cervus elaphus			5	
Dama dama	27	17	30	14
Dama_Antler	2		1	2
Delphinidae				1

Tab. 4 Wild animals from Barcın and Çukuriçi Höyük.

Isotopic Indicators of Community Organisation and Integration at İkiztepe: Implications for Anatolian Social Development in the 4th Millennium BC

Lynn Welton[1]

Abstract: İkiztepe, located on the Black Sea coast, boasts a large cemetery, which has produced almost 700 burials, often containing elaborate metal weaponry. The implications of the site's remains with regard to their social and cultural importance, and the role of metal objects and weapons as symbols of social prestige, are often avoided in synthetic discussions due to uncertainties surrounding its chronological sequence. A number of scholars have suggested shifting the occupational sequence of the site earlier than originally proposed by the excavators. These reconsiderations, however, have generally not directly addressed the remains from the cemetery. The date commonly cited for the majority of the graves is in the EB III, c. 2400–2100 BC, with a few earlier burials dating to the EB II. However, the radiocarbon dates obtained suggest a period of use for the cemetery between c. 3500–3000 calBC, in the transitional Late Chalcolithic – EB I period. These dates shed new light on the significance of the cemetery. While the size of the İkiztepe cemetery was remarkable even by the standards of the Early Bronze Age, it is virtually unheard of for the Anatolian Chalcolithic. Large cemeteries with rich grave goods dating to the Chalcolithic, however, are more commonly found in the larger Pontic world. There are also links to this area visible in other forms of material culture, including ceramics, figurines and idols. Despite this, northern Anatolia is generally thought of as being largely isolated from the broader cultural processes occurring in the 4th and 3rd millennia BC. The sizeable sample of skeletal remains from İkiztepe offers an ideal means of directly testing evidence for the movement of individuals through isotopic analysis. This discussion will focus on the results of strontium and oxygen isotopic analysis of the cemetery's human remains, along with a variety of other types of data, in order to examine evidence for mobility, community organisation and integration. This includes the identification of possible examples of long-distance migration and examining the integration of these migrants into the local community, as well as discussing evidence for the practice of transhumant pastoralism and its role in the socio-economy of the site.

Keywords: Turkey, Anatolia, İkiztepe, Chalcolithic, burials, isotopic analysis, migration, mobility, social organisation

During the Late Chalcolithic period in Anatolia, a marked degree of regionalism can be observed in material culture; this is likely at least partially a result of poor coverage in archaeological investigations throughout the country. Northern Anatolia, particularly the coastal area, is generally considered to be culturally distinct from the rest of the region, and a survey of the recent literature shows that it seems to be treated as being largely isolated from the broader cultural processes that are occurring in the larger Anatolian world in the 4th and 3rd millennia BC.[2] Although a few researchers have suggested the existence of Black Sea-based interactions, or even a circum-Pontic interaction sphere during this period, that sometimes incorporates northern Anatolia, these connections are generally reconstructed in terms of trade and the transmission of ideas, rather than the movement of actual people.[3] Overall, migration and mobility are generally not considered to be major factors in the social organisation of communities during this period. This discussion will address the role of these factors in 4th millennium development in Anatolia in general, as well as reconstituting northern Anatolia as having a role in these larger developments, by focusing on the site of İkiztepe.

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1 The University of British Columbia, Vancouver, Canada; email: lynn.welton@ubc.ca.
2 Sagona – Zimansky 2009; Düring 2011; Schoop 2011; Yakar 2011.
3 Lichardus 1988; Chernykh 1992; Makkay 1993; Price 1993; Thissen 1993; Nikolova 1995; Bauer 2006a; Bauer 2006b.

The İkiztepe Sequence and Cemetery

İkiztepe represents one of the more contentious sites in Anatolia. Despite this, it represents one of the few excavated Black Sea coastal sites that provides us with an idea of the occupation history and material culture in the region of northern Anatolia. However, discussion of the site is often avoided or discussed separately in synthetical treatments of Anatolia and its social development, both because of the difficulty of fitting the site into larger patterns observed in the plateau and in western Anatolia, as well as because of its controversial chronology.

Excavations at the site have been conducted since 1974; the excavators have proposed a primary chronological sequence with occupation beginning in the Late Chalcolithic, and continuing until the beginning of the 2nd millennium BC, with a later secondary sequence dating to the Iron Age.[4] Many scholars have suggested that much of the primary sequence should be shifted earlier, with the earliest levels dating to the mid- to late-6th millennium, and the remainder of the sequence being shifted correspondingly earlier.[5]

Of the site's four mounds, Mound II, which has been the most extensively published, has been the focus of the most attention. Some materials on Mound I have also been addressed, but generally in a less comprehensive manner. This discussion will focus on Mound I, which has produced an occupation sequence consisting primarily of domestic architecture.[6] Following this, the mound became the site of a large extramural cemetery. This cemetery is particularly spectacular because to date it has produced the remains of almost 700 individuals.[7] The graves within this cemetery were simple earthen burials, and in the majority of cases, the individual was placed on the back with the arms straight beside the body.[8]

This cemetery has received somewhat less attention than other parts of the İkiztepe sequence in chronological discussions due to its lack of final publication, although the chronological reconsiderations of the other parts of the Mound I sequence certainly have ramifications for the dating of the cemetery, suggesting that it too should be dated earlier than the mid-late 3rd millennium, where it has been placed by its excavators.[9] Lichter and Zimmermann, for example, have both suggested that at least part of the cemetery should be dated to the 4th millennium, predominantly based on the evidence of the metal objects from the graves. Zimmermann focuses on the presence of ring-shaped idols known from the 5th and early 4th millennia in eastern Europe, while Lichter also discusses the copper weaponry found at the site, which has both typological and compositional parallels in the 4th millennium levels at Ilıpınar, as well as with sites in southeastern Europe.[10]

In order to address the chronological controversies surrounding the occupation history at the site, and specifically to deal with the dating of the cemetery itself, radiocarbon dates were conducted on three human bone samples from the cemetery. These dates confirm that the cemetery does indeed date earlier than originally suggested, likely in the late 4th millennium or during the Late Chalcolithic–EB I transitional period.[11]

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4 Alkım et al. 1988; Alkım et al. 2003.
5 Parzinger 1993; Thissen 1993; Steadman 1995; Schoop 2005.
6 Bilgi 1984; Bilgi 2001; Bilgi 2007.
7 Bilgi 2003; Bilgi 2005.
8 Bilgi 1984; Doğan 2006.
9 Bilgi 2001; Bilgi 2005.
10 See also Begemann et al. 1994; Özbal et al. 2002; Lichter 2006; Zimmermann 2007.
11 See Welton 2010. Dates in Welton 2010 were calculated using the IntCal09 calibration curve; use of the Northern Hemisphere mixed marine curve to account for potential marine reservoir effects tends to move the dates only slightly later, toward the very end of the 4th millennium. However, recent studies have indicated that the İkiztepe diet was predominantly terrestrial, and only minimally marine in nature (Özdemir 2008), suggesting that use of the IntCal09 curve is not inappropriate.

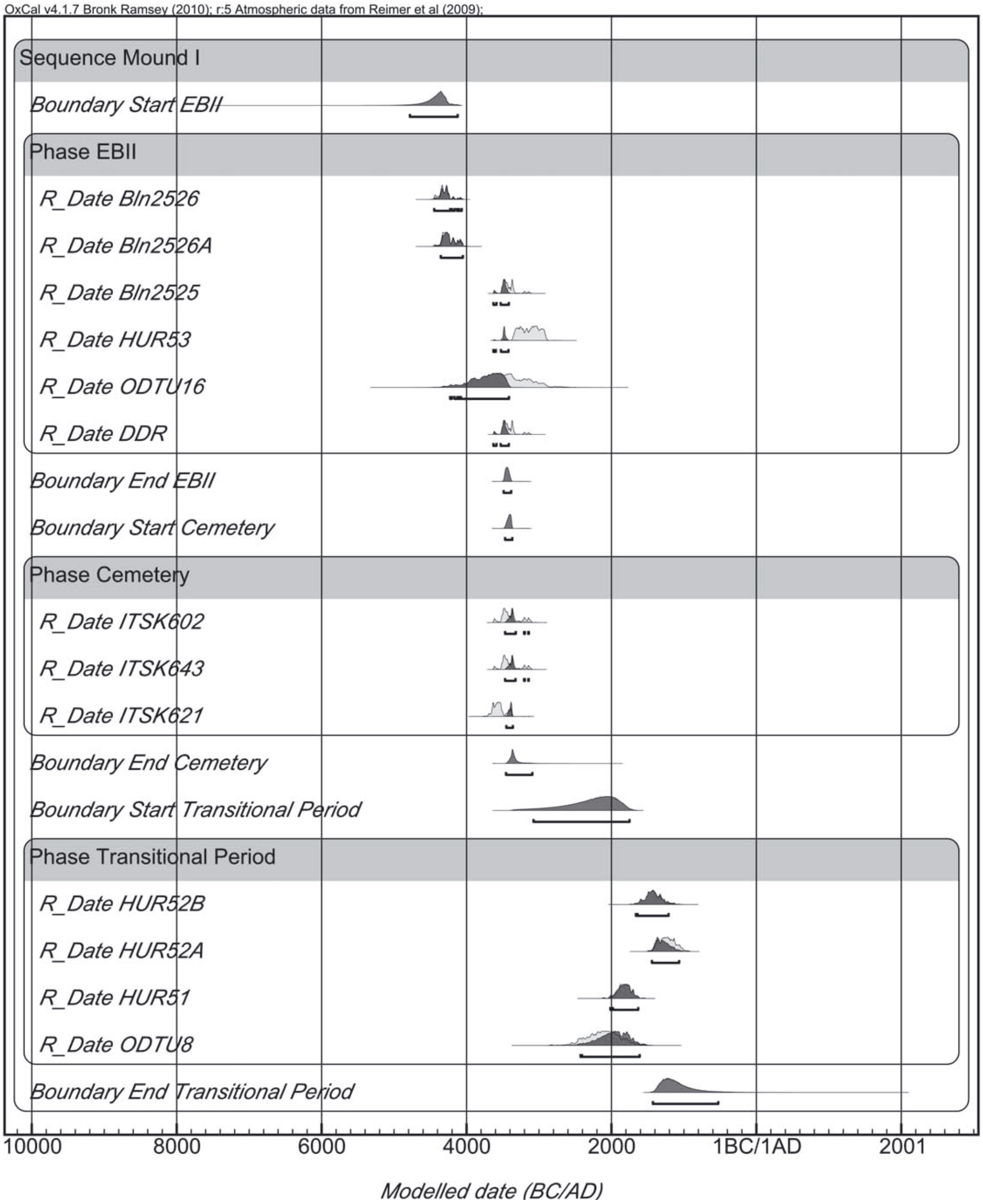

Fig. 1 Chronological reconstruction of İkiztepe Mound I.

The radiocarbon samples were selected based on the results of fluoride dating performed on a sample of human remains. Fluoride dating of bone, while not an accurate chronometric technique, has been successfully used in some cases for identifying relative sequences in cemetery contexts.[12] Such a relative dating method has the potential to provide valuable information, due to the difficulties that have been encountered attempting to create relative sequences of burials in the İkiztepe cemetery using ceramic or stratigraphic means. The fluoride dating results were used to

[12] Schurr 1989; Ezzo 1992; Johnsson 1997; Tankersley et al. 1998; Schurr – Gregory 2002.

select samples representing the proposed earliest, middle and latest parts of the burial sequence, in order to determine a possible duration for the cemetery.[13]

When these radiocarbon dates are combined with other dates that have been obtained from the preceding and following occupational levels at the site, they permit estimation of the duration of use of the cemetery. The results suggest that the cemetery was in use for less than 250–300 years (Fig. 1).[14]

The idea of a relatively short life-span for the cemetery contrasts with the reconstructions of some scholars, who have suggested that the life span of the cemetery could have been a millennium or more, a conclusion which was often based, either implicitly or explicitly, on the greater than 7m difference in depth between the burials excavated in the cemetery.[15] However, plotting the grave locations and depths in GIS demonstrates a pattern in the distribution of graves, and strongly suggests that the cemetery was located on an ancient slope.[16] This provides a reasonable and non-chronological explanation for the depth differential that has been previously commented on.

These dates shed new light on the significance of the cemetery. While the size of the İkiztepe cemetery was remarkable even by the standards of the Early Bronze Age, which boasts numerous large extramural cemeteries, it is virtually unheard of for the Anatolian Chalcolithic. The vast majority of known burials from this period are intramural, often occurring below house floors or in uninhabited areas of the settlement, and occurr in relatively small numbers at each site. Numbers generally range from a single burial to small groups of less than 10–15 individuals, although exceptions to these small numbers occur at sites such as Ilıpınar, Köşk Höyük and Kuruçay. These sites have generally produced between 30 and 60 excavated graves, comparatively large numbers in relation to other sites of the same period (Fig. 2).[17]

These numbers, however, do not compare to the known numbers of burials from Early Bronze Age cemeteries in the following period, which in many cases are in the hundreds, and which are located extramurally in much more formalized disposal areas (Fig. 3). Many of the burials known from the Chalcolithic period, and particularly from the sites containing larger numbers of burials, belong to children, who were often buried in jars and/or under the floors of houses. In some cases, burials of adults dating to the Chalcolithic period have also been found, but generally in smaller numbers. At some sites, the rarity of adult burials has been suggested to indicate the possibility of the presence of extramural cemeteries, but so far the only proposed extramural cemetery in the Chalcolithic period in Anatolia has been at Aktopraklık Höyük.[18]

As such, İkiztepe represents a thus far unique early cemetery of the late 4th millennium in Anatolia, due to its large numbers of burials, its representation of the full demographic makeup of the population, and the development of a formalized area for the placement of the dead.

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13 Many of the issues that have been identified with fluoride dating have been related to samples taken from widely varying depositional environments, while fluoride incorporation from the burial environment into bone has been suggested to be highly dependent on very localized depositional conditions (Schurr – Gregory 2002; Wrobel 2007). The İkiztepe remains originate from a physically constrained area with a consistent burial environment, and tests have suggested there to be no relationship between the observed fluoride values and the depth of the burials, which might have reflected factors such as water drainage that have been suggested to affect fluoride absorption. In addition, although admittedly based on an as yet small sample of radiocarbon dates, there appears to be a broad correlation between the results of the fluoride dating and the radiocarbon results. See Welton 2010 for further discussion of this issue.

14 Figure created using OxCal v.4.1.7. Dates for this diagram were taken from Alkım 1981; Alkım 1983; Özbakan 1988; Mellink 1992; Bilgi 2001; Alkım et al. 2003.

15 Parzinger 1993; Zimmermann 2007.

16 See Welton 2010 for more information.

17 Ilıpınar: Roodenberg 2001; Köşk Höyük: Özkan et al. 2004; Kuruçay: Duru 1996.

18 Alpaslan-Roodenberg 2011; Karul – Avcı 2011.

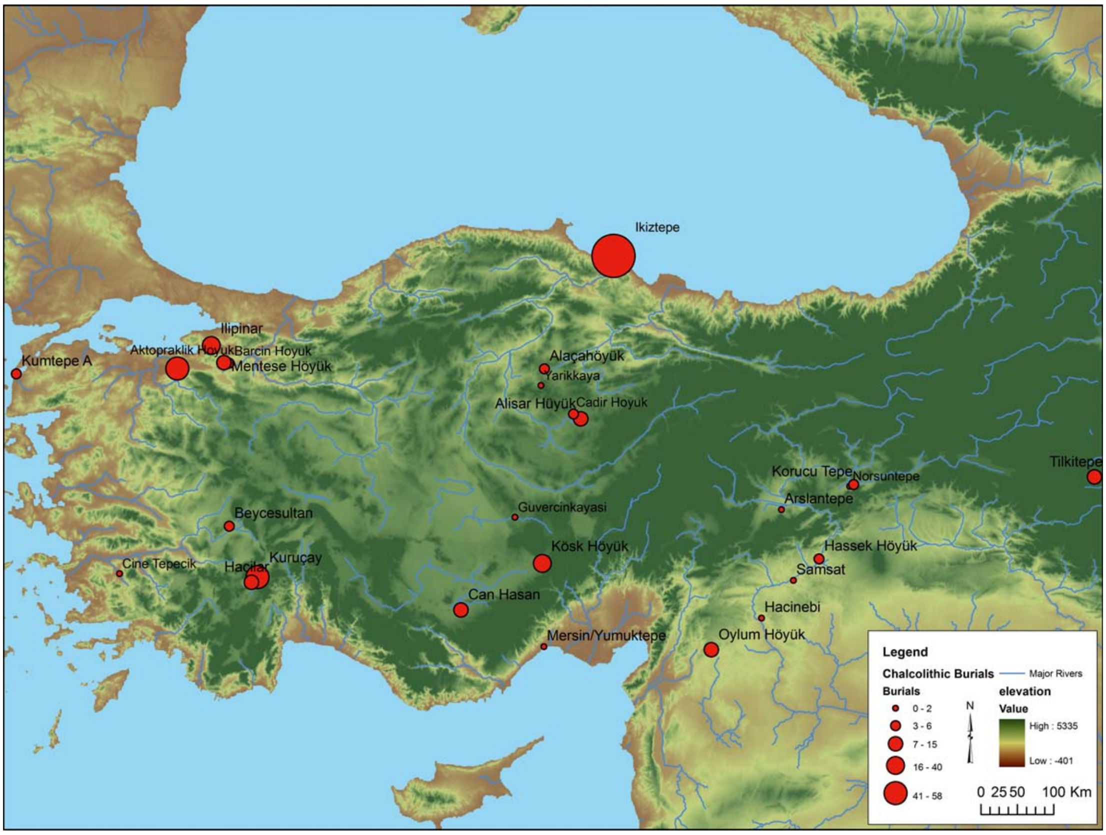

Fig. 2 Map of Chalcolithic burials in Anatolia.

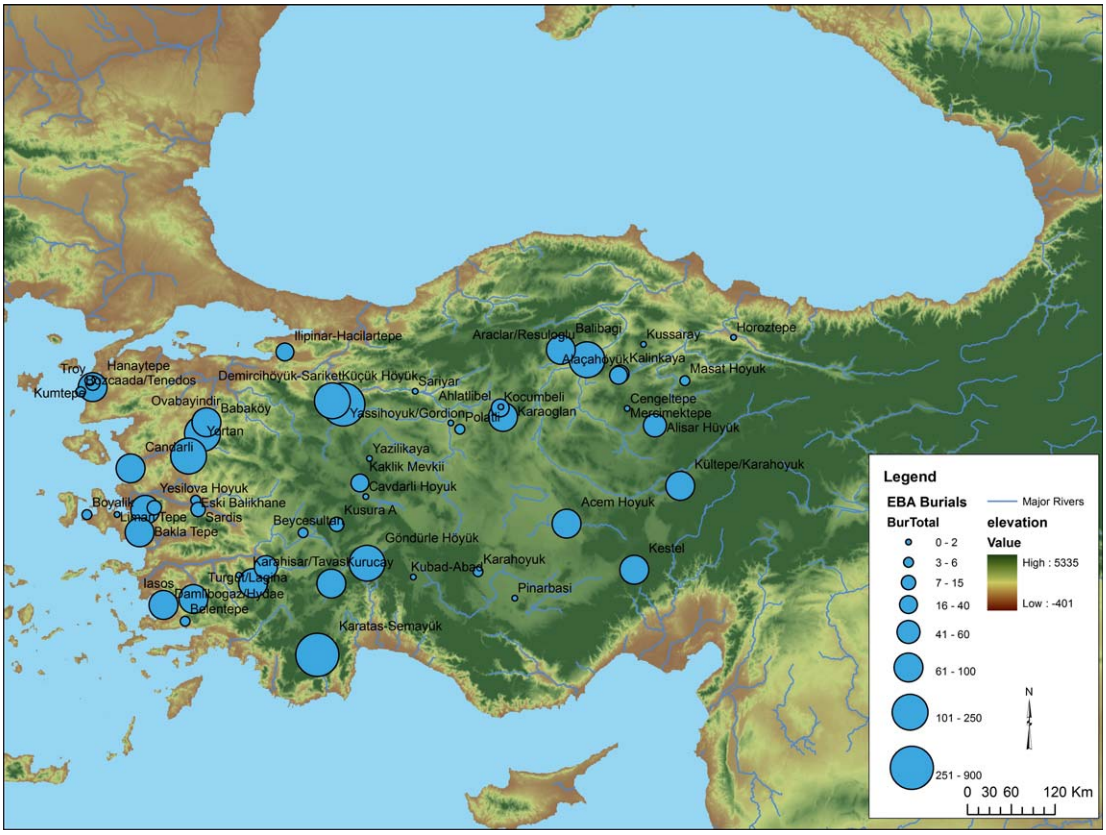

Fig. 3 Map of Early Bronze Age burials in Anatolia.

The Organisation of the Cemetery

Analysis of the cemetery's spatial organisation suggests that burial occurred preferentially within one particular area, located in the central southern part of the cemetery within a slight curve of the ancient slope. The earliest burials in the cemetery were preferentially located in this area, as were the individuals with the highest numbers of grave goods. However, it appears that there were no set rules in the placement of burials that allowed only particular groups or privileged individuals to have burials placed in this central area. Other individuals who were not members of these groups were also buried in this area of the cemetery, suggesting that burial placement in particular areas was preferential but not controlled.

Spatial analysis of the results of fluoride dating, which proposed a relative sequence for a sample of the cemetery's burials, suggests that over time the cemetery expanded out of the preferred south central area of the cemetery, filling in gaps between existing burials and expanding further to the north. The latest period of the cemetery appears to have continued to make use of the central portion of the cemetery.[19]

The occurrence of grave goods also demonstrates a temporal pattern in their distribution. In general, moderate numbers of grave goods were encountered in graves from the early period of the cemetery. Rarely do these early burials contain absolutely no grave goods. In contrast, the middle period of the cemetery's use witnesses a substantial increase in the differentiation occurring among burials based on the richness of the number of grave goods included in the graves. Graves with the highest numbers of grave goods occur almost exclusively during this period, but burials containing no grave goods also become common. Finally, during the latest period of the cemetery's use, the average numbers of grave goods appear to decrease dramatically. The highest numbers of grave goods occurring during this period are three or four objects, compared to graves with ten or more objects found during the preceding middle period.

The meaning of the distribution of grave goods included in the burials is worth discussing, since the distribution of numbers of grave goods at İkiztepe has received some attention.[20] The question is, at what point do burials begin to represent evidence for hierarchical organisation? How do we interpret a situation in which many individuals have no grave goods, with comparatively small numbers of individual burials possessing a handful of items? Does hierarchical organisation require evidence for gold or other exotic artefact types, or hundreds of objects in a few graves? And how few graves would we expect to display a rich number of burial goods in a hierarchically organized society? The graves at İkiztepe range between possessing no grave goods to possessing 14 objects; Fig. 4 visually represents the distribution of objects within the graves.

It is perhaps worth noting that there is relatively little solid evidence for the provision of grave goods that were formed with the sole intention of being provided to the dead (that is, objects that would not have been used or useable in daily life). Rather, it seems perfectly plausible that all or most of the objects included in the graves could represent the personal belongings of the individuals buried within them, or their immediate families. In the graves with the highest numbers of grave goods, the most common object type is copper weaponry. Given that the skeletal remains from the cemetery provide evidence of cranial trauma that in some cases conforms to the types of weaponry observed in the graves,[21] it seems logical to conclude that in most cases these weapons were likely actually used. Although they may not have been personally used by all of the individuals in whose graves they were included (i.e. children), it is quite likely that the inclusion of these objects could represent attempts to communicate familial status rather than individual roles.

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[19] Given the comparatively short duration of the use of the İkiztepe cemetery, these patterns should be considered to represent at best very general trends in the cemetery's use.

[20] Wittwer-Backofen 1985; Wittwer-Backofen 1987; Bilgi 2005; Doğan 2006.

[21] Erdal 2005; Erdal 2006.

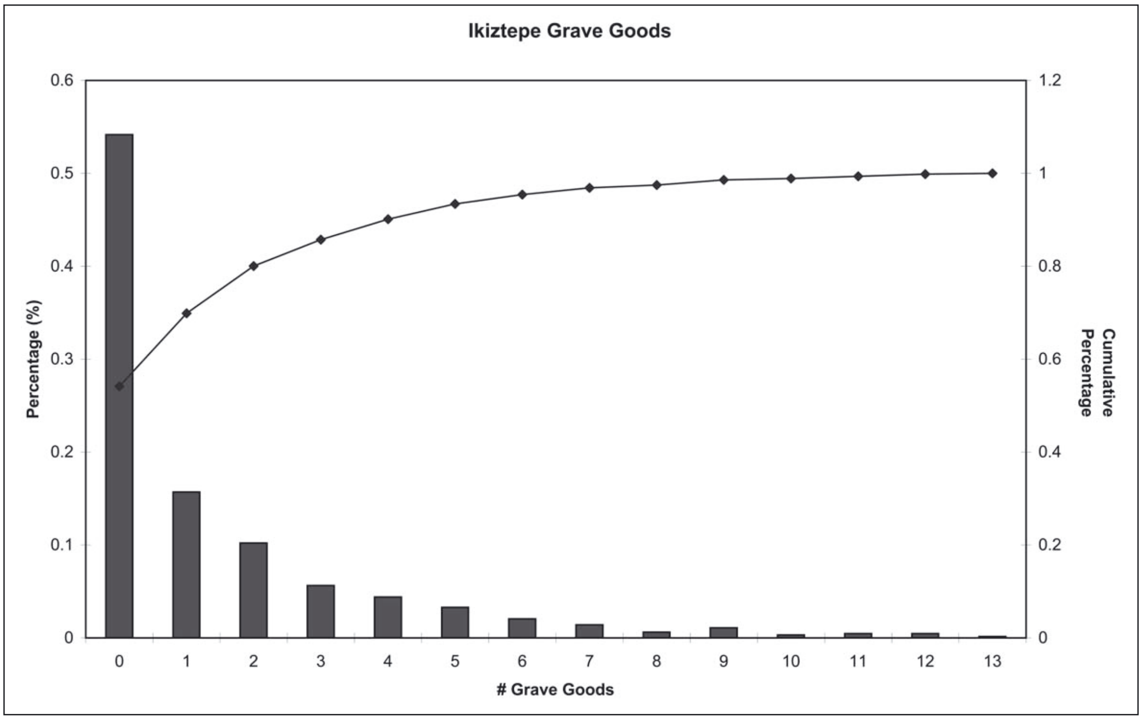

Fig. 4 Distribution of grave goods within the İkiztepe cemetery.

Furthermore, as discussed above, the provision of burial goods appears to be linked to temporal change in burial practices in the cemetery.

Bilgi, in his discussion of the cemetery at İkiztepe, selected a small number of burials containing large numbers of 'prestige' burial goods and deemed them 'distinguished' burials, which he suggested represented a single elite ruling lineage group within the community.[22] Similar to the pattern observed at İkiztepe, the cemetery at Varna displayed a small number of particularly lavish burials that could be distinguished from the remainder of the cemetery on the basis of the richness of their burial goods. Although the richness of these graves could be considered to be of an order of magnitude greater than observed in the graves at İkiztepe, in terms of the comparative distribution of grave goods amongst the population, this represents a parallel situation to Bilgi's group of 'distinguished' burials. However, Chapman suggests a completely different interpretation of these graves compared to that offered by Bilgi, providing a more heterarchical interpretation of the scenario, suggesting that these represent corporate groups within the community competing for and negotiating power relationships through conspicuous displays of wealth.[23]

Isotopic Analysis and Results

As part of this study, isotopic analysis was conducted on a sample of İkiztepe skeletal remains, with the particular aim of examining migration and mobility in the population. The isotopic composition of strontium in bone or enamel reflects the local geology of the environment in which the tissue was formed.[24] Similarly, the isotopic composition of the oxygen incorporated into bone or enamel is controlled primarily by water consumed and atmospheric oxygen. As a result, oxygen

[22] Bilgi 2005.
[23] Chapman et al. 2006.
[24] For an overview, see Bentley 2006.

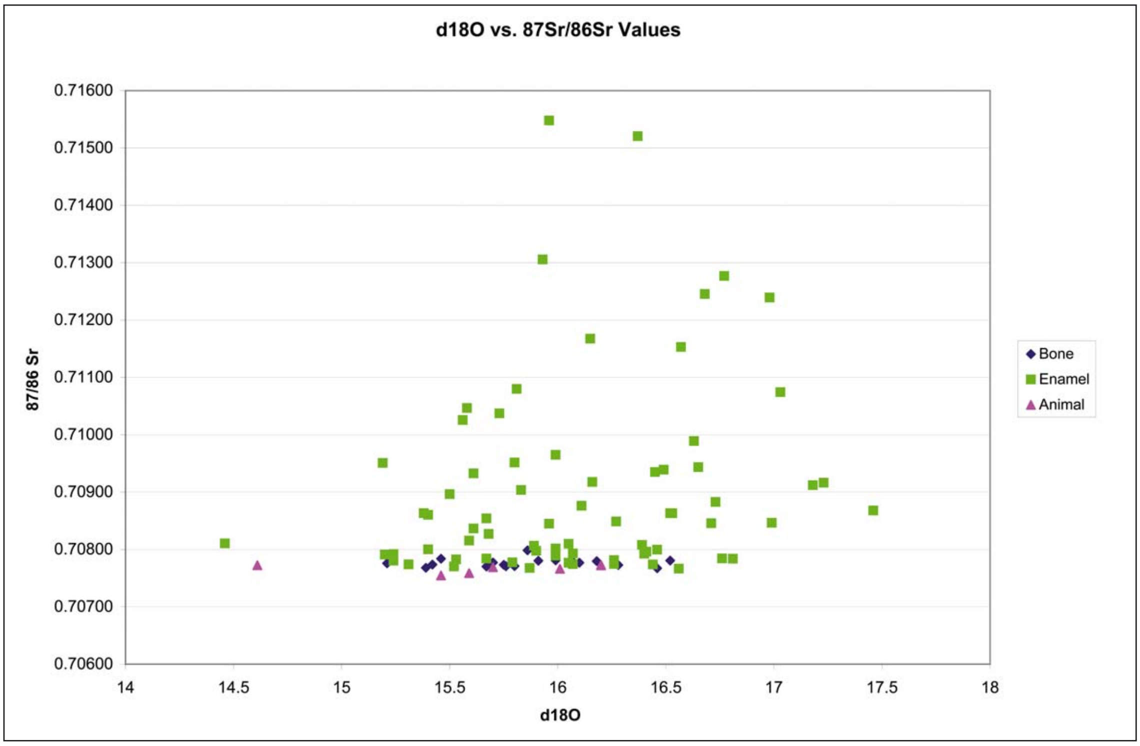

Fig. 5 Scatterplot of $\delta^{18}O$ vs. $^{87}Sr/^{86}Sr$ values for İkiztepe cemetery.

isotopic composition reflects local geography and climate.[25] These two methods are therefore complementary, each examining crucial but different aspects of the environment in which the tissues under consideration were formed.

The constant process of remodelling in bone means that the isotopic composition of human bone samples generally represents the average local conditions during the last years of life. In contrast, tooth enamel is formed during childhood and does not remodel, and thus reflects local conditions at the time of its formation during the early years of life. As a result, it is possible to use isotopic signatures in these two tissues to identify individuals who have moved between different areas during their lifetime.

For the purpose of this study, strontium and oxygen isotopic analysis was conducted on the enamel from 72 individuals. Eighteen of the examined individuals also had bone samples analysed. Finally, eight animal samples from the site's faunal collection were analysed for the purpose of providing a local baseline isotopic signature. Pigs were selected for this purpose, due to their comparatively small home range compared to other available faunal species found at the site, which are generally species herded over a large area, such as sheep, goats and cattle.[26]

The results of strontium and oxygen isotopic analysis are presented in Fig. 5. The majority of the oxygen results fall between 15 and 17‰, which is a relatively normal range of variation for a human population consuming a consistent water source.[27] Furthermore, the values themselves are within the expected range of values for the area based on local rainwater. However, despite relatively significant changes in elevation throughout northern Anatolia due to the presence of the Pontic Mountains, there does not appear to be a great deal of variation in the range of $\delta^{18}O$ values

25 For an overview, see White et al. 1998.
26 For more detailed discussion of sample selection procedures, see Welton 2010.
27 See Levinson et al. 1987; Stuart-Williams et al. 1996; White et al. 1998; White et al. 2000; Budd et al. 2004; Evans et al. 2006; Bentley et al. 2007a; Bentley et al. 2007b.

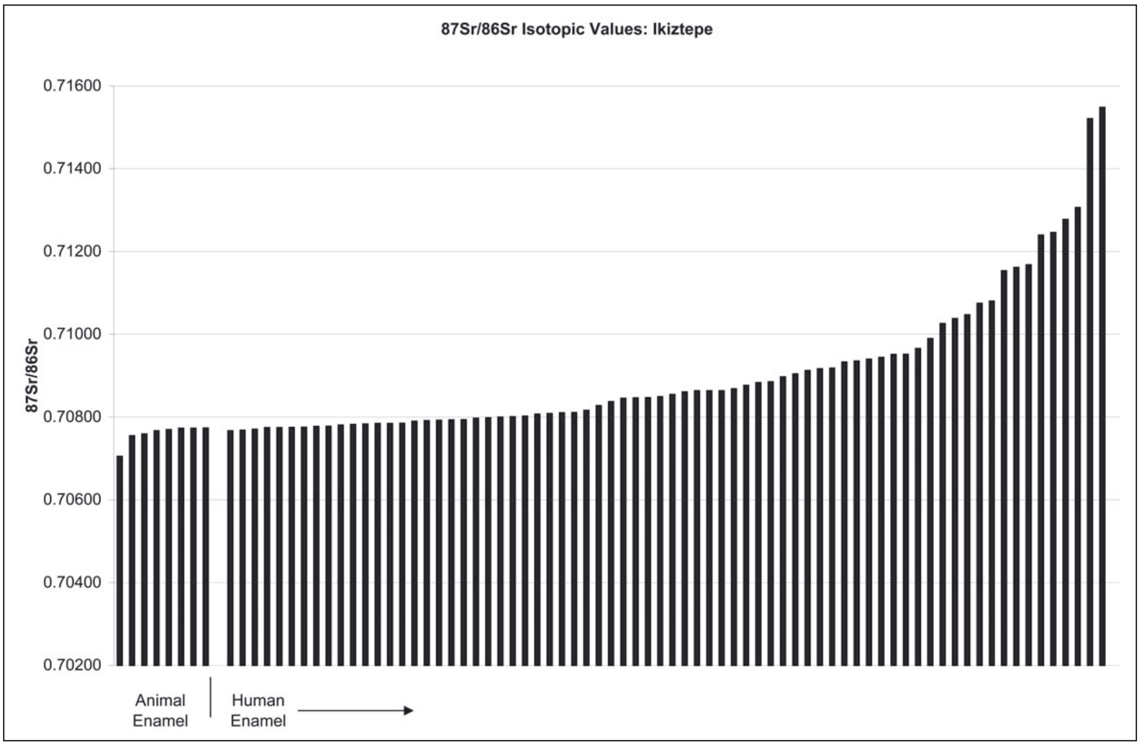

Fig. 6 $^{87}Sr/^{86}Sr$ values for İkiztepe cemetery.

for meteoric water. In fact, the range of monthly variation in $\delta^{18}O$ values in precipitation for the modern city of Bafra is greater than the variation observed between Bafra and other modern cities, including those at substantial distances and at significantly different elevations.[28] This suggests the possibility that the variation in $\delta^{18}O$ values in the Black Sea region may not be adequately sensitive for distinguishing movements of individuals between the Bafra Plain and other nearby Anatolian or Black Sea locations.

The strontium analysis, however, produced much more varied results (Fig. 6). The animal enamel and human bone samples, which are intended to provide a local baseline, demonstrate a very narrow range of variation, with similar absolute values to each other. Most of the rock types in the mountains directly to the south of İkiztepe have quite low strontium isotopic signatures, consisting primarily of carbonates and island arc magmatics. The highest available local values are those of Black Sea water, which reach as high as 0.7093, the values associated with modern ocean water.[29] The observed values in the animal and human bone samples, clustering around 0.7075, represent a reasonable value for the mixing of these sources. Many of the human enamel samples cluster in this region as well; the values of the majority of the İkiztepe population can likely be explained by the consumption of a terrestrial diet with rather low strontium isotopic signatures, perhaps supplemented by a marine dietary component with a high proportion of fish, with a higher strontium isotopic signature. However, many of the enamel samples display higher results, and in some cases, significantly higher results; samples with values higher than the sea-water values are more difficult to explain, and would require dietary inputs from areas with higher strontium signatures. This problem is further compounded by the fact that trace element analysis

[28] As calculated by the Water Isotope System for Data Analysis, Visualisation and Electronic Retrieval (WISER) application (IAEA 2006) and the Online Isotopes in Precipitation Calculator (OIPC) application (Bowen 2009).

[29] Faure – Powell 1972; Ryan et al. 2003.

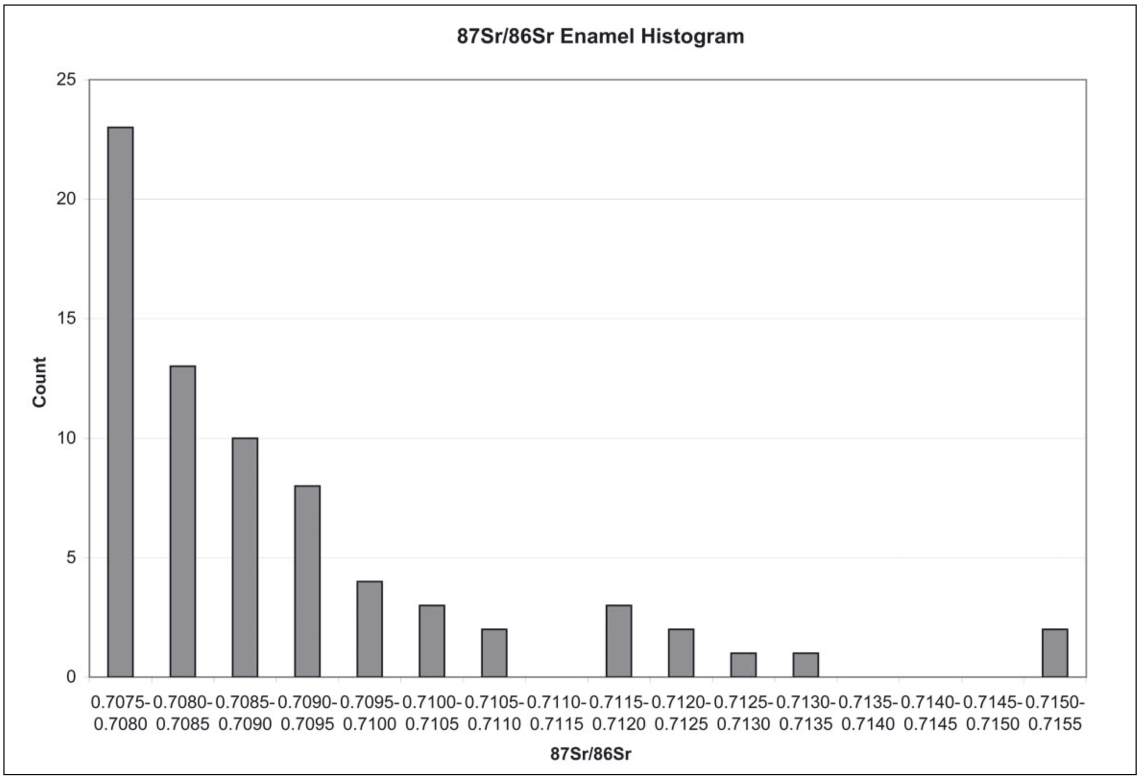

Fig. 7 Histogram of $^{87}Sr/^{86}Sr$ values for İkiztepe cemetery.

of human remains from the İkiztepe cemetery has suggested lower levels of consumption of marine resources than might be expected for a coastal site.[30]

Based on the variety of strontium isotopic signatures, it is likely that the population contains a number of individuals who were born non-locally. A histogram of the strontium results (Fig. 7) demonstrates that the distribution of the values in the sample is actually tri-modal; with the majority of the population displaying values less than 0.710, and with secondary peaks occurring around 0.712 and 0.715. The second peak around 0.712 includes 7 individuals, while the third peak around 0.715 includes two individuals. This suggests that 9 out of 72, or 12.5%, of the individuals analysed demonstrate enamel signatures that are likely to be non-local. This is actually a rather conservative estimate, as conventional methods of estimating local variation within the population would generally use a range of 2 standard deviations from the mean of the animal enamel samples or of the human bone samples,[31] both of which would result in an estimate of 65–75% of the population being born non-locally.[32] This would be a remarkably high percentage of non-local individuals. Indeed, the standard deviation in the human enamel strontium isotope values observed for the İkiztepe population is extremely high compared to most estimates for populations where this type of study has been previously completed.[33] This suggests a greater amount of mobility than is often observed.

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30 Özdemir 2008.

31 Price et al. 2000; Price et al. 2002.

32 2SD range for human bone = 0.70762–0.70791; 2SD range for animal enamel = 0.70752–0.70781.

33 İkiztepe: 0.7091 ± 0.00172; Early Neolithic Vaihingen (LBK): 0.709591 ± 0.000224 (Bentley et al. 2003); New Kingdom Tombos, Nile Valley: 0.70743 ± 0.000055 (Buzon et al. 2007); Early Medieval West Heslerton, Britain: 0.7095 ± 0.0007 (Budd et al. 2004); LMIII Sellopoulo, Crete: 0.708947 ± 0.000147 (Nafplioti 2008); Harris Creek, Middle Archaic Florida: 0.708314 ± 0.000413 (Quinn et al. 2008); Wari Empire, Conchopata, Peru: 0.70584 ± 0.00074 (Tung – Knudson 2008).

There is no evidence for any form of distinction of non-local individuals by means of burial practices (Fig. 8). For non-local individuals whose burial position could be determined at the time of excavation, the majority was buried in the standard burial position for the site, that is, they were buried dorsally. Furthermore, there is no clear pattern with regard to which sex seems to be migratory over long distances. There also appears to be no identifiable pattern with regard to the numbers or types of grave furnishings included with these individuals. The number of items included in these graves varies from none (samples ITSK306, ITSK642, ITSK268) to six (sample ITSK573), including items of weaponry. In fact, the latter burial is one of the richer burials found at the site.[34]

Identifying where these individuals might originate from is particularly difficult given the lack of comparative data for this area. There have been few studies of strontium isotopic values in animals or humans in most of Anatolia, particularly in the central and northern portions of the country.[35] It is possible to compare geological maps to identify potential broad places of origin, and to use measured values of geological formations as a guide, but the correspondence of geological formations to the biologically available isotopic values displayed by local populations is not always direct.[36]

The primary issue, of course, is where to begin looking. Do we look inland, within Anatolia itself, or do we look to the coastal region of the larger Pontic world? A number of scholars have suggested the existence of a larger circum-Pontic region of interaction, where coastal sites share more characteristics in ceramic production, metallurgical production and architecture with each other than they do with inland sites that are closer in terms of absolute distance.[37] This interaction is long-lived, and continues into the early 3rd millennium BC. However, in the following periods, the ceramics found at İkiztepe suggest an increased connection to the south, toward the Anatolian Plateau.[38] This may be a larger pattern, as it seems that regional integration in the circum-Pontic

Sk No.	Sex	Age	Head Direction	Body Position	Grave Goods	Tooth
Group 1 (0.7115–0.7135)						
ITSK306	Female	Middle Adult	Unknown	Unknown	None	LLM1
ITSK553	Male	Middle /Young Adult	Southeast	Dorsal	1 spearhead	LLM2
ITSK567	Female	Middle Adult	East	Dorsal	1 harpoon	LRM3
ITSK602	Male	Middle Adult	South	Dorsal	3 total: 1 spearhead, 1 dagger, 1 earring	URP1
ITSK621	Female	Young/Middle Adult	Unknown	Unknown	1 earring	LLM1
ITSK642	Female	Unknown/Young Adult	Unknown	Unknown	None	URM3
ITSK643	Male	Middle Adult	West	Left	1 needle	LRC
Group 2 (0.715+)						
ITSK268	Female	Young/Middle Adult	North	Unknown	None	ULC
ITSK573	Male	Older/Middle Adult	Southeast	Dorsal	6 total: 2 spearheads, 1 dagger, 1 knife, 1 harpoon, 1 whetstone	ULP2

Fig. 8 Characteristics of likely long-distance migrants.

34 Data from Doğan 2006.
35 Dufour et al. 2007; but see, for example, Meiggs 2009.
36 Sillen et al. 1998; Price et al. 2002.
37 Particularly Price 1993; Bauer 2006b.
38 Particularly in the ‘Transitional Period’; Alkım et al. 1988; 2003; Thissen 1993.

zone decreases after the mid-3rd millennium, particularly as Mediterranean/Aegean trade routes begin to increase in prominence.

After removing the nine likely non-local individuals from consideration, and looking at the rest of the population, whose strontium isotopic values exist within the primary peak of the histogram, a small group of individuals still remains with values higher than those of Black Sea water. In order to explain these values, it is necessary to look for other possible explanations that may have contributed to the population's isotopic variation.

There is little textual information about this region available, even in later periods. This is generally recognized as the area inhabited by the Kaska tribes during the Hittite Empire period.[39] The Kaska are often viewed as transhumant populations with few or no cities, and seem to have a dispersed and flexible social organisation with little evidence for domination by a single leader. Their pattern of settlement seems equally flexible; overall, the Kaska may be seen as a mobile highland people, with a combined subsistence pattern of animal herding (both mobile and non-mobile) and small-scale crop growing, with a series of small somewhat impermanent settlements and seasonal patterns of movement.[40]

Traditional practices in the mountainous regions of Turkey, which still persist today to varying degrees, involve seasonal movements of groups or portions of the society into highland areas in association with the herding of animals. These practices are often known as *yayla*. Modern and recent historical Black Sea populations commonly exploit two or more vertically differentiated environments for subsistence, through a combination of small-scale agriculture and horticulture for individual consumption and intensive animal husbandry.[41] Winter months are spent in the coastal plain engaged in agricultural production, while summer months are spent in high altitude mountain pastures, grazing sheep and goats. Generally, only a portion of the coastal plain communities engage in seasonal transhumance, however; another segment of the population remains in the settlement year-round, tending to agricultural crops. Although the modern system was likely introduced by semi-nomadic Turkic tribes that entered Turkey from central Asia around the 10th century AD,[42] there is reason to believe that these practices are well-adapted to mountainous coastal environments[43] and that ancient populations may have practiced similar patterns of transhumance. In fact, these incoming 10th century populations may have adapted their customs to transhumant traditions already in place in the region.

Such practices could potentially have added to the variability of the İkiztepe population's isotopic signatures, as individuals or groups moved between areas with slightly different strontium isotopic signatures. Given the local geology, these movements are not likely to have produced extremely 'non-local' signatures (i.e. like the outliers in the secondary and tertiary peaks in Fig. 7), but may have contributed to increased variability in a subset of the population.

Conclusions

Significantly, the İkiztepe community chose to bury their dead in a single coherent cemetery. Although the lack of evidence is likely partially a result of poor excavation coverage during this period, it certainly seems that this was a much rarer decision during the late 4th millennium than it was later, during the 3rd millennium. The presence within this cemetery of both probable long-distance migrants and mobile communities or sub-communities that may have practiced transhumance, alongside more sedentary village populations is important in itself, because it sug-

[39] Glatz – Matthews 2005; Matthews – Glatz 2009.
[40] Matthews – Glatz 2009.
[41] Yakar 2000.
[42] Geray – Özden 2003.
[43] Yakar 2000.

gests a strong degree of integration of these individuals into the larger community. The apparent lack of differentiation in burial practices between these groups further underlines this integration. The İkiztepe cemetery seems to reflect the existence of a commonly accepted pattern of burial activity that represented a coherent means of ritual and mortuary expression in the community, where preferential locations and styles of burial were shared amongst the different individuals and groups within the community, suggesting a system of shared values.

The İkiztepe cemetery seems to present less evidence for the existence of an elite than is often suggested. Rather, perhaps, it suggests the formation of symbols of prestige in the form of imagery based on war and conflict, but this development seems to have translated into comparatively little in the way of economic or political stratification. At the same time, there appears to be an expansion in the broader sense of shared social identity beyond the immediate or extended family, incorporating the larger community, who shared a common formalized area for the disposal of the dead. This may be related to inter-community warfare or conflict and the need to formulate a cohesive community identity as a response to conflict. The social processes that we see reflected at İkiztepe likely represent the nascent stages of processes that continue in the 3rd millennium.

Despite the marked regionalism that is visible in Anatolia in the Chalcolithic period, it would be overly simplistic to assume that communities or regions were isolated from each other, or that social development during this time was dominated by insularity. In fact, the evidence from İkıztepe suggests there was a great deal of mobility, and even long distance migration, suggesting that inter-regional interaction was not a rare occurrence. In particular, northern Anatolia appears to have played an important part in this inter-regional interaction, and displays important developments in social complexity during this period. Finally, these results suggest that methods such as isotopic analysis have the potential to provide valuable information about social organisation, even in circumstances where the knowledge of material culture remains comparatively limited.

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Lithic Production before and after the 4th Millennium BC on the Lower Danube, in Southeast Bulgaria, the Marmara Region and the Eastern Aegean

Ivan Gatsov,[1] *Petranka Nedelcheva*[2]

Abstract: This paper investigates the lithic artefacts produced before and after the 4th millennium BC. The lithics derive from several research projects that took place in the southern Balkans, in the region around the Marmara Sea – present-day northwestern Turkey –, in Thrace and the eastern Aegean. A number of different features of the chipped stone assemblages under investigation have been analysed and compared in terms of raw material procurement strategies, technology and the morphology of the retouched implements. As a result of this ongoing research, various technological and typological features and raw materials were identified. Interpretations concerning lithic procurement, technology and distribution during the 4th millennium BC are stifled by the scarcity of evidence during this time period. Presently it cannot be determined whether this lack of data is due to research strategies or influenced by other factors.

Keywords: Southern Balkans, Marmara region, eastern Aegean, 4th millennium gap, lithic technology, chipped stone industry, raw material procurement

This paper investigates lithic artefact assemblages pertaining to the 5th and to the 3rd millennia BC. The artefacts were collected during different types of archaeological research projects, which took place in the region of the lower Danube of northeast Bulgaria, in southern Bulgaria – more precisely in upper or northern Thrace –, in the region around the Sea of Marmara, and in the area of the north-eastern Aegean.

A number of different features of the chipped stone assemblages under investigation have been analysed and compared with regards to raw material procurement strategies, technology and the morphology of the retouched implements. As a result of this ongoing research, a distribution area for a 5th millennium trapezoidal blade technology could be identified.[3] This region stretches from the lower Danube valley to the region of present day upper northern Thrace.[4]

Within this technology, blades were produced by lever and standing pressure mode of detachment and punch or indirect percussion, as well. In general, core reduction is based on the exploitation of high quality flint sources located in northeast Bulgaria, more precisely in the area of the Ludogorsko plateau.[5] Thus, at the time of the 5th millennium BC the system of raw material procurement and distribution included the areas of the settlement of Pietrele Magura Gorgana (Fig. 1.1), and the Durankulak and the Varna necropoleis.

With reference to the southeast Bulgarian region, it is very likely that at least a fraction of the flint used for the production of Chalcolithic chipped stone assemblages, from Karanovo VI, Azmak Chalcolithic layer (Fig. 1.2), Drama, Merdžumekja (Fig. 1.3), was exported from north-eastern Bulgaria as regular pressure and punch blades.[6]

In the south an entirely different situation emerges. In eastern Thrace, during beginning of 6th millennium and in the 5th the very well-documented settlement Aşaği Pınar presents an entirely

1 New Bulgarian University, Sofia, Bulgaria; email: igatsov@yahoo.com.
2 New Bulgarian University, Sofia, Bulgaria; email: pepini@gbg.bg.
3 Pelegrin 2012, 465–500.
4 Manolakakis 1996, 119–123; Sirakov 2002, 213–246; Manolakakis 2005; Gatsov – Nedelcheva 2012, 247–251.
5 Manolakakis 2011, 225–244; Nachev unpublished.
6 Boyadžiev 1995, 149–191; Manolakakis 2011, 225–244; Nachev, unpublished.

Fig.1 Lever pressure blades; 1. Pietrele Magura Gorgana; 2. Azmak, Chalcolithic layers; 3. Drama, Chalcolithic layers (Drawings: P. Nedelcheva).

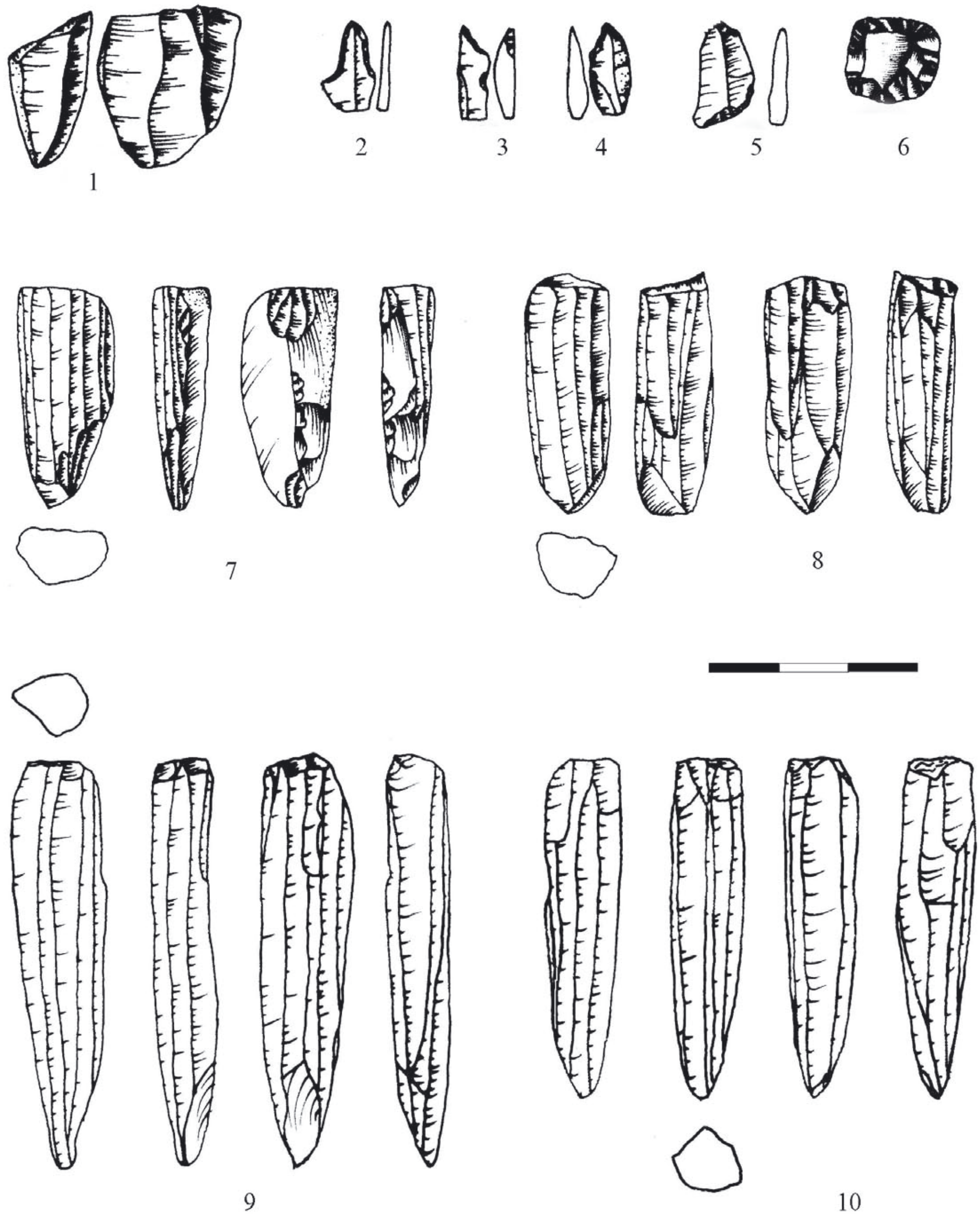

Fig. 2 1. core; 2–4. micro perforators; 5. segment; 6. micro end scraper; 7. ten bullet cores; 1–6. Aşaği Pınar; 7–9. Barçın Höyük; 10. Aktopraklik, Chalcolithic layers (Drawings: P. Nedelcheva).

different lithic industry.[7] The assemblages are characterised by the use of local raw material varieties, the use of relatively small sized blades and flake cores, high frequency of micro perforators and drills, as well as micro end scrapers and segments (Fig. 2.1–6). Core reduction was achieved by applying punch and direct percussion techniques. In M. Özdoğan's words: "Obviously with the present evidence at hand, it is not possible to draw a picture of what happened in eastern

[7] Parzinger – Schwarzberg 2005.

Thrace during the 4th millennium BC. Prior to the 4th millennium, there is a break in settlements both on the Anatolian and the European sides of the Sea of Marmara".[8]

In the area of the Marmara Sea and the northern Aegean shore, a very characteristic bullet core technology along with several retouched tool types appeared between the 7th and 5th millennia BC at Ulucak,[9] Ilıpınar, Fikirtepe, Pendik, Barçın Höyük,[10] in the Yenişehır region, at Aktopraklık, Menteşe, and Gülpınar (Fig. 2.7–10). Flint core specimens were reduced mainly by standing pressure and punch. Simultaneously, obsidian blade cores were knapped mostly by means of standing and hand pressure techniques. The similar system of raw material procurement and a number of parallel technological and typological features could imply that groups with similar social organization were present in western Anatolia from the 7th to the 5th millennia. Considering the recent results from Gülpınar, for the moment it can be stated that this is the latest manifestation of bullet core technology in the area under discussion.[11] The end of the Gülpınar sequence is related to the end of 5th millennium BC.[12]

Now, let's turn to the 3rd millennium BC. For this time period the Bulgarian territory lacks sufficient archaeological exploration, resulting in a paucity of data. At this stage of research, a small quantity of lithics related to the Early Bronze Age – Cernavoda III derives from the Drama-Merdžumekja excavation in southern Bulgaria.[13] These flint specimens were recovered from areas P10–P13, Q10–13, and R9–13. Among the lithics, some denticulated specimens have been recorded as well. Unfortunately, the insufficient quantity of the flint artefacts from the Late Chalcolithic – Karanovo VI period and the Early Bronze Age – Cernavoda III periods does not afford more refined results.[14]

However, some basic characteristics of the Early Bronze Age chipped stone technology from the 3rd millennium BC on the territory of western Anatolia, especially from the area south of the Marmara Sea and northern Aegean area can be defined.[15] The lithic technology during this period was based on local varieties of silicates and a short distance system of procurement and distribution. The use of coarse-grained local stone varieties had a great impact on the technological characteristics, which determine the implementation of direct percussion techniques, resulting in considerable technical uniformity and simplicity through time. Consequently, the lithic technology did not change significantly during the course of the Bronze Age.

As a whole, the lithic industry related to the 3rd millennium BC on the north Aegean island of Gökçeada – the Yenı Bademlı settlement –, the western Anatolian littoral – Troy – and in eastern Thrace – Kanlıgeçit – are linked by common traits, e.g. a similar distribution system based on local raw material varieties, on spot knapping activities, flake orientated lithic industry, ad hoc tool making, and typological uniformity (Fig. 3.1–8). Therefore, one can assume that Early Bronze Age lithic assemblages are characterized by low skill technological capabilities, direct percussion techniques, and ad hoc flake tool production. This technology was aimed at obtaining flakes and flake utilization with or without secondary modification.[16]

In the assemblages under study, flakes and blades with denticulate retouch prevail from the outset of the 3rd millennium BC. Some of these denticulated pieces are characterized by semi-flat invasive bifacial retouch.[17] Within the assemblages, retouched specimens have been recorded as

8 Özdoğan 2004, 19–26.
9 Çilingiroğlu – Abay 2005, 12; Çilingiroğlu 2009, 7, fig. 2; Çilingiroğlu 2011, 67.
10 Gatsov et al. 2009, 35–48; Gatsov et al. 2012, 125–133.
11 Gatsov – Nedelcheva in preparation.
12 Takaoğlu 2006, 289–315.
13 Gleser 2011, 177–204; Gleser – Thomas 2012, 283–295.
14 Gatsov – Nedelcheva, 2012, 247–251.
15 Özdoğan 2003, 105–120.
16 Gatsov – Nedelcheva in print.
17 Gatsov – Karimali 2007, 393–401.

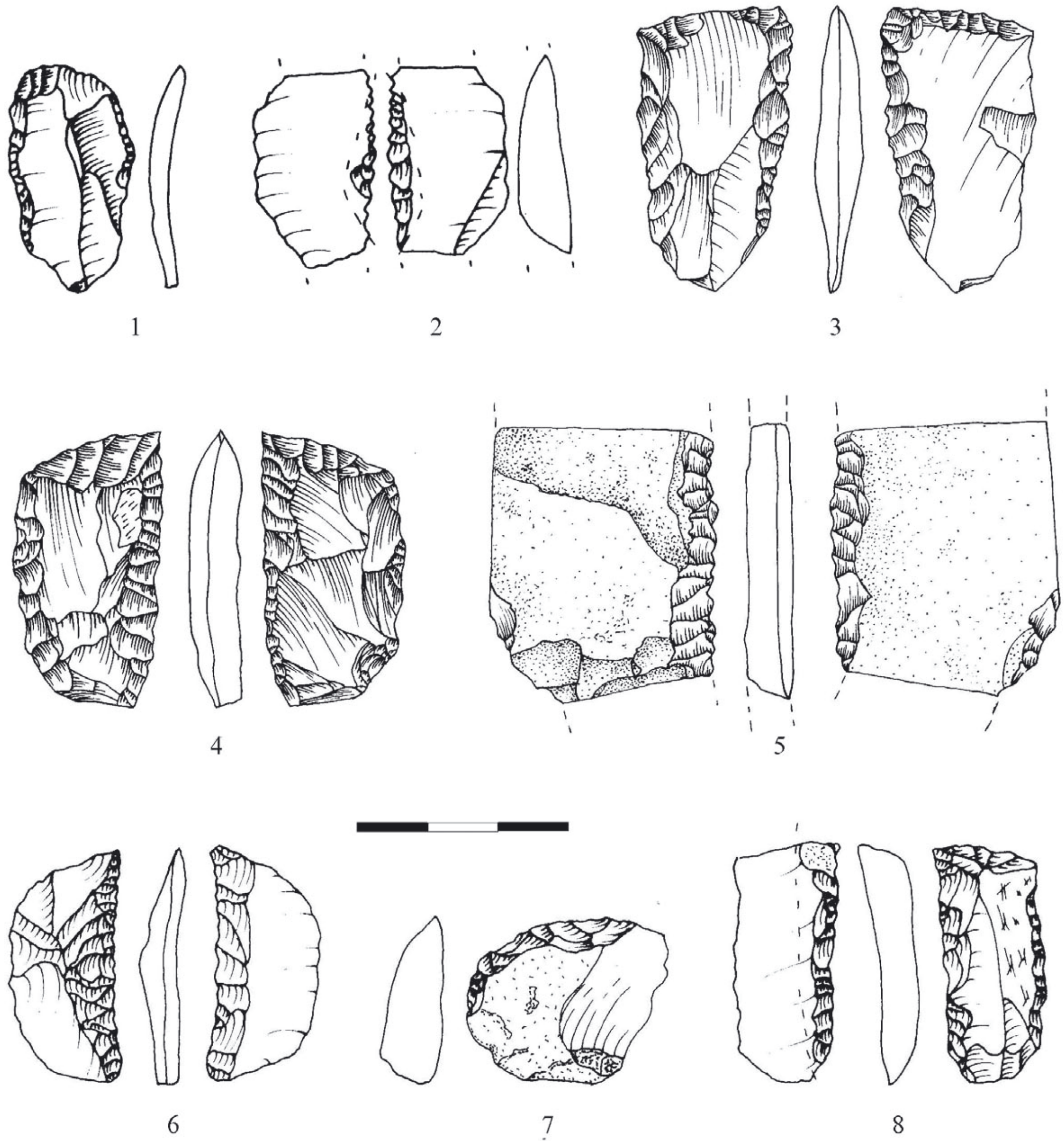

Fig. 3 1. retouched flake; 2–6, 8. denticulated pieces; 7. end scraper on flake; 1–2. Yenı Bademlı; 3–5. Troy; 6–8. Kanlıgeçit (Drawings 1–2: P. Nedelcheva; 3–8: I. Gatsov).

single items; as a rule these are atypical perforators and bores, flake end scrapers, irregular blades and flakes with denticulate retouch.

Apart from a few obsidian specimens in the form of small blade fragments and single tools, obsidian cores and core-reduction by-products are missing. Certainly the obsidian was brought to the settlements in the shape of percussion blades. Given the fact that at the settlements under study obsidian artifacts have been found in very small quantities, it can be assumed that the allocation of this raw material was not a high priority for the population in this area during the Early Bronze Age.

At this stage of the investigation it can be stated that the scarcity of evidence for the 4th millennium, especially concerning chipped stone assemblages, stifles interpretations for the territory encompassing the lower Danube to western Anatolia. To what extent this gap is a result of lack of research or other factors is difficult to determine at the moment.

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Weaving Society in Late Chalcolithic Anatolia: Textile Production and Social Strategies in the 4th Millennium BC

Ulf-Dietrich Schoop[1]

Abstract: The nature and development of textile production in prehistoric Anatolia has received very little systematic attention so far. This paper attempts to show that it is at the end of the 5th millennium BC when we first see a great increase of effort being invested into this field, a development which may be linked to the introduction of wool-producing caprids into the region. The social and economic implications of this development are investigated through a review of the evidence for flax-cultivation, pastoral strategies and the distribution of tools used in textile manufacture. The paper questions views that woven textiles were produced for their use-value and that they served the generation of cumulative wealth in this initial configuration. Alternative explanations are sought to understand better why the production and consumption of textiles suddenly became of central interest to Anatolian societies during the Late Chalcolithic and following times.

Keywords: Turkey, Anatolia, Late Chalcolithic, textile production, flax/linen, wool, pastoral economy, social complexity

The publication of E. Barber's[2] seminal book on prehistoric textiles has given rise to a renewed interest in early Near Eastern and Mediterranean textile production.[3] The significance of textile production in the development of complex social and economic structures has been emphasised in a number of models describing this process. Very little comparable interest can be seen in the study of prehistoric Anatolia, despite the rich 'textile history' of the country – a fact very obvious to Barber herself. The present essay thus addresses two related issues, 1. it attempts to develop some clearer ideas about the nature of society in Late Chalcolithic Anatolia.[4] Following some earlier expressed doubt[5] whether metal can be seen as the primary motor of social change at this early stage (a discussion not repeated here), 2. the possible connection between textile production and the emergence of social complexity in prehistoric Anatolia will be investigated. I acknowledge the important contribution of a very stimulating paper by B. Arbuckle[6] which greatly helped to bring my own mulling over this issue to a preliminary conclusion – although it must be admitted that the interpretations presented here deviate both from Arbuckle's opinion and my own initial expectations.

Approaches to Social Evolution in Late Chalcolithic Anatolia

Our general understanding of the development of society in Anatolia has remained limited. This is especially true for the Chalcolithic period which has been marred with chronological problems.

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1 School of History, Classics and Archaeology, University of Edinburgh, Scotland; email: Ulf.Schoop@ed.ac.uk.
2 Barber 1991.
3 E.g. Nosch – Gillis 2007; Breniquet 2008; Völling 2008; Burke 2010; Michel – Nosch 2010; Good 2012; Nosch – Laffineur 2012.
4 In the context of the present paper, Anatolia is seen as the part of modern Turkey which is delimited by the Aegean seaboard and the Bosporus in the west and the Taurus Mountains in the east, including those of the eastern Aegean islands (now part of modern Greece), which were connected to the mainland in the past.
5 Schoop 2011a.
6 Arbuckle 2012a.

This, together with the limited number of sites which have been excavated and published, has made the development of abstract concepts difficult. It is therefore not surprising that the few attempts which have been made at shedding light on this issue have remained rather generic and necessarily limited by the amount of actual evidence. Eslick[7] made a noteworthy attempt to systematically apply a neo-evolutionary framework to the Anatolian situation. She saw early indications of social differentiation in the Late Chalcolithic, classifying the social model of this period as a low-level chiefdom. The argument was based on the presence of buildings (slightly) more substantial than neighbouring structures at Kuruçay and Bağbaşı, indications of specialised activity such as metalworking, and the existence of storage facilities. Elsewhere, the presence of complex social structures has been postulated for individual sites, often based on the existence of 'special' buildings and boundary walls. At early 5th millennium Güvercinkayası, these features are seen as an indication for an early urbanisation process while at Çadır Höyük the presence of a central authority is claimed.[8] Other scholars have taken a more sceptical stance on such architecture-based reconstructions and pointed out the possibility for alternative explanations in all these cases.[9]

It is probably fair to say that there is little unequivocal evidence for social differentiation during any stage of the Chalcolithic period so far – social elites, if existent, have remained tantalisingly elusive. On the other hand, there has been little coherent discussion concerning the specific nature of *any* kind of social organisation present in Anatolia between the 6th and the 4th millennia BC. An important factor to note is that societies west of the Taurus were on a very different societal trajectory during this period, as well as the following Early Bronze Age, when compared to contemporary developments in northern Syria and upper Mesopotamia.[10]

One crucial aspect has remained particularly underdeveloped in this discussion: the question of the economic basis underlying the possible emergence of complex social structures. One of the few voices addressing this matter notes the absence of economic changes necessary for such a development: "Indicators that point to the presence of a controlled surplus economy are totally absent. The settlements ... are small, being on the scale of villages, with no remains suggesting the presence of a ruling class that is in control of the economy. Nowhere to the west of the Taurus range, there are temples, monumental public buildings, communal storage facilities or socially differentiated buildings. ... This does not imply that there was not a ruling social group; but is seems evident that this ruling social body, whatever its social structure may be, ... was not interested either in the accumulation or in the distribution of commodities".[11] This statement contrasts dramatically with a recent analysis by B. Arbuckle[12] who investigated pastoral strategies followed at a number of central Anatolian sites. Arbuckle suggests the presence of a 'managerial elite', systematic surplus production and complex economic relationships for the Late Chalcolithic. He postulates the existence of stable social hierarchies, which were supported through an economy based on wool production. It appears attractive, therefore, to re-visit the evidence available for Chalcolithic economies in Anatolia as a whole and to inspect it for concurrent changes with developments in the social arena.

Approaches to Chalcolithic Economies: The 'Secondary Products Revolution' Model

One of the most influential scholars to produce a theoretical model for post-Neolithic societal development that was not primarily focussed on metallurgy was the late A. Sherratt. His concept

7 Eslick 1988.
8 Gülçur 2003; Steadman et al. 2007; Steadman 2011.
9 Schachner 1999, 62; Düring 2011a.
10 Özdoğan 2002; Çevik 2007; Özdoğan 2007.
11 Özdoğan 2002, 67–68.
12 Arbuckle 2012a.

of a 'Secondary Products Revolution' can be seen as the Chalcolithic paradigm *par excellence*.[13] Sherratt proposed the convergence of a collection of intensifying practices in animal husbandry which collectively transformed human societies in the Old World in fundamental ways. At the base of this development was an economic shift from an exclusively post-mortem use of domestic animals towards a permanent exploitation of the regenerative products of the living animals. These new techniques consisted of the extraction of caprine and bovine milk as sources of protein, the exploitation of animal muscle power for traction (transport and plough-assisted agriculture), and the use of sheep and goat as a source for textile fibre, replacing flax with wool. These innovations, although primarily economic in nature, affected the adopting societies in their entirety; they triggered changes in an interconnected web of aspects reaching from the economy and technology to social structure and ideology. The increasing significance of livestock made agriculturally marginal land accessible which in turn contributed to the rise of mobile pastoralism. Plough-assisted agriculture increased yield but also led to male domination of this sector (in contrast to earlier female-dominated hoe agriculture). The relegation of women to the domestic sphere simultaneously led to a decline of female status and to their availability as domestic manufacturers of value-added goods (such as textiles). Increased production, easier transport and the creation of a domestic labour force strongly supported the development of trade/exchange.[14]

Sherratt's model has been criticised on the basis of evidence pointing to an earlier existence of some of the components of the Secondary Products 'package'. In particular, the use of milk has now been shown to have extended far into the Neolithic. However, as Greenfield rightly points out, "in the Secondary Products Revolution model, the issue has never been when the innovations were first invented or introduced to a new area, but *when the scale of exploitation changed*".[15] Sherratt saw this development as a cumulative process which unfurled its 'revolutionary' power only with all components in place.[16] In his original view, this process was ultimately linked to the first steps toward urbanisation in Uruk Mesopotamia from the middle of the 4th millennium BC onward. From here, it spread through most of the Old World, affecting the adopting societies in similar ways but with differing results that were dependent on local conditions. The link to Uruk Mesopotamia and the use of the term 'revolution' explicitly refer back to V. G. Childe's concept of the global significance of the Urban Revolution.[17]

The 'Secondary Products Revolution' model thus places one of the most significant steps in the formation of Old World economies into a usually disregarded time period. It offers a coherent explanation for a large number of interrelated changes which can be observed during this time and most of its supporting arguments can be tested on multiple levels. Finally, the model has proved flexible enough to accommodate a number of changes in its premises that have been necessitated by progress in archaeological research since its original formulation.

Turning to our specific topic of interest, Sherratt's time-line for the changes in the textile industry has remained surprisingly intact, although the exact circumstances of the emergence of woolly breeds of sheep are still unclear.[18] One notes, however, that Sherratt seems to have been much less interested in the topic of wool-production than in the other two 'families' of secondary products, milking and traction. For Sherratt, wool was essentially a product of agriculturally marginal areas and mainly produced for exchange. The rise of a wool-processing work-force appears more a consequence than a moving factor within the general framework of changes caused by the Secondary Products Revolution: "One factor which favoured the expansion of textile production was the

13 Sherratt 1981; Sherratt 1983. For recent discussion of the concept and the integrity of the model, see Greenfield 2010; Halstead – Isaakidou 2011; Marciniak 2011.
14 Sherratt 1981, 285–299.
15 Greenfield 2010, 43 (emphasis in the original).
16 Sherratt 1997, 237.
17 Sherratt 1997, 498.
18 Greenfield 2010, 35–37.

change to a predominant male role in agriculture, leaving women free to spin and weave".[19] While Sherratt went to great lengths to integrate wool *production* into his general model, he paid very little systematic attention to the question of where the sudden general *demand* for woollen textiles originated from – which would seem a rather crucial aspect of this part of the model.

Caprine Wool in Mesopotamia – 'The Fibre Revolution'

Following the formulation of the Sherratt's model, the socio-economic impact of early textile production has seen relatively little attention. An important exception is an influential paper published by J. McCorriston in 1997. Its title, 'The Fibre Revolution', already shows that the angle from which the paper has been written is equally 'Childean' in character. Without specific reference to the 'Secondary Products Revolution', McCorriston attempted to model the adoption of wool production in southern Mesopotamia. Based on the appearance of a larger and more robust breed of sheep in Late Uruk contexts (possibly introduced from the Iranian plateau), the introduction of wool fibre is dated to the middle of the 4th millennium BC when it largely replaced the earlier production of flax fibre. This development triggered a number of changes in economic and social relations which are intimately connected with the emergence of the state at this junction.

McCorriston suggests that the herding of wool-bearing sheep on agriculturally marginal land would have created new opportunities for surplus production. The cultivation of flax required the allocation of prime agricultural land and considerably more labour input in nearly all steps of fibre production than wool. The transition to animal fibre allowed the re-allocation of highly productive agricultural land to cereal crops; labour formerly dedicated to flax cultivation could now be partly re-invested within the household: "Within households relying on marginal agricultural land, labour freed from producing fibre might have been diverted to producing surplus textiles for exchange. Such a strategy would have triggered specialization in textile craftsmanship".[20] Later conditions suggest that these domestic specialists were female.

This process was accompanied by a general transition from corporate, lineage-based possession of resources to individual property rights which resulted in a part of the population losing access to land. The last stage of this process and the great interest in wool production by palace institutions are relatively well-documented in the earliest Mesopotamian records: wool-based textile production became subject to temple and palace control, and these institutions employed a labour force of low-paid and low-status female textile workers (mirroring a generally declining position of women in society). Thus, textile production and its appropriation by state institutions played a critical role in the emergence of urban society – there is a direct link between a (wool-based) textile industry and social complexity.

Similar to Sherratt, McCorriston argues that the introduction of animal-based textile fibres had drastic social and economic implications which led to agricultural intensification, increased significance of the pastoral sector and growing pressure on land rights. Both models hold that the intensification of textile production had a strongly detrimental effect on female status in society. We note that McCorriston also regards textiles as products with evident use-value, seeing no need to investigate the increased demand for this commodity. Ignoring the disagreements relating to certain aspects of Sherratt's and McCorriston's arguments,[21] we need to ask ourselves how far this discussion may inform us about social processes in Chalcolithic Anatolia.

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19 Sherratt 1981, 283.

20 McCorriston 1997, 525.

21 On Sherratt see Halstead – Isaakidou 2011, and earlier discussion from Bökönyi 1994. On McCorriston, see the comments following her paper: McCorriston 1997, 535–544.

Anatolian Chronology and the Beginning of the Late Chalcolithic Period

Our picture of the chronological sequence in Anatolia has changed quite dramatically over the last decade.[22] This concerns, firstly, the extension of the period which has turned out to be significant longer than initially anticipated, and secondly, the relative position of many of the known sites to each other which has become much clearer than before. It has also become apparent that the current terminology is not extremely well suited to describe the major historical trends. The concept of an Anatolian 'Chalcolithic' is a particularly problematic one since it has never been properly defined and its transitional dates have been established at different times and were based on differing criteria.[23] Thus, it would be wrong to see the Anatolian Chalcolithic as a unified period with a specific character. The Early Chalcolithic is essentially a continuation of Neolithic traditions without a major break. At the transition into the Middle Chalcolithic period, sometime in the second half of the 6th millennium, we see a partial disturbance of this post-Neolithic world whose most obvious result is the establishment of stronger links with the southern Balkans, especially apparent in pottery shapes and decoration. It is at present still difficult to understand the causes and implications of this phenomenon which clearly included an ideological component. At the same time, many earlier local features survived these changes. Thus, the 5th millennium exhibits both idiosyncratic characteristics and indications for continuity. A better understanding of this pivotal period will certainly be one of the major challenges for future research.

The end of this phase in the last centuries of the 5th millennium BC is a fundamental turning-point in Anatolian prehistory. It is at this junction, marking the beginning of the Late Chalcolithic, when most of the trajectories that had their origins in the Neolithic were discontinued and replaced by the establishment of new, long-term structures which continued into the Early Bronze Age without a major disruption. Besides a clear typological break in material culture, many sites are now found in new locations, often at the base of mounds that continued to be inhabited into the Bronze Age.[24] New social practices emerge such as commensal drinking and a more bellicose ideology. There are also important developments in the field of metal technology. However, one of the most significant changes occurs in the field of textile use.

Textile Remains in Prehistoric Anatolia

Among the oldest textile finds in the Near East, only a few have proven to be made from animal fibre. These early woollen remains all date to the 4th and the transition to the 3rd millennium BC and include the finds from the Cave of the Treasure in Nahal Mishmar, the fragments from the 'Royal Tomb' at Arslantepe VIB in the Malatya plain and the Novosvobodnaya Kurgan 2 in the northern Caucasus.[25] Only at the Late Neolithic site of Sabi Abyad in northern Syria has a case for earlier wool use been made, although this is based on indirect evidence.[26]

Very little has been written on prehistoric Anatolian textile production thus far and the small body of available literature is mainly concerned with the 3rd millennium BC.[27] Actual textile remains from pre-Bronze Age contexts have remained scarce. The oldest known examples derive from Çatalhöyük where a large number of textile fragments have been found. These were identi-

[22] For more detail on chronological issues, see Schoop 2005; and contributions by different authors in Steadman – McMahon 2011.
[23] Schoop 2005, 14–17; Schoop 2011b, 150–152.
[24] Cf. Özdoğan 1996; Özdoğan 2002.
[25] Bar-Adon 1980; Shishlina et al. 2003; Frangipane et al. 2009.
[26] Rooijakkers 2012.
[27] Balfanz 1995; Baykal-Seeher – Obladen-Kauder 1996, 214–245; Richmond 2006; Firth 2012.

fied as linen[28] and Burnham[29] comments on the remarkable quality of the fabric. All of the fragments were associated with burials of the mid-7th millennium BC; many pieces belonged to cloth used to wrap individual bones in collective graves.[30] One 'ball of fine cloth' was used to stuff the interior of a human skull.[31] Dating to the end of the 7th millennium BC are minute mineralised textile remains adhering to the shoulder of a terracotta figurine found at Ulucak Vb. These were probably remnants of the fabric used to wrap the figurine.[32] The nature of the fibres is not indicated. At Late Chalcolithic Kuruçay Höyük, the bones of an infant in a grave vessel appear to have been wrapped in woven cloth. More grave vessels contained the dissolved remnants of similar fabrics.[33] The final example is from the grave of a young child in Alişar Höyük Level 13 (4th millennium BC) which contained the remains of woven fabric.[34] While the identification of these remains as linen was only tentative and not based on strong evidence, the textile experts consulted by H. H. von der Osten were surprised by the fine quality of the fabric and the complex weaving technique employed.[35]

Flax in Early Anatolian Agriculture

Looking at the available 'raw materials' exploited for Anatolian textile production, we may turn to plant-based fibre supply first. The number of archaeobotanical investigations available for prehistoric Anatolia is not extensive. In Çatalhöyük East, flax represents only a very minor part of the assemblage,[36] despite the fact that linen textiles have been found at the site. Apart from this, evidence for flax cultivation is conspicuously absent from all investigated Neolithic and Early Chalcolithic sites around the central Anatolian plain and in the Lake District.[37]

In the Marmara region, flax has been recognised in Ilıpınar IX and VIII, i.e. in contexts belonging to the Fikirtepe Culture.[38] Flax continued to be important during the following phases, and toward the middle of the 6th millennium BC, "flax ... seems to belong to the staple crops of Ilıpınar. ... Both the sample frequencies and the number of recovered flax seeds indicate that this crop was most probably cultivated on a reasonable scale during Phases VI–VB".[39] Based on the small size of the seeds, Cappers argued that they belonged to a strain cultivated for its fibres rather than the oil.[40]

In the Troad, flax is present in the earlier 5th and the later 4th millennia BC. At both Middle Chalcolithic Kumtepe A and Late Chalcolithic Kumtepe B, *linum* seeds are present in small amounts.[41] Flax seeds also appear in the 'Chalcolithic levels' of the site Çukuriçi Höyük near Ephesus.[42] In Late Chalcolithic Kuruçay, there is evidence for intensive (or at least long-established) use of

28 Ryder 1965.
29 Burnham 1965, 171.
30 Helbaek 1963; Mellaart 1967, 205, 211, 219.
31 Mellaart 1967, 204.
32 Çilingiroğlu 2009, 15–17, fig. 7.
33 Duru 1996, 24, pl. 51.1.
34 Von der Osten 1937, 48, 50, 51, figs. 58, 60.
35 Fogelberg – Kendall 1937.
36 Fairbairn et al. 2002, 47; Fairbairn 2005, 199.
37 Cf. Nesbitt – Martinoli 2003, 32, tab. 4.
38 Van Zeist – Waterbolk-van Rooijen 1995, 161, 164–165.
39 Cappers 2008, 128.
40 Cappers 2008, 125.
41 Riehl 1999a, 104, 150; Riehl 1999b, 399, fig. 35.
42 Thanheiser in Horejs 2008, 103.

flax as it was accompanied here with substantial numbers of specialised flax weeds.[43] Flax is also mentioned in passing as part of the botanical assemblage in prehistoric Aphrodisias-Pekmez.[44]

In the northern part of the Anatolian plateau, flax seeds have been found at the Late Chalcolithic sites of Çadır Höyük and Çamlıbel Tarlası.[45] At İkiztepe, near the Black Sea coast, flax appears regularly from the beginning of settlement in the Middle Chalcolithic onward.[46]

Despite the restricted scope of the archaeobotanical data, current evidence indicates that flax cultivation was practiced on a limited scale in most Anatolian regions throughout the Chalcolithic period. The lack of evidence for flax cultivation in the preceding periods is of interest as this appears to correspond to an absence of fibre-processing tools (see below).

Pastoral Strategies in the Anatolian Chalcolithic

The question of Chalcolithic pastoral strategies specifically aimed at wool production has so far only been raised by Arbuckle.[47] Based on a comparative analysis of three faunal assemblages from central Anatolia, Arbuckle describes a number of important developments within a generally increasing significance of sheep. At mid-6th millennium BC Köşk Höyük, sheep and goats were apparently kept predominantly for the production of meat and therefore slaughtered at a young age – hardly any male sheep reached adult age. This pattern changed in the Middle Chalcolithic (early 5th millennium BC) when the proportion of caprids in the faunal spectrum rises to over 80%. At this time there is an overall increase in the survival rate of sheep into adult age, with a certain bias toward ewes. This has been interpreted as representing a strategy aimed at a mixture of primary and secondary products, especially milk. A very similar pattern was also noted at the contemporary site of Güvercinkayası.

While Köşk Höyük and Güvercinkayası are situated in Cappadocia, the third site lies in a different environmental zone further to the north. At mid-4th millennium BC (Late Chalcolithic) Çadır Höyük, caprids account for c. 48% of the faunal spectrum and almost all sheep reached adult age. The demographic profile for sheep shows a pronounced survivorship of large adult males who are the principal producers of wool: “Because large numbers of rams and wethers are not needed for herd reproduction and because these animals compete with reproductive females for grazing and fodder resources, this strategy indicates that LC herders were willing and able to invest significant resources in the production of wool as a surplus commodity”.[48] Arbuckle is convinced that the scale of wool production exceeded local needs: “... sheep management practices at Çadır suggest considerable investment in the intensive production of wool, likely as a commodity rather than for local household production”.[49] The information from Çadır Höyük is so far the best prehistoric faunal assemblage indicative of a sheep-rearing strategy aimed at wool production. Unfortunately, the broad chronological gap between Late Chalcolithic Çadır Höyük and Middle Chalcolithic Güvercinkayası/Köşk Höyük makes it difficult to estimate the timing of this transition.

We lack comparable clarity for the rest of Anatolia, though there are several other faunal assemblages that can be assessed. A small faunal assemblage from mid-6th millennium Boğazköy-Büyükkaya shows a high percentage of caprids (68%), among which sheep are slightly in the majority. Adult animals are well represented and most of these are female.[50] The 4th millennium

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43 Nesbitt 1996.
44 Joukowsky 1986, 31.
45 Smith 2007, 182; Papadopoulou – Bogaard 2012, 127–128.
46 Van Zeist 2003, 551, 574.
47 Arbuckle et al. 2009; Arbuckle 2012a.
48 Arbuckle 2009, 187.
49 Arbuckle 2012a, 309.
50 Von den Driesch – Pöllath 2004, 3–4.

BC hamlets Çamlıbel Tarlası and Yarıkkaya deviate from the pattern established for Çadır Höyük and show a pastoral economy mainly based on cattle and pig. Among the Çamlıbel Tarlası caprids (around 20%) sheep clearly predominate. More sheep than goats survived into adult age, indicating that secondary products were clearly important.[51] On the western limit of the plateau in Orman Fidanlığı, sheep played a key role in the first part of the sequence (6th millennium BC) and were apparently raised for their meat. Uerpmann comments on the exceptional size of the sheep at Orman Fidanlığı. At this time goats were in the minority and likely used for milking. Later, in the 4th millennium BC, the hunting of wild equids became the dominating feature of the economy.[52]

In the Anatolian southwest, at Aphrodisias-Pekmez (late 5th/early 4th millennium BC), caprids represent a third of the assemblage while hunted red deer account for another 31%. About half of the caprids reached adulthood and goats outnumber sheep by about 2:1.[53] In 4th millennium BC Bağbaşı, caprids represent about one third of the small faunal assemblage. Sheep are better represented than goats and show signs of use for secondary products.[54]

On the Aegean coast, the late 7th/early 6th millennium BC levels at Ulucak revealed an overwhelming focus on caprids in the faunal assemblage (c. 80%), within which sheep dominate with a factor of 3:1. According to Çakırlar,[55] the age profile suggests slaughtering for meat for the older part of the sequence. Towards the middle of the 6th millennium this changes to a pattern indicative of milk production. At Çukuriçi Höyük near Ephesus, on the other hand, caprids increase in numbers from the end of the Early Chalcolithic onward, reaching their maximum population in the Early Bronze Age.[56] In the northern Aegean, at Kumtepe, there is a pronounced shift in the pastoral economy between the early 5th and the late 4th millennia BC. However, we do not see an increase in the significance of sheep or goats. Instead, a predominance of cattle in Kumtepe A (which was also noted in roughly contemporary contexts at Beşik-Sivritepe) is replaced by an increased use of pig in Kumtepe B. A faunal pattern with an emphasis on sheep-rearing does not appear in this area before the onset of the 3rd millennium BC.[57]

In the Marmara region, some of the early 6th millennium BC sites such as Upper Menteşe and Ilıpınar X show a very strong reliance upon caprids in combination with a herding strategy aimed at the exploitation of milk.[58] At early 4th millennium Barcın Höyük, caprids also played an important but by no means dominating role. While cattle were obviously kept for secondary products, the age profile of caprids is much closer to a herding strategy aimed at the exploitation of meat with a smaller portion kept for secondary products. As in the Troad, a distinguishing factor is the increasing significance of pig keeping.[59]

Obviously, environmental diversity and chronological distance make it difficult to discern clear trends in the small number of analysed assemblages although some general observations may still be made. Caprids were an important component at all settlements throughout the period; only Ulucak produces high caprid percentages comparable to the central Anatolian assemblages, and only Çukuriçi appears to display a linear quantitative increase of caprids over time. With few exceptions (Aphrodisias-Pekmez), sheep are better represented than goats and almost all reports mention clear signs for strategies aimed at the exploitation of sheep for secondary products. There was considerable regional and chronological diversity in the pastoral strategies employed during the period in question. Many sites of the early 6th millennium BC appear to rely strongly on small-stock raised for meat and milk (e.g. Ulucak, Ilıpınar, Menteşe, Orman Fidanlığı, Büyük-

51 Boessneck – Wiedemann 1977; Bartosiewicz – Gillis 2011.
52 Uerpmann 2001.
53 Crabtree – Monge 1986.
54 Hesse – Perkins 1974.
55 Çakırlar 2012, 13–18.
56 Galik in Horejs 2008, 101–102; Horejs et al. 2011, 54–59.
57 Boessneck 1986, 330–331; Uerpmann 2003, 253–254.
58 Thissen et al. 2010.
59 A. Galik in Gerritsen et al. 2010, 209–210.

kaya). While this was often followed by inventories with balanced proportions of the important domesticates, some communities concentrated on cattle for secondary products and pig for meat (e.g. Kumtepe, Barcın, Çamlıbel Tarlası, Yarıkkaya). In northwest Anatolia, in particular, there appears to have been a noteworthy disinterest in caprids during the 5th and 4th millennia BC. Throughout the Chalcolithic, certain communities specialised in the harvest of locally plentiful natural resources – marine (Beşik-Sivritepe, Fikirtepe)[60] or terrestrial (red deer in Pekmez, equids at all sites surrounding the central Anatolian plain) – in addition to livestock-breeding.

There may be a general trend of increasing survivorship of adult sheep through time; this trend continues into the Bronze Age and is noted at all sites where Bronze Age layers follow such of the Chalcolithic period. Since crucial information on the sex ratios within the ovicaprid populations is almost entirely lacking, it is very difficult to relate any of this evidence to the existence or inception of pastoral strategies based on wool exploitation. Certainly, the situation is not incompatible with Arbuckle's general conclusion of the appearance of a wool-based economy in the Late Chalcolithic. There is, however, little indication for a drastic increase in the *scale* of caprine pastoralism which would seem a precondition for the existence of tribute-collecting 'managerial elites' or even systematic production for external markets at this stage.[61] Wool-production (if such there was) could have been only one of many pastoral strategies concurrently followed by Late Chalcolithic communities in Anatolia.

An important factor, long noted in the discussion surrounding the Secondary Products Revolution, is that sheep and goats are not naturally suited as producers of wool. The fleece of these animals had to be improved by selective breeding, a long and complex process which went through several distinctive stages. Fully improved breeds of fleece-bearing sheep were probably not in existence before the Iron Age.[62] It is still difficult to trace the spatial and chronological development of this artificial process based on the physical remains of the animals themselves or more indirect evidence. It is mostly assumed that the initial improvement of fleece-bearing sheep took place on the Iranian plateau or in the southern Caucasus, possibly in the 5th/4th millennia BC, and that these breeds spread from there.[63] The appearance of a distinctively new breed of sheep has not been claimed at any Chalcolithic site in Anatolia so far. A remarkable change in body size has been noted at several central Anatolian sites at the beginning of the 2nd millennium BC. Von den Driesch and Pöllath[64] suggest that this points to a very late introduction of woolly sheep into Anatolia. It appears more likely, however, that the phenomenon (observed at several of the major Middle Bronze Age centres) was caused by the more systematic approach which the emerging state institutions took toward wool production (see below). Exotic breeds of sheep in prehistoric Anatolia, if present, seem morphologically less conspicuous than elsewhere. The first woolly sheep which arrived in Anatolia must have been still relatively primitive and probably had not yet entirely lost their coarse overcoat, the kemp. The wool was harvested by plucking or combing during the spring moulting period, and the yield per animal must have been considerably lower than at later times.[65]

Textile Tools – Spindle Whorls and Loom Weights

Intensification of a technically complex practice such as textile production should find a reflection in material culture. Like in many similar cases, the processing of animal or plant fibres is possible with relatively simple tools which leave little or no trace in the archaeological record. The ques-

60 Boessneck – von den Driesch 1979.
61 Cf. Arbuckle 2012a, 310.
62 Ryder 2005.
63 E.g. Benecke 1994, 136–142, 231–234; von den Driesch – Pöllath 2004, 22.
64 Von den Driesch – Pöllath 2004, 21–23.
65 Ryder 2005.

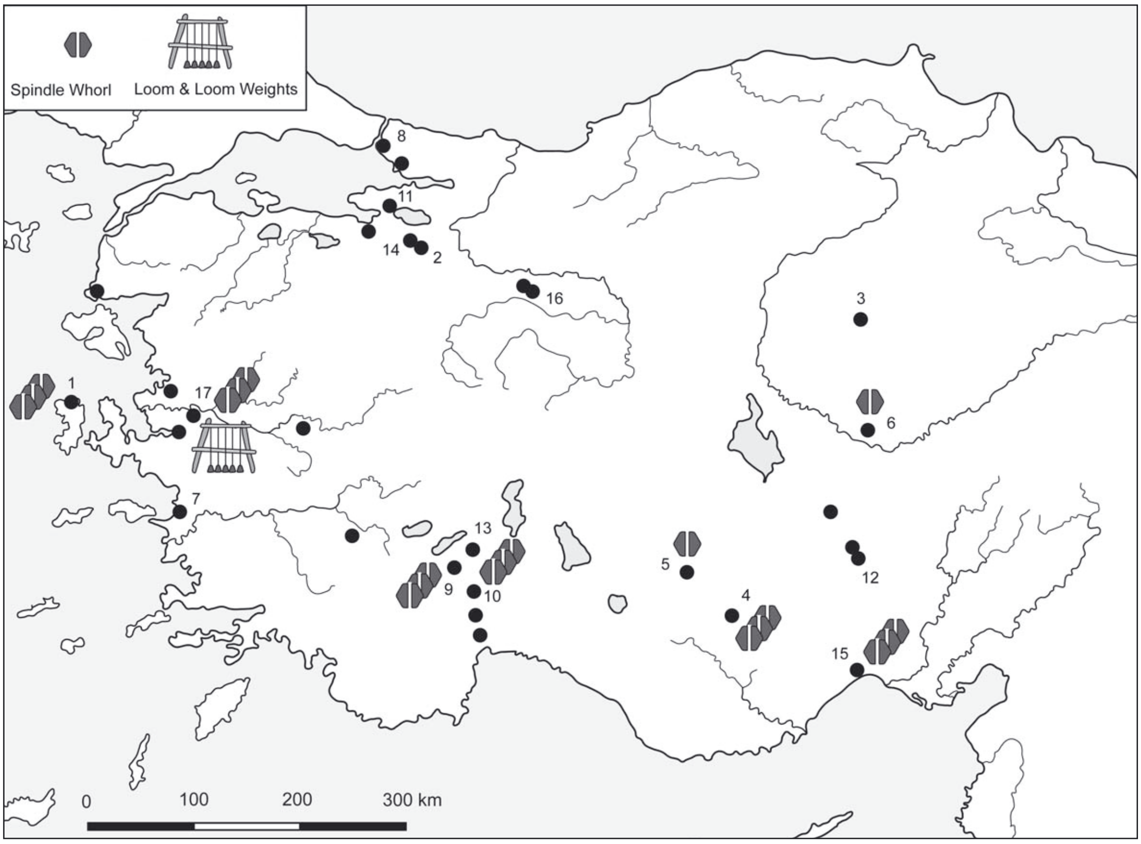

Fig. 1 Distribution of textile tools and sites mentioned in the text until c. 5500 BC. 1. Ayio Gala; 2. Barcın Höyük; 3. Büyükkaya; 4. Canhasan; 5. Çatalhöyük; 6. Civelek; 7. Çukuriçi Höyük; 8. Fikirtepe; 9. Hacılar; 10. Höyücek; 11. Ilıpınar; 12. Köşk Höyük; 13. Kuruçay; 14. Menteşe; 15. Mersin-Yumuktepe; 16. Orman Fidanlığı; 17. Ulucak (map: U. Schoop).

tion of beginnings is therefore always difficult to answer, especially when the finished products are of perishable nature. Since we are not so much interested in the *beginnings* of fibre production, however, it may be argued that only the *regular* execution of certain activities requires the use of formalised equipment. The warp-weighted loom, in particular, is a complex apparatus which requires considerable effort, knowledge and skill to construct and to operate. We may therefore reasonably expect a change in the scale of textile production to be marked by a noticeable increase in the frequency and quantity of formal tools associated with this industry, notably spindle whorls and loom weights.

Hardly any artefacts relating to textile production are known from the early Neolithic phases despite the fact that some production must have taken place at this time. A single spindle whorl is reported from Çatalhöyük.[66] It is not until the Late Neolithic (the end of the 7th millennium BC) that the first such tools make a somewhat more regular appearance, albeit in very low frequency (Fig. 1).[67] The evidence appears to be mainly restricted to the Lake District and the southern part of the Aegean coast. A number of clay spindle whorls were discovered in Hacılar VI and in Ulucak Vb.[68] Isolated finds are known from Kuruçay 12–7 and the caves of Ayio Gala.[69] From the re-

66 Mellaart 1967, 211.

67 The 'Early Neolithic' spindle whorls from Suberde cited by: Barber 1991, 51 no. 8 are from a mixed surface context and most likely considerably younger. See Bordaz 1969, 51.

68 Mellaart 1970, 164; Çilingiroğlu 2009.

69 Hood 1981, 64, 66, 72; Duru 1994, 67.

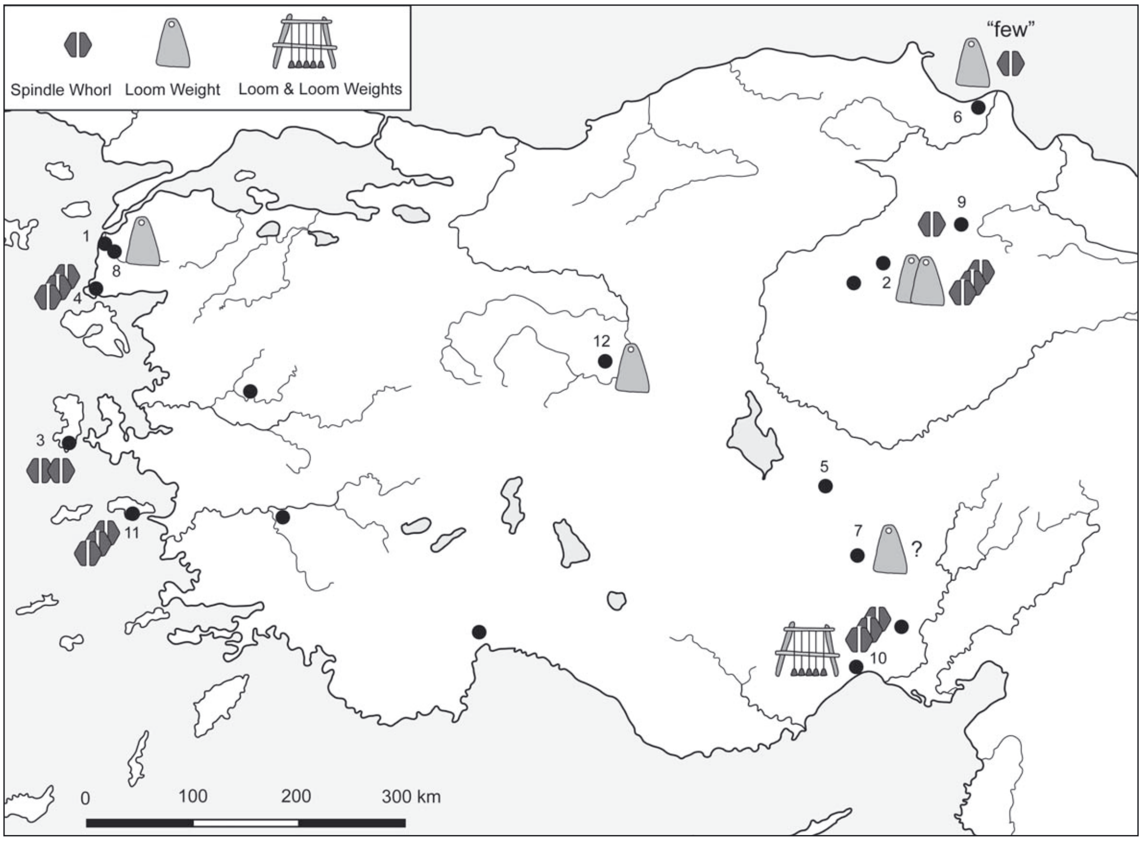

Fig. 2 Distribution of Middle Chalcolithic textile tools and sites mentioned in the text (c. 5500–4250 BC). 1. Beşik-Sivritepe; 2. Büyük Güllücek; 3. Emporio; 4. Gülpınar-Chryse; 5. Güvercinkayası; 6. İkiztepe; 7. Köşk Höyük; 8. Kumtepe; 9. Kuşsaray; 10. Mersin-Yumuktepe; 11. Tigani; 12. Yazır Höyük (map: U. Schoop).

gions surrounding the central plain, we have a few spindle whorls from Canhasan 2B and 2A and a single piece from the Civelek Cave, all dating around the middle of the 6th millennium BC.[70] In Mersin-Yumuktepe, spindle whorls do not occur before layer XXIV with a similar absolute date of the mid-6th millennium BC.[71] Ulucak (Layer IVb, dated 5900–5800 BC) is the only site with loom weights; and their concentration within a single building may indicate the placement of a loom.[72] The peculiar 'donut' shape of the Ulucak weights is unique to this site.

During the Middle Chalcolithic, objects related to textile production still mainly occur as isolated finds (Fig. 2). Two important developments can be observed at this time: such tools now make their appearance in the Anatolian north, and loom weights are somewhat more frequent. The latter show the typical conical to drop-like shape with a single horizontal perforation at the narrow end which remains the standard for the next two millennia (cf. Fig. 4). Most of these finds post-date 5000 BC, including a number of spindle whorls from Emporio IX/VIII and from Tigani II/III.[73] In the Troad, four spindle whorls were found at Gülpınar-Chryse while a single fragmentary loom weight was found at Kumtepe A.[74] Another loom weight from the lower levels at Yazır Höyük[75] demonstrates weaving on the western plateau. Further examples were found in the Çorum

70 Schachner et al. 1997; French 2010, 43, 123, 126.
71 Garstang 1953.
72 Çilingiroğlu 2009, 14, 15, fig. 5.
73 Hood 1981, 637, 674; Felsch 1988, 133.
74 Sperling 1976, 326; Takaoğlu 2006, 307.
75 Temizer 1960, 157, pl. 45.6.

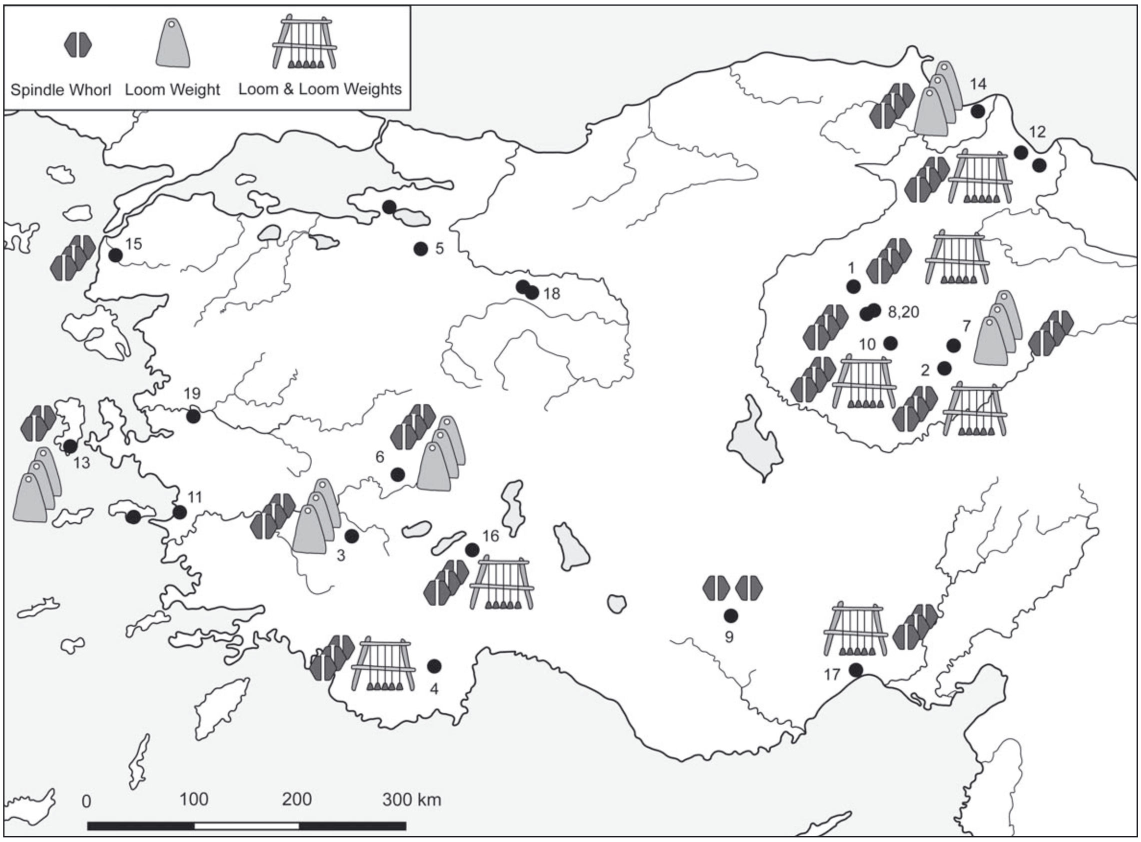

Fig. 3 Distribution of Late Chalcolithic textile tools and sites mentioned in the text (c. 4250–3000 BC). 1. Alaca Höyük; 2. Alişar Hüyük; 3. Aphrodisias-Pekmez; 4. Bağbaşı; 5. Barcın Höyük; 6. Beycesultan; 7. Çadır Höyük; 8. Çamlıbel Tarlası; 9. Canhasan; 10. Çengeltepe; 11. Çukuriçi Höyük; 12. Dündartepe; 13 Emporio; 14. İkiztepe; 15. Kumtepe; 16. Kuruçay; 17. Mersin-Yumuktepe; 18. Orman Fidanlığı; 19. Ulucak; 20. Yarıkkaya (map: U. Schoop).

Province: four spindle whorls and two loom weights are recorded at Büyük Güllücek with one additional stone whorl recorded at Kuşsaray.[76] Only a small number of spindle whorls and loom weights are reported from the earlier phases at İkiztepe. While such artefacts are not yet mentioned in the preliminary reports from Güvercinkayası, an unknown number of loom weights are mentioned for Köşk Höyük.[77] Loom weights occur in Mersin-Yumuktepe from level XVII onward. An accumulation in the corner of a collapsed house belonging to the following layer XVI (which has central Anatolian connections) is the only indication for a loom placement from this period.[78]

With the onset of the Late Chalcolithic during the last centuries of the 5th millennium BC this picture changes dramatically (Fig. 3). Almost all sites belonging to the Late Chalcolithic have produced objects relating to textile production, most of them in large quantities. Nearly every site has loom weights in addition to spindle whorls, and a fair number of sites have produced contextual evidence for the existence of actual looms. Already the oldest contexts from Aphrodisias-Pekmez and Beycesultan exhibit a rich assemblage of spindle whorls and loom weights.[79] At İkiztepe on the Black Sea, these artefact classes increase abruptly in the Late Chalcolithic.[80]

76 Koşay – Akok 1957, 42; Koşay 1968, 92.
77 Silistreli 1989, 462.
78 Garstang 1953, 139.
79 Lloyd – Mellaart 1962, 269, 275; Joukowsky 1986.
80 The increase is said to occur in the 'EBA II' layers of the site. See Alkım et al. 2003, 56, 148. For the probable absolute dating of the İkiztepe 'EBA II' to the 4th millennium BC, see Thissen 1993; Schoop 2005, 320, 331–332.

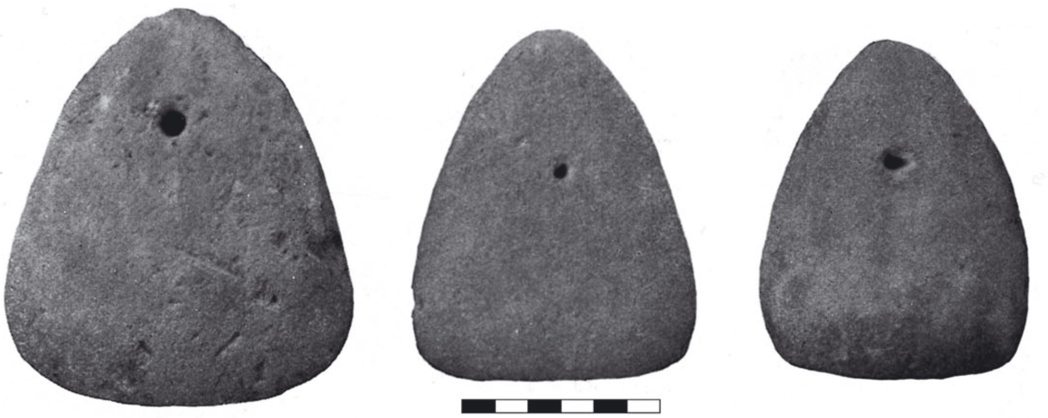

Fig. 4 Loom weights from Late Chalcolithic Alişar Hüyük (after von der Osten 1937, fig. 99; by permission of the Oriental Institute, University of Chicago).

Most of the evidence for looms originates from a later stage of the 4th millennium. Concentrations of loom weights in the interior of houses are accepted here as such evidence.[81] From the Late Chalcolithic layers at Alişar 'several nests' of conical to drop-shaped loom weights are reported (cf. Fig. 4). One group of nine such weights were found together on the floor, at the foot of a wall within a room in Level 13.[82] At Alaca Höyük, in a context containing Alişar-type Late Chalcolithic pottery and, therefore, probably dating to the later 4th millennium BC, a group of 27 drop-shaped loom weights was found together.[83] Many more loom weights of the same type are catalogued as individual finds. At Çengeltepe, another site in the Yozgat Province, a group of 13 loom weights together with spindle whorls and a number of perforated sherds were found on the floor of a burnt house.[84] At Dündartepe (Summit), near Samsun at the Black Sea coast, a group of 45 loom weights were found together in the ruins of another burnt building and spindle whorls made from clay and bone are said to be very common.[85] The associated material culture from this site corresponds to the Late Chalcolithic ('EB II') phase at İkiztepe.[86]

In the southwest Anatolian Lake District, Eslick reports a probable loom emplacement in the interior of one of the few houses at Bağbaşı.[87] Several drop-shaped loom weights were found in this area and were accompanied by more than a dozen spindle whorls. In Late Chalcolithic Kuruçay, more than 100 loom weights were found in the debris of two buildings, indicating loom placements at the time of their destruction.[88] Spindle whorls made from clay and bone are very numerous at Kuruçay – frequent use left many of these with glossy surfaces.[89] In Mersin-Yumuktepe XIIB, Garstang found a group of loom weights and spindle whorls associated with a low platform in the corner of a room. He regarded this arrangement as the remains of a 'weaver's workshop'.[90]

81 Çilingiroğlu 2009, 14, referring to Barber 1991, 101–102, correctly points out that concentrations of weights do not necessarily represent remains of the collapsed looms themselves but that such weights could equally well have been stored belonging to inactive or even dismantled looms. The Anatolian cases are generally not documented in sufficient detail to distinguish between these alternatives. For our present purpose, however, it does not really matter whether a particular loom was active or not at the time when the weights entered the archaeological record.

82 Von der Osten 1937, 39, 42, 93, 96, figs. 44, 99.

83 Koşay – Akok 1966, 216.

84 Ünal 1966.

85 Kökten et al. 1947, 374.

86 Thissen 1993.

87 Eslick 1992, 35–36, 47.

88 Duru 1983, 24, pl. 18.2.

89 Duru 1996, 53, 55.

90 Garstang 1953, 172–173, fig. 110.

Thus, the distribution of the Late Chalcolithic finds heavily clusters in the mountain zones in southwest and north-central Anatolia. Hardly any tools related to textile production are known from the region around the Sea of Marmara; neither spindle whorls nor loom weights are reported from the early 4th millennium BC layers at Barcın Höyük near Bursa.[91] From Canhasan Layer 1 on the southern margin of the central Anatolian plain, only two questionable spindle whorls are known.[92]

On the basis of the artefactual evidence, we can state with some confidence that there was indeed a massive surge in textile-related activity during the 4th millennium which coincides with the major re-adjustments in material culture that mark the beginning of the Late Chalcolithic period. This indicates a fundamental change in textile production which penetrated Anatolian society down to the single-site level – possibly even to the single-household level. This 'revolutionary' development was preceded by a formative phase in the 5th millennium during which its spatial and technological foundations were laid. Reversely, it can be concluded that woven fabrics, despite existent, did not play a major role in Anatolian society prior to the end of the 5th millennium BC.

The archaeozoological evidence from Çadır Höyük and the 4th millennium wool finds from neighbouring regions strongly support the assumption that this strategy was based on animal rather than plant fibres. It is therefore quite likely that this shift signifies the beginning of a wool-based textile industry. At the same time, the low-level signal of flax in the botanical assemblages typical for the earlier periods continues unchanged into the 4th millennium and shows that the production of plant fibres was not abandoned. Finally, the negative archaeozoological and artefactual data from Barcın and Orman Fidanlığı may indicate that the new strategy was not picked up in all Anatolian regions simultaneously.

Social and Economic Implications

But what actually occurred during this crucial juncture? The developmental sequence of the woollen textile industry comprises a number of contradictions. One of the most interesting questions is where the sudden demand for large quantities of woven fabrics came from. Implicit in the previously described models is the self-explanatory, factual need for woven garments. It is quite difficult to see in our case where such a need arose from. The infilling of the Anatolian landscape was already completed in the 6th millennium BC, including the more climatically challenging highland areas on the plateau – woollen underwear was apparently not a necessary prerequisite. As shown by the mid-4th millennium BC Alpine Iceman 'Ötzi', complex clothing efficient in cold environments is perfectly possible without the use of woven fibre.[93] We may even ask whether the early history of woven fabric was about costume at all – certainly none of the admittedly small number of early textile finds originate from ancient garments.

If woollen clothing was not a necessary ingredient of Late Chalcolithic life, why did people invest so much effort into the production of woven fabric? A linen-based textile industry was already in place for considerable time, and it appears – most significantly – to continue unchanged into the Late Chalcolithic. Despite this, we observe the entry of a new source of fibre, implying an overall increase in the scale of textile production above previous levels. This increase is accompanied by a specialised tool-kit which is now in general (rather than sporadic) use. Since we see here an investment into a practice without an obvious adaptive benefit, it is likely that this new practice belongs to the sphere of social relations.

What, then, are the social and economic implications of such behaviour? This is an especially pertinent question when taking into account the apparent absence of an elite layer in Late Chal-

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91 Gerritsen et al. 2010.

92 French 2010, 123–124.

93 Goedecker-Ciolek in Egg – Spindler 1992, 100–113; cf. Winiger 1995.

colithic society who would have been eager to encourage systematic surplus production. The production of animal fibre requires the presence of a number of animals kept outside subsistence requirements; since rams and wethers are the primary producers of wool the potential for multiple-use strategies is relatively limited. This implies an over-all increase of animal numbers. Upkeep and feeding of these animals must have required extra labour (as low-level flax production continued) and the availability of extra land, marginal or not.

Wool obviously represented a surplus product with the potential for accumulation (which is somewhat limited by its perishable nature). There is, therefore, also a certain potential for tribute extortion and redistribution practices. It would have been quite difficult, however, to control the production and distribution of the output of such a strictly domestic industry which did not require specialisation above the levels required in a domestic setting. It is quite significant that no *relative* increase in sheep numbers in proportion to the remaining domestic species is observable at this time. This means that although overall numbers of livestock may have somewhat increased, there was no systematic attempt at surplus maximisation such as can be observed in later periods. Essentially, we seem to be confronted with a strategy that was not primarily aimed at the establishment and preservation of vertical social structures.

West African Textile Economies

Such behaviour is not without parallels elsewhere. For example, the significance of textiles has been documented in considerable detail for West African societies in later pre-colonial and colonial times. A famous study by the social anthropologist M. Douglas[94] investigates such a textile economy among the Lele in the Kasia River region in what was, at the time of the study, the Belgian colony of Congo. The Lele lived in self-sufficient villages without noteworthy surplus production. Lele textile manufacture was based upon the fibres of the raffia palm, and its products constituted a central aspect in Lele social life. In west-central African societies, raffia palms were usually owned by the corporate group whose male members were responsible for their planting and tending. The labour-intensive extraction and preparation of the fibres and the production of textiles are distinctively male tasks. All men and boys weave, and raffia-related matters are typical topics of male conversation.[95]

Although raffia could also be worn as a garment, this was not the principal objective of its production and acquisition. Raffia cloth was needed (and sometimes consumed) in the rituals marking the important transitions in the life of an individual: child birth, marriage and death/burial. Raffia textiles were quantified and used as the primary means of payment for goods or services in different social situations. Examples are fees for the entry into religious societies, marriage dues, fines, blood-compensations or the acquisition of slaves. As Douglas points out, however, raffia cannot be seen as a true currency in Lele society since it is not freely convertible. Raffia cloth could not be acquired in situations outside of its social context; Douglas found it very difficult to obtain raffia as the Lele were not prepared to sell it to her for money.[96]

The demands on an individual's stock of raffia were typically larger than what he could produce himself, and he therefore had to draw upon the cooperation of family members and the corporate group, leading to a lifelong mesh of mutual obligations. The creation of such a network of obligations was in fact the ultimate aim of raffia transactions. The larger such a network became, the more prestige it brought to the individual at its centre. Within this context, raffia was rarely accumulated. In M. Douglas' words, "Since it is desired, not as purchasing power, present or future, but for the sake of the prestige gained by parting with it, there is no point in hoarding raffia. ... The

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94 Douglas 1958.
95 Douglas 1958, 111; Martin 1986, 1–2.
96 Douglas 1958, 115–117.

Lele would agree with the millionaire industrialist who said that the ultimate failure of a rich man was to die rich".[97] Raffia cloth, when eventually used as a garment, lasted only a short length of time. Thus, the actual use-value of raffia textiles was a very subordinate aspect in its production and exchange – raffia primarily served as a means to create and maintain a large network of social relations which often extended beyond kin-based relations.

Further toward the African west coast, raffia and other textiles served similar purposes in a variety of societies which were often organised in considerably steeper hierarchies.[98] In such contexts, there was more incentive for accumulation and greater freedom to convert textiles into commodities, i.e. textiles assumed more characteristics of a true currency. Most of the western African textile-based economies eventually collapsed during the process of colonial take-over when they were undermined by the introduction of exotic fabrics that were mass-produced in Europe.[99] However, the situation demonstrates the flexibility of such textile-based economies which seem to be easily adaptable along a continuum reaching from near-egalitarian societies to the needs of the pre-industrial state.

A Very Schematic Model for the Social Role of Textile Production and Textile Use in Late Chalcolithic Anatolia

The Anatolian evidence for early textile use and the Lele example allow us to develop some clearer ideas about the role textiles played in the 4th millennium BC. I see the emergence of pervasive textile use as a social strategy which accompanied the shift from a more community-centred ideology of earlier times to a structure which placed greater emphasis upon individual achievements. Textiles were likely used in the first instance as a means to meet social obligations within a system which placed high demands on the productivity of individuals and their social web as a precondition to acquire prestige, access social and cultic roles, and, possibly, also to obtain spouses and slaves. A corollary of this would have been increased competition within and between communities, with the main external effect being a greater demand on land rights. A reflection of the latter may be seen in the concomitant appearance of formalised weapons.

It is quite easy to see that such a system would have an inherent tendency to develop toward an unequal distribution of wealth within society and the creation of steeper and more formal hierarchies. The fact that such features do not become tangible prior to the later Early Bronze Age suggests the existence of social mechanisms which decelerated this process and stabilised the overall system. Of particular significance is the apparent lack of evidence for an increasing scale of sheep-raising, a phenomenon which may be understood through the Lele case. Douglas[100] points out that the time and effort the Lele invest into teasing out help from relatives, into the negotiation of raffia loans for particular projects, or into the recovery of outstanding debts has little relation to the requirements of making new raffia. Cloth raised through social channels, however, carries considerably more prestige since it demonstrates the extent of an individual's social bonds. The consequence is a permanent artificial *shortage* of raffia. This clearly shows that we are not dealing with a supply-and-demand driven economy but with a tool that facilitates and drives a specific set of social relations. A similar strategy in Late Chalcolithic Anatolia would inhibit large-scale investment into the growth of flock sizes and therefore correspond better to the actual situation in the archaeological record.

Besides providing individuals with a transient platform to obtain social standing, the production, distribution and consumption of textiles would have strengthened cooperation within

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97 Douglas 1958, 118.
98 Kriger 2006.
99 Martin 1986.
100 Douglas 1958, 117.

corporate groups. Household production was simultaneously encouraged and 'capped' with the actual output limited by fluctuating household fortunes, a characteristic of the domestic mode of production. As the emphasis was on circulation rather than accumulation, textiles could be converted into social capital in a much more formalised way than before – but not into cumulative wealth or permanent social standing. Thus, rather than encouraging the emergence of stable social hierarchies, this initial configuration may have served to keep them relatively flat.

It is difficult to make assumptions on gender roles based on the Anatolian evidence alone, but there appears little reason to link this development to a status decrease of the weavers. If the model argued for here is accepted, textile production should rather be seen as a prestige-generating activity. Evidence from the 3rd millennium BC (cited below) is highly ambiguous as far as gender roles in textile production are concerned; the situation leaves the identity of the early producers of fibre entirely open – men, women or both may have spun the yarn and sat before the Chalcolithic looms.

Thus, the social and economic reorganisation which took place at the end of the 5th millennium can be seen as the birth of a new long-term structure which drastically departed from older traditions and extended into the 3rd and early 2nd millennia BC. Although the central role textiles played in this new arrangement seems to emerge quite rapidly and in high intensity at the beginning of the period, it would be wrong to see this development as a complete break with the preceding periods. A general tendency of sedentary Anatolian communities to gradually develop individualising features has been noted from the late 7th millennium onward.[101] A non-ordinary perception of textiles is already possible for the earliest finds which all come from 'liminal' contexts; either associated with death (Çatalhöyük, Kuruçay, Alişar) or with supernatural entities (Ulucak). Therefore, the concept of a special nature associated with woven fabric may actually have had considerable antiquity before this material was forcefully moved into the centre of social life.

Finally, it needs to be emphasised that we are not dealing with an entirely linear development. There is considerable spatial and chronological diversity in the economic strategies and social organisation of the different geographic 'theatres' during the early part of Anatolian history. After the beginning of the Late Chalcolithic, not all regions appear to have converted immediately to the 'textile model' and many continued older strategies. The distribution of finds *could* indicate that the mountain zones in the north and the southwest were the initiators of this new structure, although there is a danger of circularity in this conclusion since these regions are over-represented in terms of excavation.

The period which will prove critical to understanding the background of the change is without doubt the 5th millennium. Unfortunately, the 'Middle Chalcolithic' is one of the least well-understood periods in Anatolian prehistory and the extant information is both sparse and strikingly diverse, prohibiting insight into the economic and social constraints of the period.[102] Possible external triggers for this essentially internal development could have been a major climatic deterioration at this junction,[103] or the introduction of genetically modified, woolly breeds of sheep from the east or northeast.

Anatolian Textile Economies in the 3rd and 2nd Millennia BC

The textile industry of the Early Bronze Age can only be touched on here although it certainly did not lose any of its importance, even if metal seems to have increasingly been the medium of accumulated wealth.[104] However, instruments related to textile production continue to appear in

[101] Düring – Marciniak 2006; Marciniak – Czerniak 2007.
[102] Cf. Düring 2011b.
[103] Cf. Riehl – Marinova 2008.
[104] Bachhuber 2009; Bachhuber 2011.

special, now often even high-status contexts. An interesting case is the Demircihöyük necropolis where spindle whorls occurred in both male *and* female graves, which could also contain weapons to demonstrate the warrior status of the interred.[105] I take this as evidence that spinning was neither seen as an exclusively female task in the 3rd millennium, nor as a low-status activity. In fact, the contrary seems to be true. At Alaca Höyük and Horoztepe in central Anatolia, spindles made from copper, silver and electrum appear as part of the inventory of extraordinarily rich graves.[106] Like the rest of the inventories, these spindles were evidently meant to serve as status markers. Yakar and Taffet have further argued that they probably carried a strong symbolic/ritualistic meaning.[107] It seems that the production and exchange of textiles was still an important social strategy in the final centuries of the 3rd millennium BC.

This represented an open door for the Old Assyrian merchants in the early 2nd millennium BC when they began to inject exotic fabrics into a country which had been obsessed with its own textiles for more than two millennia. The Assyrian presence caused two important structural changes: firstly, they transformed at least part of the 'textile market' into a true prestige good economy whose exotic source could now be controlled by the emerging Anatolian elites. Secondly, their activities introduced silver as a means of free exchange in Anatolia, which helped to create a more profit-orientated economy in the area where they were active. These changes were immediately exploited by the Anatolian elites for their own benefit.

The Assyrian activities did not ruin the Anatolian production of textiles, however. The newly emergent palaces had great interest in local fabrics of different types whose designations, such as *pirikannum, sapdinnum* or *tisābum,* are preserved in the sources.[108] It is worth noting that this interest appears to be largely focussed on textiles made from wool and that linen fabrics played only a minor role.[109] Huge amounts of wool were mobilised and traded at this time. Although Assyrian traders occasionally latched onto this trade, it is clear that production, demand and consumption were essentially an inner-Anatolian affair.[110] It appears likely that a substantial part of the processing of wool and its conversion into woven fabrics took place in the palaces of the local rulers.[111] Animal remains belonging to the native Anatolian centres of this period are predominantly sheep and goats with a marked survivorship of adult male sheep, a pattern typical for a wool-based exploitation of these animals.[112] Thus, it can safely be assumed that large-scale production of woollen textiles and their redistribution were an important part of the political economy of Middle Bronze Age Anatolia, to which the Assyrian traders merely contributed the exotic, and therefore more valuable, top-end.

The Assyrians had mixed feelings about the exchange of local textiles. At one stage, there even existed an internal Assyrian order which forbade the merchants to engage in their trade[113] as this was seen as a threat to the Assyrian imports which earned them remarkable profits of up to 200%. The attitude is well exemplified in the exclamation of one Assyrian merchant: "What is the profit of *pirikanū* that I would trade them? May [the gods] Aššur and Šamaš trample it to dung!"[114]

105 Seeher 2000.
106 See the discussion of these objects in Barber 1991, 60–62.
107 Yakar – Taffet 2007; see also Bachhuber 2011, 167–171.
108 Michel – Veenhof 2010, 226.
109 Michel – Veenhof 2010, 211–218.
110 Lassen 2010.
111 Lassen 2013.
112 Arbuckle 2012b.
113 Veenhof 1972, 126–128; Michel – Veenhof 2010, 239.
114 Cited after Michel – Veenhof 2010, 238, no. 167.

Conclusions

This paper revolves around a fundamental change in the organisation of society during the Late Chalcolithic. At the onset of this period in the last quarter of the 5th millennium, a new and pervasive economic strategy emerged which centred on the production and distribution of – probably woollen – textiles. This strategy had repercussions that affected pastoral strategies and space requirements, but ultimately served social aims. Economically, it placed greater weight on the household as the central productive unit. Socially, it created the opportunity for individuals to obtain personal prestige through a network of social obligations, a purpose for which textiles were much better suited than other materials more difficult to obtain. As such, textile production played a central and dominating role in Late Chalcolithic society. Following this initial configuration, the central role of textiles in Anatolian society can be followed into later periods when the practice eventually lost its egalitarian character and led to the emergence of more vertically structured forms of society. I would argue that textiles did not serve this purpose yet in the Late Chalcolithic, but rather they were used within a context of flat hierarchies and a more transient nature of personal social status.

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The Development of Metallurgy in Western Anatolia, the Aegean and Southeastern Europe before Troy

Ernst Pernicka[1]

Abstract: In the Near East copper has been worked and used since ca. 10,000 years ago and it was long assumed that the knowledge and practice slowly diffused to southeastern Europe and beyond, analogous to the Neolithic lifestyle. However, the evidence for this is scarce if not nonexistent. When radiocarbon dates of the southeastern European Chalcolithic demonstrated that abundant metal usage was earlier than in western Anatolia, C. Renfrew proposed a totally independent discovery and development of metallurgy in this region. The discovery of two Chalcolithic copper mines at Aibunar in Bulgaria and Rudna Glava in Serbia seemed to confirm this hypothesis. However, no evidence for smelting was found and chemical and lead isotope analyses have shown that none of the analysed Chalcolithic copper objects can be correlated to the ores of Rudna Glava. Accordingly, a somewhat intermediary model was proposed in which the spread of metal usage and production was explained by the acquisition of metal objects as 'exotica' and often by the movement of people possessing metallurgical expertise. Since the production techniques and object forms used in each early region mostly reflect local standards, this is seen as a process of incorporation and innovation by the communities involved rather than a straightforward or inevitable adoption. Such a model inherently raises the question of contacts between neighbouring regions and, indeed, new finds in the Aegean and in western Anatolia have come to light that may be relevant for this discussion. The paper will summarise the new evidence of metal production and distribution in the 5th and 4th millennia and discuss possible interactions between these regions.

Keywords: Western Anatolia, Aegean, southeast Europe, Copper Age, metallurgy

Beginning of Metal Usage

There is overwhelming evidence that the earliest use of metal, respectively copper, occurred in the Fertile Crescent roughly contemporaneously with the transition to sedentary life. This may be somewhat surprising because gold is generally known to occur as metal in nature and seems to be much more conspicuous than copper. One reason may be that large gold nuggets are much rarer than those of native copper. Furthermore, there is not a single gold deposit known in the Fertile Crescent. On the other hand, since both metals do occur in nature one may well ask why they were used so late in the history of mankind. It seems that they did not offer any practical or aesthetic use for Palaeolithic hunters and gatherers. This is not to say that colours were not appreciated in this period. Indeed, red pigments, especially, were actively sought after since the Middle Pleistocene[2] and even extracted by underground mining in the Upper Palaeolithic on the island of Thasos in the northern Aegean.[3] Its use for covering buried individuals, e.g., the Gravettien burial of two infants,[4] clearly shows that the colour red was associated with blood and, thus, carried an enormous symbolic value. However, the colours green and blue do not appear to play a role in this concept as is demonstrated by Palaeolithic cave paintings where only yellow, red and black pigments were used (red and yellow ochre, hematite, manganese oxide and charcoal).

1 University of Heidelberg and Curt-Engelhorn-Center for Archaeometry, Mannheim, Germany; e-Mail: ernst.pernicka@cez-archaeometrie.de.

2 Marean et al. 2007.

3 Koukouli-Chrysanthaki – Weisgerber 1999.

4 Einwögerer et al. 2008.

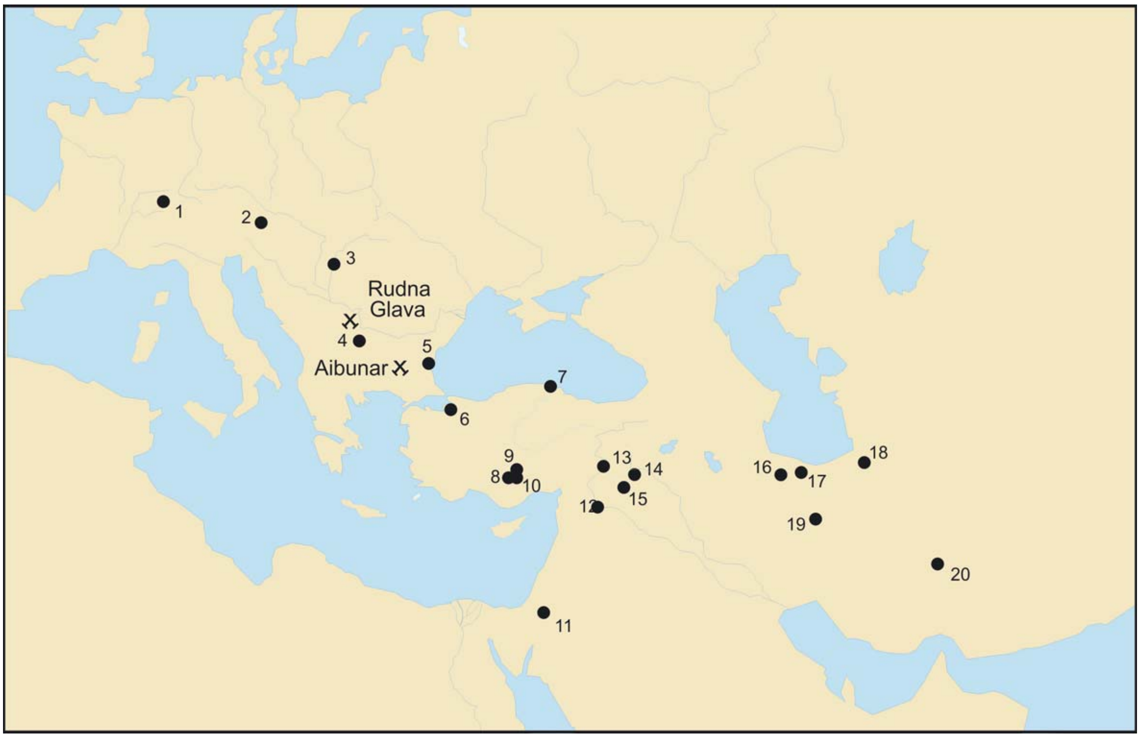

Fig. 1 Sites mentioned in the text: 1. Cortaillod; 2. Mondsee; 3. Herpaly, Hodmezövasarhely-Gorzsa; 4. Belovode, Majdanpek; 5. Varna; 6. Ilıpınar; 7. İkiztepe; 8. Can Hasan; 9. Aşıklı Höyük; 10. Çatal Höyük; 11. Nahal Mishmar; 12. Habuba Kabira; 13. Norsuntepe; 14. Çayönü, Hallan Çemi; 15. Yarim Tepe; 16. Chesmeh Ali; 17. Tepe Zageh; 18. Tepe Hissar; 19. Arisman; 20. Tal-i-Iblis.

This changed decisively around 10,000 BC when varieties of green stones were used for pendants and other jewellery, mainly beads so that their appearance is even considered a hallmark of the pre-pottery Neolithic of the Near East.[5] Since many oxidised copper ores are green, this provided the possibility that occasionally native copper was also collected by chance. At one of the earliest sites where native copper was worked, namely Çayönü in eastern Anatolia (Fig. 1), many more malachite beads than beads of native copper were found. The identification of native copper was accomplished by metallography[6] and the detection of trace element patterns in the copper finds.[7] Moreover, it was found that the native copper lumps were hammered into foils to produce rolled beads by applying intermittent heating,[8] which technically makes sense because on deformation copper becomes hard and brittle and tends to crack. Annealing makes it soft and ductile again. The application of heat to stone material should be no surprise. Heated stones were used for cooking and heat was applied to alter the mechanical properties of stones, e.g., for cleaving. However, the application of elevated temperatures (a few 100°C are easily achieved in an open fire) to copper minerals changes their colours, first from green to black and occasionally even to red under reducing conditions. This was certainly observed and may have provided the stimulus for more experimentation until eventually copper ores could be reduced to copper metal. The decisive role of colours for the beginning of metal usage was

5 Bar-Yosef Mayer – Porat 2008.
6 Muhly 1989.
7 Pernicka, unpublished analyses.
8 Annealing in metallurgical terms, also identified at slightly later Aşıklı Hüyük, Yalçın – Pernicka 1999.

already formulated in the 1980s by Gerd Weisgerber and the author[9] and has recently been re-examined without referring to earlier literature.[10]

It is much less clear, where and when this decisive step towards pyrometallurgy proper was made and if it was a unique invention or if it occurred at several locations at different times independently. One thing is clear though: It cannot have been a chance discovery in an open campfire, because the reduction of copper oxides requires high temperatures of more than 1100°C, beyond the melting temperature of 1083°C, and reducing conditions with oxygen largely removed. Such conditions are best achieved in a closed reaction vessel but experiments have shown that, in principle, it is also possible to reduce copper with low yields in an open crucible under a charcoal cover. In the early Neolithic settlement of Çatal Höyük in central Anatolia, copper ore displaying signs of strong heating was recovered from layers dating to the 7^{th} millennium BC. However, it is unclear if the heating was due to destruction by fire or intentional. In any case, all copper finds investigated so far consist of native copper.[11]

Beginning of Pyrometallurgy

Unequivocal evidence for the transformation of ores to metal is the occurrence of metallurgical slag and/or slagged crucibles. Such finds are presently only known from the 5^{th} millennium BC creating a gap of more than three millennia between the earliest working and the smelting of copper. It is suggested that the subsequent step for melting copper was caused by excessive annealing.[12] The foremost evidence for this hypothesis comes from a mace head from Can Hasan in southeastern Turkey that was dated to around 6000 BC. The thick hole of the mace head could not have been produced by drilling; therefore, it was concluded that it must have been created by casting, which of course requires the melting of copper. However, it was later shown that the mace head was made from a large chunk of native copper similar to a large copper bead.[13] Another hypothesis suggests that lead may have guided the way to smelting.[14] Other than copper and gold, lead practically does not occur as metal in nature. If lead metal is found in early archaeological contexts, it is by itself evidence for the smelting of ores. Furthermore, lead is much easier to reduce from its major mineral, galena (PbS), and melts at a much lower temperature, namely 327°C. Accordingly, it is conceivable that liquid lead metal may have been produced accidentally in an open fire. Such an incidence would certainly not have passed unnoticed and may have shown the principle of smelting. In this context, the lead bangle from Yarimtepe I in northern Iraq, dated to the 6^{th} millennium BC is of great significance. Galena was also found among the minerals at Çayönü and Çatal Höyük,[15] where it was made into elongated, drilled beads. Galena is a heavy, black, soft mineral with an intensive gloss and can easily be shaped with stone working techniques. Apparently it was occasionally used for ornaments; consequently, it is not so surprising that lead is the second metal to be worked by man.

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9 Pernicka 1995.

10 Roberts et al. 2009. Incidentally, there seems to be an error in the distribution maps of this article. In the legends areas denoted with different colours are described as >10,000 BC and so forth. This sign means ‘larger than’ and cannot be right. There is no real copper working before 10,000 BC. It probably should be written as <10,000 BC, which would mean ‘10,000 BC or younger’.

11 Birch et al. 2013.

12 Wertime 1964; Wertime 1973.

13 Yalçın 1998.

14 Krysko 1979.

15 Sperl 1990.

Origin and Spread of Pyrometallurgy

Besides the lack of information on the technological development of pyrometallurgy, it is also unknown, where it took place and if it happened more than once. It was long assumed that the knowledge and practice slowly diffused to southeastern Europe and beyond, similar to the Neolithic lifestyle. However, the evidence for this is scarce if not non-existent. When radiocarbon dates of the southeastern European Chalcolithic showed that abundant metal usage occurred earlier than in western Anatolia Colin Renfrew (1969) proposed a totally independent discovery and development of metallurgy in this region. The discovery of two chalcolithic copper mines at Aibunar in Bulgaria and Rudna Glava in Serbia seemed to confirm this hypothesis. However, no evidence for smelting was found; moreover, chemical and lead isotope analyses have shown that none of the analysed chalcolithic copper objects can be related to the ores of Rudna Glava. Accordingly, a somewhat intermediary model was proposed in which the spread of metal usage and production was explained by the acquisition of metal objects as 'exotica' and often by the movement of people possessing metallurgical expertise. Since the production techniques and object forms used in each early region mostly reflect local standards, this is seen as a process of incorporation and innovation by the communities involved rather than a straightforward or inevitable adoption.

In the 5th millennium BC, there are at least four regions in the Near and Middle East that have yielded evidence for early pyrometallurgy: i) In the Iranian highland west and south of Teheran (Tepe Zageh, Cheshme Ali), ii) another one in the southern foothills of the Zagros mountain chain (Tal-i-Iblis), iii) in southeastern Anatolia along the middle Euphrates in the Taurus mountains (Norşuntepe) and iv) in the Levant in the Jordan valley and the Arabah between the Dead Sea and the Red Sea (Nahal Mishmar, Feinan). Nahal Mishmar also provided some of the earliest evidence for lost-wax casting.

On the other hand, the earliest indication for copper smelting was recently reported from Serbia.[16] A small amount of copper slag was found near Belovode in contexts of the early 5th millennium BC, demonstrating that within one millennium we have a few indications extending over a very large area ranging from southeastern Europe until southern Iran (Fig. 2). It is hard to imagine that independent developments took place in this area within a relatively short time span, especially since it is known that the Neolithic package of cultural techniques spread out from the Fertile Crescent exactly over this area in the millennia before. In principle, the new discoveries in Serbia together with the still earliest copper mines of Rudna Glava in Serbia and Aibunar in Bulgaria could alter the direction of the presumed spreading of pyrometallurgy. Nevertheless, even the collective evidence is rather slim and may only be a snapshot of present knowledge.

A strong argument in favour of a monocentric origin of pyrometallurgy is supported by the fact that it is a rather complex technology that was not generally known but rather kept secret by a few specialists even in later periods. In addition, the shapes of the metal objects produced are quite similar as well as the installations for smelting, e.g., in Feinan in Jordan and Arisman in central Iran. Furthermore, the spread of pyrometallurgy in Europe shows a similar chronological drift from southeast to northwest similar to the spread of Neolithic subsistence two millennia earlier (Fig. 3). Consequently, metal production on the British Isles begins in the 3rd millennium BC while it is already flourishing in the 4th millennium BC in central Europe.

Early Gold Metallurgy

Although according to present knowledge lead appears earlier than gold in the archaeological record, it did not have an impact on the use of other metals. It became more abundant only when it was discovered that it often contains silver, but mainly as waste or cheap and little useful material

[16] Radivojević et al. 2010.

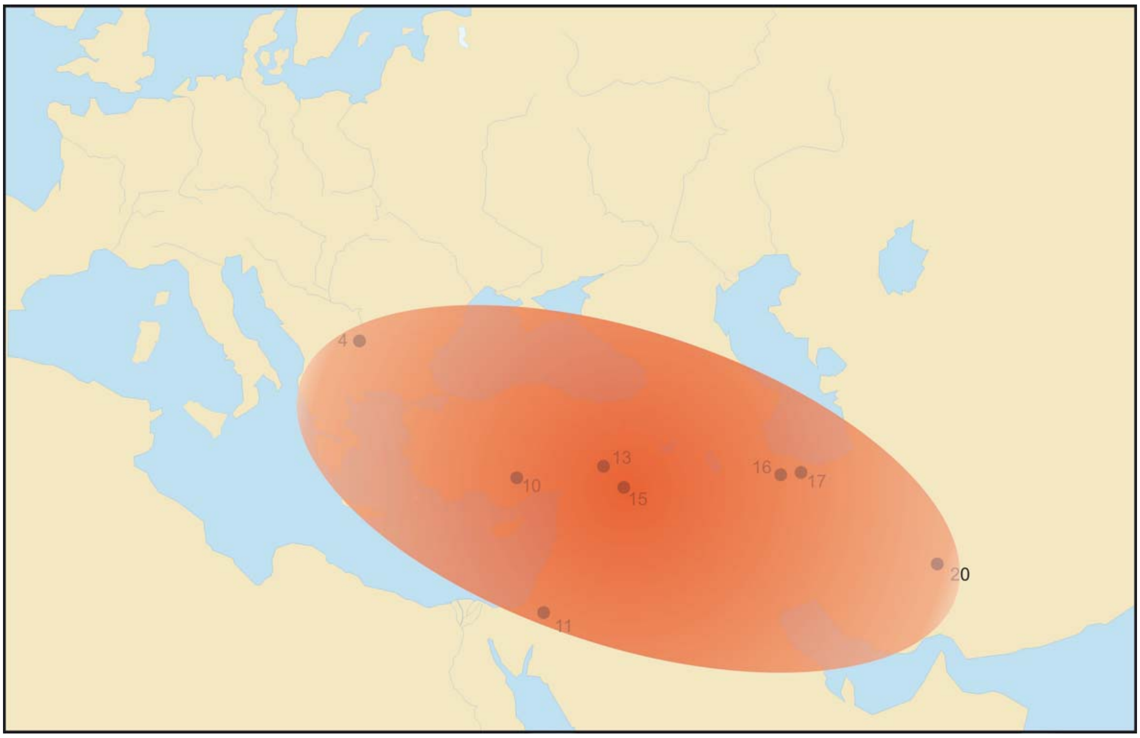

Fig. 2 Sites with proven or possible evidence for smelting in the 5th millennium BC.

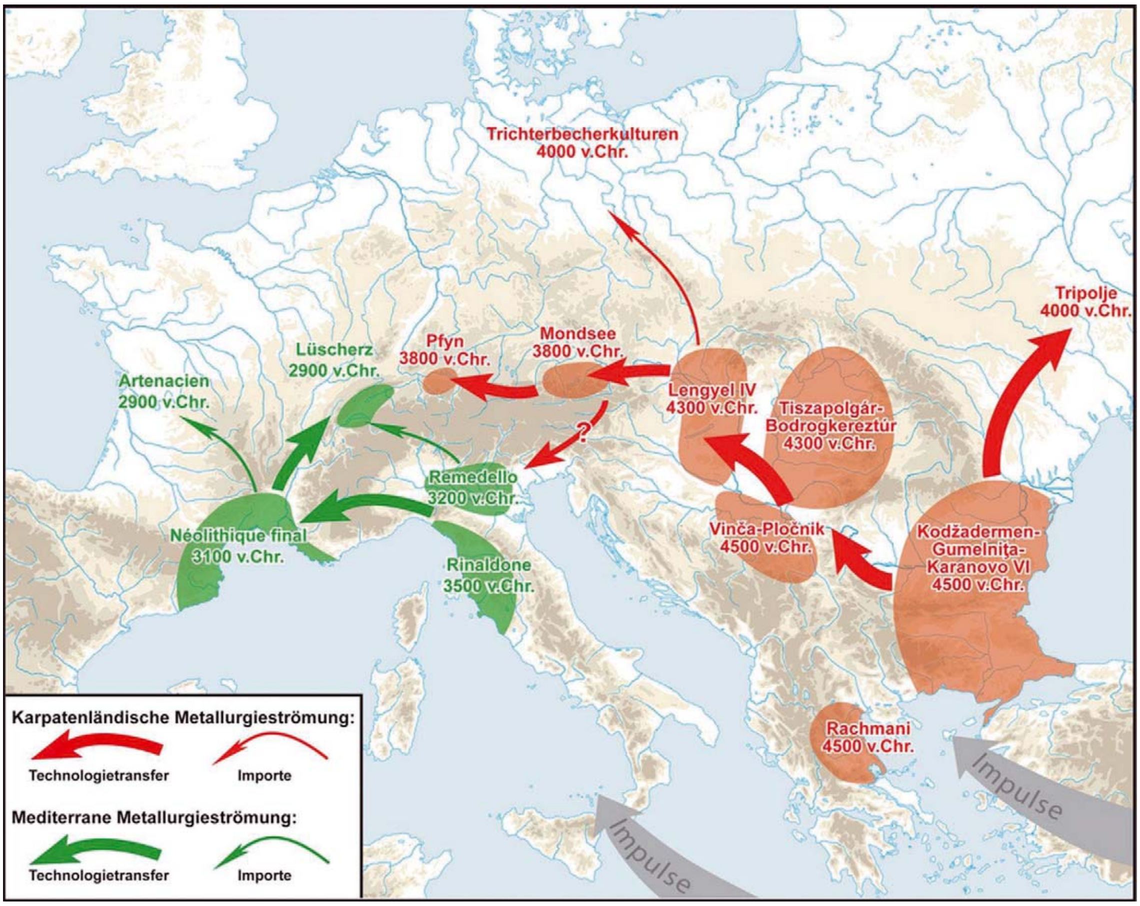

Fig. 3 Spread of metallurgy in Europe (after Strahm 2012, 28, fig. 1).

(see below). However, when gold was added to the range of metals available, it was apparently considered as valuable from the beginning and a material used to display rank and status. It also appears in rather large quantities in the burial site of Varna I on the Black Sea coast dated to the second half of the 5th millennium.[17] More than 300 burials were excavated, which contained altogether more than 3000 gold objects comprising some 6kg gold. This spectacular entry of gold into the cultural history is the more extraordinary considering that the number and masses of the gold objects are unequally distributed to a few burials containing more than 90% of the objects and more than 99% of the gold. It has frequently been suggested that this may indicate a hierarchically organised early society whose members wanted to display their wealth and rank. From the metallurgical point of view, it appears that, within the short period of use of the burial site a development from small and simple forms to elaborate and technologically challenging ones becomes visible. The latter were certainly cast by various techniques including lost-wax casting and even intentional alloying of gold with copper and represent the earliest evidence for the intentional mixing of metals to alter their properties.[18]

Copper was also cast although this is substantially more difficult with pure copper, since molten copper absorbs oxygen, which it releases on cooling. This produces gas bubbles that can cause major defects in the finished product. However, it was nevertheless mastered as indicated by biconvex shapes such as the axe adzes produced in southeastern Europe in great numbers beginning in the 5th millennium BC. Such shapes require at least bivalve moulds and some complex shapes can only be made by lost-wax casting. In this period metal objects are rare in the Aegean and in western Anatolia and the few that are known are typologically related to the Balkan region. This seeming geographical gap in the distribution of metal finds between southeastern Anatolia and beyond and southeastern Europe led to the suggestion of an independent development of metallurgy there.[19] During the last two decades, new research with new finds may eventually close this gap as it has already happened for the 4th millennium BC.

Copper Alloys

According to the present evidence it seems that copper was first alloyed with gold. By the end of the 5th millennium BC, pure unalloyed copper mainly used for the production of ornaments and implements was replaced by copper rich in arsenic. This type of copper is usually termed 'arsenical copper', because it is unclear and disputed if it represents an actual alloy, i.e. the intentional mixture of metals. The advantages of this new material were at least twofold: It is substantially harder and it has much better casting properties than pure copper. In addition, high arsenic concentrations changes the colour to a silvery appearance.

After the climax of metal production during the late 5th millennium BC comes a period that is remarkably poor in metal finds in southeastern Europe as well as in the Aegean. However, shortly thereafter arsenical copper appears as a new material almost simultaneously from the Near and Middle East to central Europe (Mondsee, Cortaillod).[20] According to Chernykh, Aviloval, Borceva and Orlovskaja[21] this marks the restructuring of cultural relations between Anatolia and Europe that led to the formation of the so-called Circumpontic Metallurgical Province, extending into Iran and central Asia as we now know (Fig. 4). Until recently, the only evidence from western

17 Ivanov 1991.
18 Leusch et al. forthcoming
19 Renfrew 1969.
20 Sangmeister 1971; Schubert 1981.
21 Chernykh et al. 1991 describe the distribution of arsenical copper in what they term Early Bronze Age and include the Kura-Araxes and the Maikop cultures. However, this terminology is only consistent with the EB1 period in eastern Anatolia, which already begins in the second half of the 4th millennium BC.

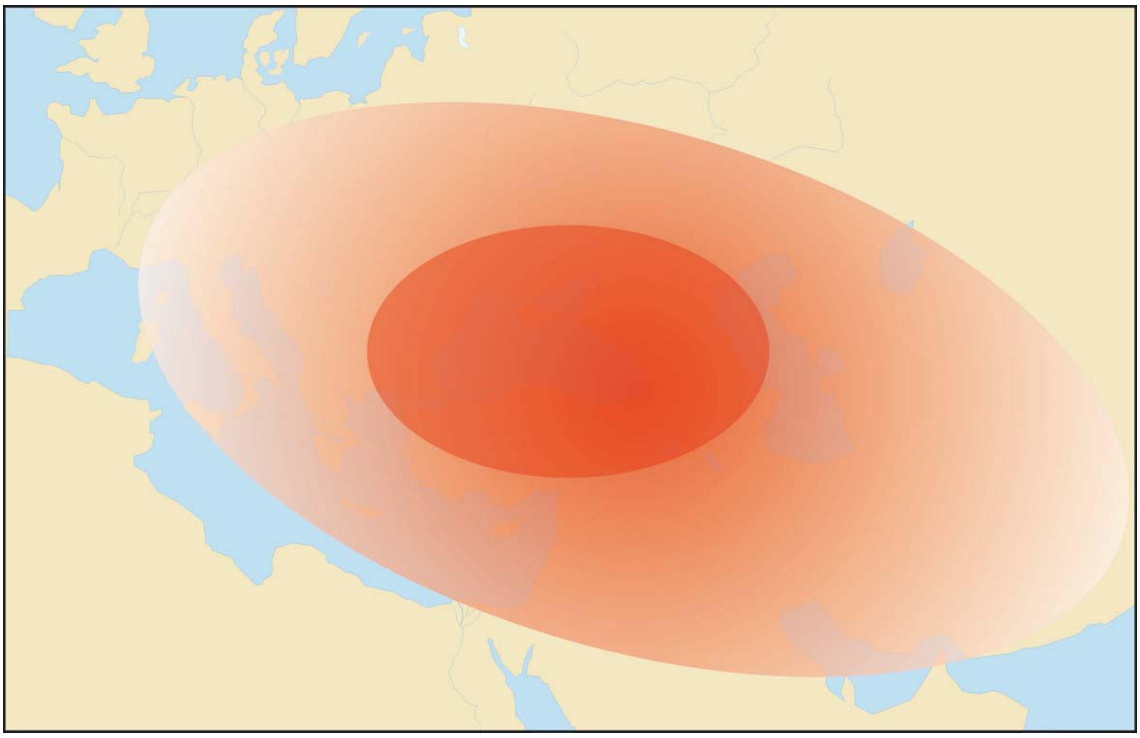

Fig. 4 Distribution of arsenical copper in the 4th millennium BC (outer ellipse). The inner ellipse roughly describes the extent of the Circumpontic Metallurgical Province according to Chernykh et al. (1991).

Anatolia for such a cultural and technological affinity is the metal finds from İkiztepe[22] and Ilıpınar[23] that consist almost exclusively of arsenical copper and the earliest of which also date to the middle of the 4th millennium BC.

There has been a long debate whether arsenical copper was produced by deliberately adding arsenic to copper or, for that matter, as-rich ores to copper ores, or whether a mixture of the two just happened to be available. The main arguments for an accidental production was the observation that there was little control of the arsenic concentrations, which range roughly between 0.5 and 5% (Fig. 5) and the fact that minerals containing arsenic are often present as minor components in copper deposits. This is not to say that the superior qualities of arsenical copper went unnoticed. It is certainly possible that copper ores containing arsenic were actively sought or that accidentally produced arsenical copper was selected by some kind of material testing and used for specific purposes.

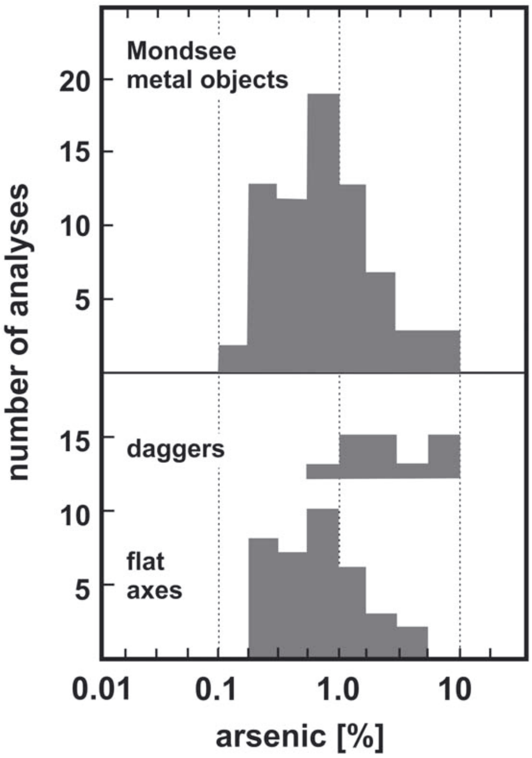

Fig. 5 Concentrations of arsenic in metal objects of the Mondsee group dated to the middle of the fourth millennium BC. Practically all objects consist of arsenical copper with arsenic ranging between 0.5 and 5%. Daggers generally contain more arsenic than the average.

22 Bilgi 1984; Bilgi 1990.

23 Begemann et al. 1994.

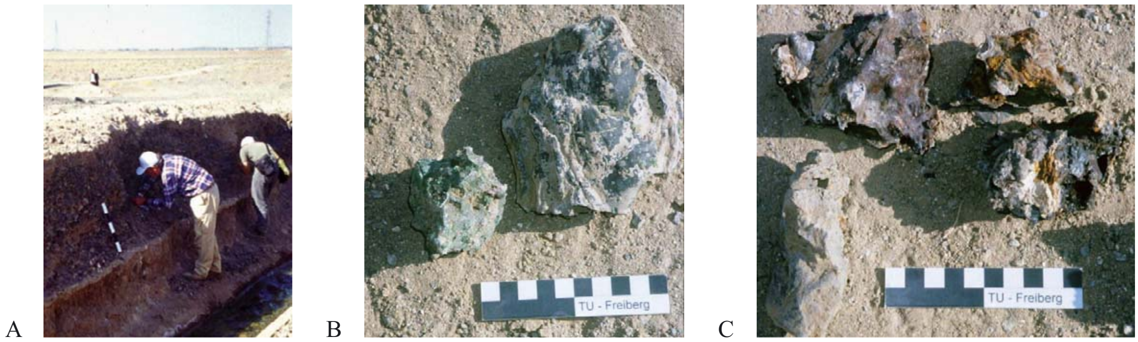

Fig. 6 A. Slag heap in area A at Arisman in central Iran dated to the beginning of the third millennium BC. B. Typical 'green' slag of Arisman A with green stains of oxidised copper. C. 'Brown' slag of Arisman A with stains of iron oxides.

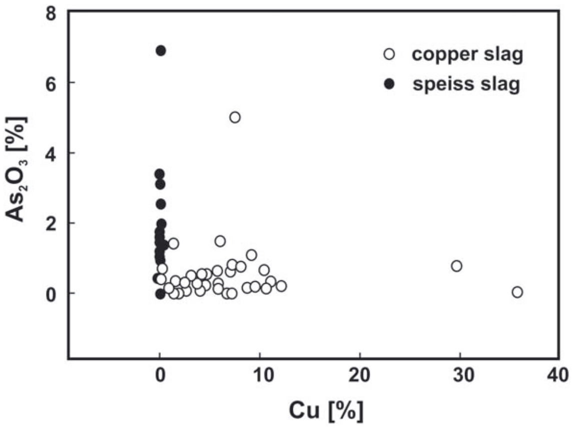

Fig. 7 Copper and arsenic concentrations 'green' and 'brown' slag from Arisman A. The 'green' slag is from copper production and generally has low con entrations of arsenic while the 'brown' slag virtually contains no copper but considerable concentrations of arsenic which is due to inclusions of small droplets of *speiss*.

Less controversial is the notion that the ancient metalsmiths were aware of the superior mechanical qualities and, of course, the different colour of arsenical copper. This is borne out by the observation that frequently daggers and axe blades were considerably re-worked after casting which increases their hardness decisively. In fact, as a weapon the geometrical form of a dagger makes sense only when using a hard material like arsenical copper and it is certainly no coincidence that such daggers appeared for the first time together with the first appearance of the new metal.

The metallurgical problem lies in the high volatility of arsenic (sublimation point 615°C) so that – other than tin metal – it cannot be added directly to molten copper although the element also occurs in nature. Previous research has shown that a number of different routes could lead to arsenical copper, including the smelting of fahlore,[24] the co-smelting of native copper and copper-arsenide minerals,[25] and the conscious addition of an arsenic-rich mineral, such as realgar/orpiment, arsenopyrite or löllingite, to copper metal or copper ore.[26] More recently, Thornton and others[27] proposed that an artificial iron-arsenic alloy, called *speiss*, was produced in Early Bronze Age Tepe Hissar, north Iran, presumably to be added to copper metal for the production of arsenical copper. Rehren, Boscher and Pernicka[28] found that this material was produced in large quantities at Arisman side-by-side with copper in a different process (Figs. 6–7), accordingly, it appears that the majority of arsenical copper was produced intentionally. Arsenopyrite (FeAsS) is the most frequently occurring arsenic mineral that is occasionally found as an accessory mineral in copper deposits but more often in hydrothermal veins together with gold and tin. At Arisman, it was apparently not co-smelted with copper ores but smelted separately to form *speiss*. The reason for this seemingly more elaborate procedure may have been a better efficiency and at least some con-

24 Lechtman – Klein 1999.
25 Budd et al. 1992.
26 Heskel 1983; Thornton et al. 2002.
27 Thornton et al. 2009.
28 Rehren et al. 2012.

trol in adding arsenic to copper. This suggests a fundamental progress in the understanding and control of metallurgical processes already in the 4th millennium BC. The motivation for this development could have been the introduction of the dagger.

Again the question arises if the development from the use of pure copper to arsenical copper was more or less unavoidable and could have taken place independently in different regions or if this new knowledge was acquired in a single region and spread out from there. The coincidence in time and space of this new technology clearly favours the latter model. Subsequent to any technical breakthrough leading to the discovery or invention of a previously unknown material, or one with superior qualities, a lively trade in the new commodity can be expected to develop between its place of invention and production and more or less distant customers. However, considering that ideas travel more lightly than material goods and assuming that reasons not to keep a technical secret in its place of origin will always exist, the monopoly in the production of such materials or goods could presumably never be maintained for long. Competing production centres will come into being wherever required raw materials are available and where there was a need, or where such a need could be created, for the new material. Indeed, *speiss* could have been traded in its own right for alloying purposes like tin metal. Incidentally, since arsenic commonly occurs together with gold and tin it is conceivable that this combination may have eventually paved the way to tin smelting and consequently to the production of tin bronzes.

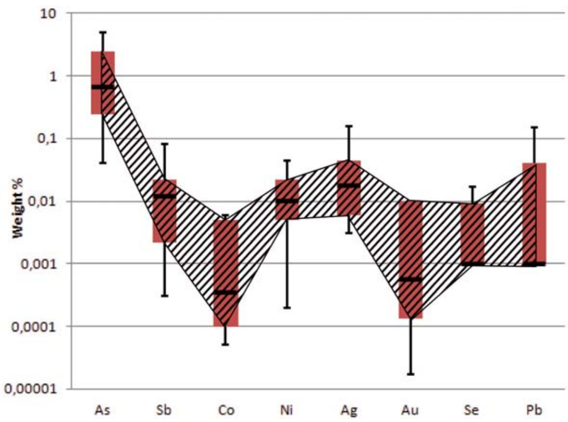

Fig. 8 Chemical 'fingerprint' of the metal objects of the Mondsee group. The shaded area encompasses the area of the boxplots showing 80% of the measured values for each element. The protruding antennae indicate the whole range of the measurements; the black horizontal bar indicates the median value for each element.

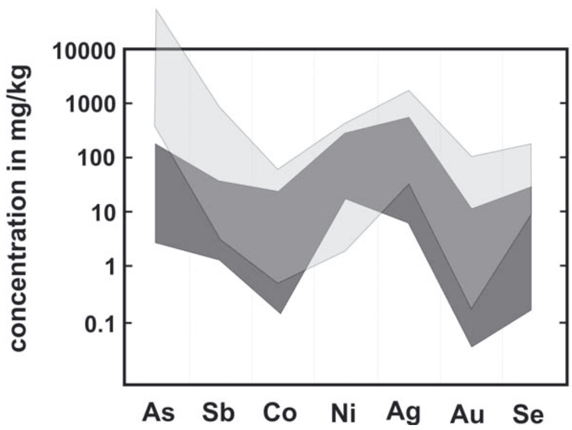

Fig. 9 Comparison of the trace element pattern in chalcolithic copper objects from Serbia and Bulgaria which can be related to the copper deposit of Majdanpek (dark area) with copper objects of the Mondsee group (light grey area with the total spread of concentrations from Fig. 8).

This raises a problem for the discussion of metal provenance studies, because the trace element patterns and the lead isotope ratios are a mixture of two different materials which need not come from the same deposit. This example resembles the discussion on provenance determination of tin bronze and similar arguments apply to arsenical copper. There are no systematic trace element analyses of arsenopyrite but as common impurities Ag, Au, Co, Sn, Ni, Sb, Bi, Cu, and Pb are mentioned. Unfortunately, these are the same elements that are used for the classification of archaeological copper artefacts. On the other hand, most prehistoric metal objects consisting of arsenical copper have low concentrations of impurities (Fig. 8), like the 4th millennium BC artefacts of the Mondsee cultural group[29] and of Ilıpınar in northwest Anatolia.[30] If those objects were made from copper that was alloyed with arsenic by the

29 Frank – Pernicka 2012.

30 Begemann et al. 1994.

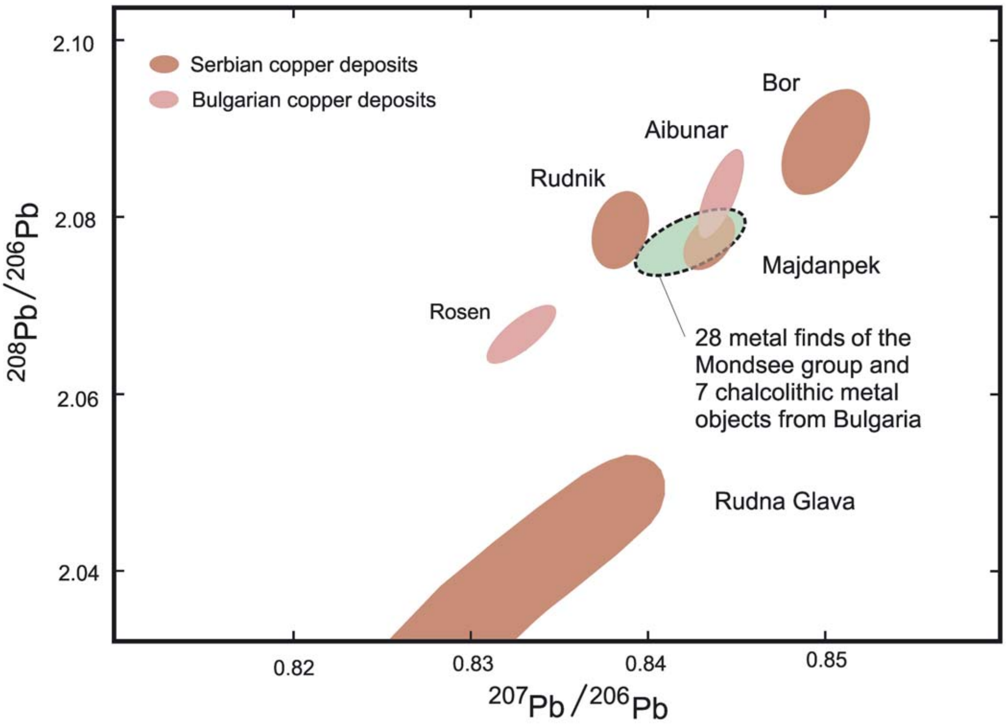

Fig. 10 Lead isotope ratios of copper deposits in Serbia and Bulgaria and of metal artefacts of the Mondsee group. Almost all analysed metal objects are more or less consistent with Majdanpek. The slightly extended range of Mondsee artefacts may be due to alteration of the lead isotope ratios by the addition of arsenic.

addition of *speiss* then we may assume that arsenopyrites generally have low levels of impurities or that they are not completely absorbed by the molten copper. This may also apply for lead and tin bronze; one may conclude that the lead isotope ratios in arsenical copper are dominated by the lead from copper and not from the *speiss*. For the metal artefacts of the Mondsee group no good match with copper ores of the east Alpine region has been observed, neither in trace element composition nor in lead isotope ratios. Typological aspects and the distribution of arsenical copper in the 4th millennium BC suggest an origin from southeastern Europe. The best isotopically matching copper ores from this region are from Majdanpek in Serbia, a very large deposit that was exploited as early as the 5th millennium BC.[31] The copper produced from those ores was rather pure and assuming that only arsenic was added then the trace element pattern of the Mondsee metal would also fit (Fig. 9). In this case, the lead isotope ratios may also have been slightly modified, which may explain the not so perfect fit of Majdanpek ores with Mondsee copper (Fig. 10).

At the beginning of the 3rd millennium BC, arsenical copper began to be replaced by a copper tin alloy, usually called bronze or, better, tin bronze.[32] It is still not clear where and why this happened because the material properties of arsenical copper and tin bronze are rather similar. One reason may be related to the aesthetic appearance of the alloy, particularly because its gold colour. Another incentive may be the better control of the composition of the alloy as indicated by recipes on cuneiform tablets from Mesopotamia, which archive the exact weight proportions for the production of tin bronze. Recently it has been suggested that tin bronze may have already

[31] Pernicka et al. 1993.

[32] In modern metallurgical terms, any alloy with copper as the major component is called ‘bronze’ except the alloy of copper and zinc which is brass. Accordingly arsenical copper could be called bronze or arsenic bronze. To avoid ambiguity it has become common practice in archaeology to call the alloy of copper with tin ‘tin bronze’ and the alloy of copper with arsenic ‘arsenical copper’.

been produced in the 5th millennium BC.[33] However, this suggestion is presently based on a single well stratified find which may be an accidental product of copper ore containing some tin. Low concentrations of tin were also recorded in three chalcolithic copper finds from Herpaly and Hodmezövasarhely-Gorzsa in Hungary[34] but the contexts are not beyond doubt. Nevertheless, this is certainly not a solid basis for postulating a "polymetallic (r)evolution of the 5th millennium BC".[35] If the archaeological contexts and thus the dating of these finds with unusually high tin concentrations should stand up against scrutiny, (none of them can be dated typologically) then one must keep in mind that these very early tin bronzes had no impact at all, neither to the metallurgical practices nor on the early societies.

Silver

The present evidence shows that silver was first used in the Near East. It is unclear, exactly where, and when it appeared, but the distribution of silver objects seems to 'conform to a pattern, similar in type to that of lapis lazuli distribution in the late fourth and early third millennia'.[36] It is worth noting that the appearance of silver objects coincides with an increasing number of lead artefacts, both in space and time, suggesting that silver may have been produced from argentiferous lead ores from the beginning, even though metallic silver does occur in nature. However, native silver is infrequently found as large lumps but rather in the form of wires with dull surfaces. This is due to the sulphide or chloride coating of the material. Consequently, its lackluster may not have attracted ancient metallurgists. Alternatively, silver could be produced from argentiferous lead ores in a two-stage process. It is a moot point to discuss, if cerussite (lead carbonate) was used, as suggested by Wertime (1973), or for that matter galena (lead sulphide). Both lead ores would have to be smelted under reducing conditions to produce argentiferous lead, from which silver would have to be separated by selective oxidation. This process, called cupellation, produces silver with a trace element pattern that is different from native silver. While cupelled silver always contains at least a few tenths of a percent lead, the concentration of this element is usually much lower than in native silver. On the other hand, native silver that is generally rather pure, often contains measurable quantities of antimony and mercury which are rarely detectable in silver derived from cupellation.[37]

The principles of the ancient metallurgy of silver are well known,[38] and it is generally assumed that cupellation was already practiced in the 4th millennium BC.[39] At least two sites, Habuba Kabira in northern Syria[40] and Fatmalı-Kalecik in eastern Anatolia, have produced metallurgical debris from workshops that provide unequivocal evidence for the process in the middle of the 4th millennium BC.[41] At the beginning of the 3rd millennium BC cupellation was performed almost at an industrial scale at Arisman in central Iran.[42]

The earliest silver object has long been held to be a silver ring from Beycesultan, level XXIV,[43] that was dated by the excavators around 4300 BC.[44] However, two radiocarbon dates from levels

33 Radovojević et al. 2013.
34 Pernicka, unpublished analyses.
35 Radivojević et al. 2013.
36 Prag 1978.
37 Pernicka 1987.
38 Bachmann 1993.
39 E.g. Moorey 1994.
40 Pernicka et al. 1998.
41 Hess et al. 1999.
42 Pernicka et al. 2011.
43 Lloyd – Mellaart 1962, 280–283.
44 See also Wertime 1973; Prag 1978.

XXVl and XXVIII, respectively, rather suggest that the correct date should be around the middle of the 4th millennium[45] or even as late as 3000 BC.[46] Another very early find that may date to the first half of the 4th millennium[47] has been reported from Tepe Sialk, level 111:5.[48] Several dozen silver objects from Uruk,[49] as well as finds from Susa,[50] from Korucutepe,[51] Alişar Hüyük[52] and pre-dynastic contexts in Egypt[53] may be contemporaneous or slightly later. Chronological complications surround more than 233 objects from the eneolithic cemetery of Byblos that were dated to 3880–3200 BC.[54] However, these dates are disputed, and other authors have suggested later dates ranging to the late 3rd millennium.[55]

There is no securely dated silver object for the 4th millennium BC in the Aegean. There is one find of silver from the Alepotrypa cave on the Mani peninsula on the Peloponnese that is sometimes dated early on typological grounds.[56] However, the hoard (two pairs of earrings, a pendant, a cylindrical bead and a necklace consisting of 168 small flat silver beads) was recovered before the systematic exploration of the cave commenced. Although the pendant resembles those made of gold in the Chalcolithic of southeastern Europe the necklace has its closest parallel with one from Louros on the island of Naxos, which is dated to EH 1.[57] Since lead appears only in the 3rd millennium in the Aegean[58] it seems that the knowledge of silver production from argentiferous lead ores was introduced into the Aegean from the east. Furthermore, silver did not reach southeastern and central Europe before the 1st millennium BC; therefore, there is no case for an indigenous development of this rather complex two-stage technology.

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Metallurgy during the Chalcolithic and the Beginning of the Early Bronze Age in Western Anatolia

Mathias Mehofer[1]

Abstract: The archaeometallurgical and archaeological research carried out in southeastern Europe, the Aegean and Anatolia has provided a general insight into cultural interactions that occurred during the 4th millennium BC. For example, metal objects that were found in the rich graves of Novosvobodnaja, Majkop or Arslantepe provide evidence that various metals such as gold, silver, lead and arsenical copper were already available in Anatolia and the Caucasus in the 4th (and early 3rd) millennium BC; heavy shaft hole axes and other implements occurred in the Balkans during that period as well. To date only a few settlements have been found along the west Anatolian coastline which yielded evidence confirming the production or melting of metal in the 4th and early 3rd millennia BC. Çukuriçi Höyük as one of these few examples provides evidence for intensive metalworking, e.g. the production of arsenical copper during EBA 1. Moreover, the production of a silver-copper alloy suggests that the metallurgists at Çukuriçi Höyük had the knowledge of particular smelting and alloying techniques, which attests to a wide-ranging social and technological network at the beginning of the 3rd millennium BC. This well-developed system of metalworking is rooted in the Late Chalcolithic period, as indicated by lead isotope analyses carried out on objects found at Çukuriçi Höyük. Furthermore, archaeological objects as well as analytical results obtained from finds unearthed in the regions under study indicates a 'connection' with the Balkans, as shown by two recently found 'ring idols' near Izmir.

Keywords: Turkey, western Anatolia, Chalcolithic, Early Bronze Age 1, development of metallurgy, arsenical copper, copper processing, bronze, precious metals, 'ring idols', Archaeometallurgy

The 4th millennium BC has been described as an era of transition, which was characterised by many socio-economic changes. Various important phenomena can be observed against this background: the invention and utilisation of the plough, the wheel and the wagon, metallurgy, the domestication of the horse and the occurrence of new types of weapons, for example the shaft-hole axe or swords.[2] These observations allow the conclusion that wide-ranging systems of communication already existed during this time. Rich grave offerings dating from the 4th and early 3rd millennia BC (e.g. Majkop, Novosvobodnaja, Arslantepe, Alacahöyük)[3] yield evidence pointing to an advanced society with a stratified structure. Various metals such as gold,[4] silver,[5] lead[6] and copper[7] were available and placed within elaborately furnished graves of an élite segment of society.

In the late 4th millennium and the first half of the 3rd millennium BC important changes in metalworking technology took place in Anatolia and Greece.[8] Several sites in Turkey have revealed

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1 Archaeometallurgy, VIAS – Vienna Institute for Archaeological Science, University Vienna, Austria; e-mail: mathias.mehofer@univie.ac.at.

2 Benecke 1994, 455–466; Maran 2004; Hansen 2009, 29–30,36 fig. 35; Burmeister 2010, 223; Courcier 2010, 88–89, figs. 10 –11; Hansen 2011; Hansen, this volume 243–260.

3 Hančar 1937; Koşay 1944; Frangipane – Palmieri 1983; Hauptmann et al. 1999; Frangipane et al. 2001; Govedarica 2002; Hansen 2009, 29–30,36, fig. 35.

4 Zimmermann 2005, 191, 195–197, fig. 1.

5 Hess et al. 1998, 64; Pernicka et al. 1998, 123; Prag 1978, 39; Hauptmann – Pernicka 2004; Papadopoulos 2008.

6 Hess et al. 1998, 59; Pernicka et al. 1990, 58.

7 Zwicker 1980 ; Pernicka 1987; Pernicka et al. 1984; Lutz et al. 1991; Schmitt-Strecker et al. 1992; Begemann et al. 1994; Pernicka 1995; Hess et al. 1997; Özbal et al. 1999; Yalçin 2000 ; Hauptmann et al. 2002; Pernicka et al. 2003; Thornton et al. 2009; Meliksetyan – Pernicka 2010.

8 Day – Doonan 2007; Tzachili 2008.

Fig. 1 The metallurgical ensemble, found at Çukuriçi Höyük comprises numerous crucibles, moulds, blow pipes, tools, semi-finished as well as finished products dating to the Late Chalcolithic period and EBA 1 (photo: N. Gail/OAI).

fragments of metalworking. Finds from Arslantepe, Çamlıbel Tarlası, Murgul and Norşuntepe[9] are particularly impressive. Only a few settlements along the Western Anatolian coast yield definite evidence attesting to the processing of metal (especially copper) during the Late Chalcolithic and Early Bronze Age. Considering the question of early copper working in western Anatolia the results from the Çukuriçi Höyük offer new insight and new data for this discussion.

Metalworking at the Çukuriçi Höyük

At the Çukuriçi Höyük the remains of a major metalworking workshop, dating to the Late Chalcolithic and EBA 1, were found. Metal objects, as well as metallurgical ceramics, were recovered throughout the entire tell. In a multi-phase building complex, within the former centre of the tell, two different kinds of furnaces and fireplaces were uncovered.[10] The excavation revealed oval or 'horseshoe' shaped constructions, which were abutting the wall. Furthermore, round bowl-shaped fireplaces situated in the centre of the room were excavated. Numerous crucible fragments were found (Fig. 1), as known from other Early Bronze Age sites. Additionally, many blow pipes, as well as copper prills and semi-finished products came to light. Of particular interest, among the finds, was a mould for casting flat axes and a block anvil[11] for forging metal by shaping bars into finished objects. Four moulds for rod ingots in different sizes[12] show, that metal was collected

9 Zwicker 1980, 17; Lutz et al. 1991; Hess et al. 1997, 75; Hauptmann et al. 1999; Schoop 2011.
10 Horejs et al. 2010, 10, figs. 2.17; 8.
11 Horejs et al. 2010, 15–16, figs. 4–7; Mehofer, in preparation.
12 Horejs 2009, 363, fig. 6; Horejs et al. 2010, 15, fig. 4; Mehofer, in preparation.

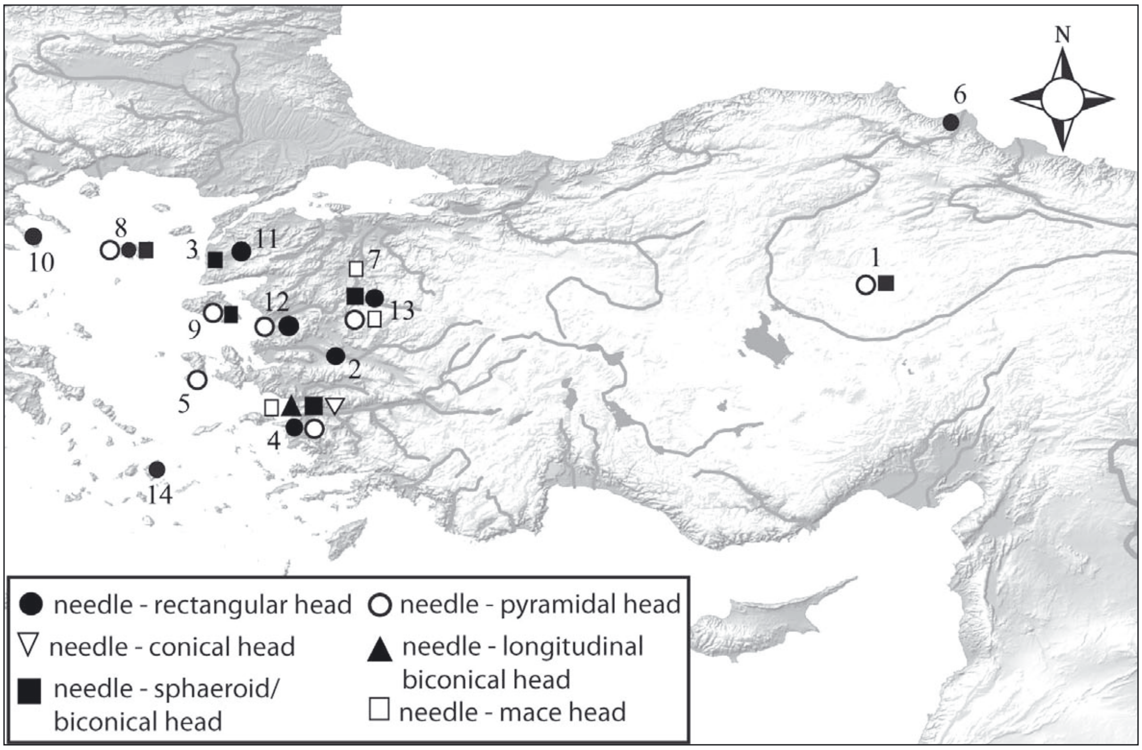

Fig. 2 The map shows sites where needles of similar type like the Cukurci Höyük examples were found. 1. Alishar Höyük; 2. Ovabayındır; 3. Besiktepe; 4. Çukuriçi Höyük; 5. Emporio; 6. İkiztepe; 7. Babaköy; 8. Poliochni; 9. Thermi; 10. Torone; 11. Troia; 12. Yeni Yeldegirmentepe; 13. Yortan (© M. Mehofer, VIAS).

and casted into different standard sizes at the tell.[13] These facts indicate that metal was not only produced for domestic use but also for trading. Lead and other metals were present as well as different tools including several chisels[14] attesting to the presence of specialised crafts. Another highlight worth pointing out are the various weapons, which were excavated over the past two years. Four daggers, two flat axes and an arrowhead found in EBA 1 contexts, indicate a stratified society (Fig. 1). Furthermore, a great amount of pins and needles came to light – up to 27 exemplars which can be subdivided into different types (Fig. 2). They can be compared to needles from other western Anatolian sites such as Babaköy, Demircihöyük, Troy I, Poliochni, Thermi, Yeni Yeldeğirmentepe or Yortan[15] but some of them are still unique, for example, a needle with a conical head and a decorated shaft (Figs. 1 and 2). An evaluation of their earliest appearance shows that almost all of these types can first be found in western Anatolia. A needle with a rectangular head from the Aegean island of Naxos[16] constitutes the only older exception.

The spectrum of finds does not only comprise a large number of arsenical copper artefacts (130 objects so far) but also includes precious metals, Bronze objects,[17] and an artefact made of a specific silver-copper alloy of c. 49% silver and c. 49% copper.[18] In his studies on 'elite' graves and precious weapons made of gold and silver, Svend Hansen demonstrates that it is possible to reconstruct a wide-ranging communication network[19] which stretched from the Balkans to Meso-

13 Mehofer, in preparation.
14 Meißeltyp 7b nach Müller-Karpe 1994,165, pl. 69.1–9.
15 Maran 1998; Kouka 2002; Mehofer, in preparation.
16 Zachos 2007, 177, 184, fig. 11.2k.; Zachos 2010
17 Mehofer, in preparation.
18 Horejs 2009; Horejs et al. 2010, 16, 21, fig. 6.2, tab. 1; Horejs – Mehofer, in print.
19 Primas 1988; Born – Hansen 2001, 52, fig. 45; Hauptmann et al. 2002; Hauptmann – Pernicka 2004.

potamia[20] at the beginning of the 3rd millennium BC. With regard to the observable distribution of this specific silver-copper alloy, the find from the Çukuriçi Höyük fills the gap[21] between the Balkan region and Eastern Turkey. As such, the small fragment has the same lead isotope ratios as other metal artefacts found on the tell. Hence, it is reasonable to believe that it was produced on the site. It also proves that the metallurgists at Çukuriçi Höyük were aware of these wide-ranging exchange and communication systems.

Archaeometallurgical Analysis

The excavation revealed not only a very rich metallurgical assemblage, but also a small number of slag fragments and smelting debris. Many of these remnants were found in an Early Bronze Age 1 workshop area (rooms 1 and 2).[22] Although these fragments seemed inconspicuous they have a unique appearance, e.g. they are heavier than the vitrified crucibles and brown in colour. Comparative pieces are known from Liman Tepe and Bakla Tepe and were also recovered from Çamlıbel Tarlası, Norşuntepe and other sites.[23] Cross-sections of these objects were produced to analyse them with an optical microscope and a scanning electron microscope.[24] The analyses of a piece of smelting debris,[25] found in layer SE 368 of workshop area 1, made it possible to recognise that the sample can be divided into three sections. In the first section, copper, arsenic, iron and sulphur were present, in the second section copper was the dominant element, and in the third section arsenic had a higher concentration than copper or sulphur. The micrograph (Fig. 3A) shows that copper(iron)sulphides in globular form (Tab. 1) are present which can be identified as 'Kupferstein = matte'.

		O	S	Fe	Cu	As	Σ
07/368/6/501	sulphidic inclusions, spot analyses	n.d.	22.3	0.3	76.1	1.3	100
07/368/6/501	sulphidic inclusions, spot analyses	n.d.	21.8	1.8	74.8	1.6	100
07/368/6/501	sulphidic inclusions, area analyses	4.9	19.8	4.7	71.3	4.2	100
07/368/6/501	iron arsenides, spot analyses	n.d.	0.5	41.3	1.2	57	100
07/368/6/501	iron arsenides, spot analyses	2.4	0.6	42.4	0.7	56.3	100
07/368/6/501	iron arsenides, spot analyses	n.d.	0.4	40.3	1.2	58.1	100

Tab. 1 Spot- and area analyses (SEM-EDS) of sulphidic inclusions and iron arsenides in sample no. 07/368/6/501 (cat.no. 220), measurements in mass%, n.d. = not detected, normalised to 100%.

In the right part of the micrograph, white dendritic inclusions were visible, which turned out to be iron arsenide (mainly as FeAs – Tab. 1) or so-called 'speiss'. They were embedded in a matrix in which arsenic and iron are the dominant elements (Fig. 3A).

20 Objects made of such an alloy are known from Bosnia, Koumasa on Crete, Arslantepe and Uruk-Warka (Mesopotamia). Gale et. al 1985, 372, tab. 1; Müller-Karpe 1989, 182, fig. 4 ; Born – Hansen 2001; Horejs et al. 2010, 27–28.

21 Horejs et al. 2010, 23, fig. 10.

22 Mehofer, in preparation.

23 Zwicker 1980, 17; Yalçin 2000; Kaptan 2008, 246, 250, figs. 5–8; Rehren – Radivojevic 2010, 208, fig. 63a.

24 Optical microscope: Olympus BX 51; SEM–EDS: Zeiss EVO 60 XVP with an EDS system produced by Oxford Instruments (INCA 400). Accelerating voltage: 20 kV, working distance of 9.5mm, beam current 100µA, dead time between 30 and 40%. The stability of the beam current was verified by cyclical measurements of a cobalt standard. All results were normalized to 100% and are given as mass percentage.

25 Find no. 07/368/6/501 = cat. no. 220, Mehofer, in preparation.

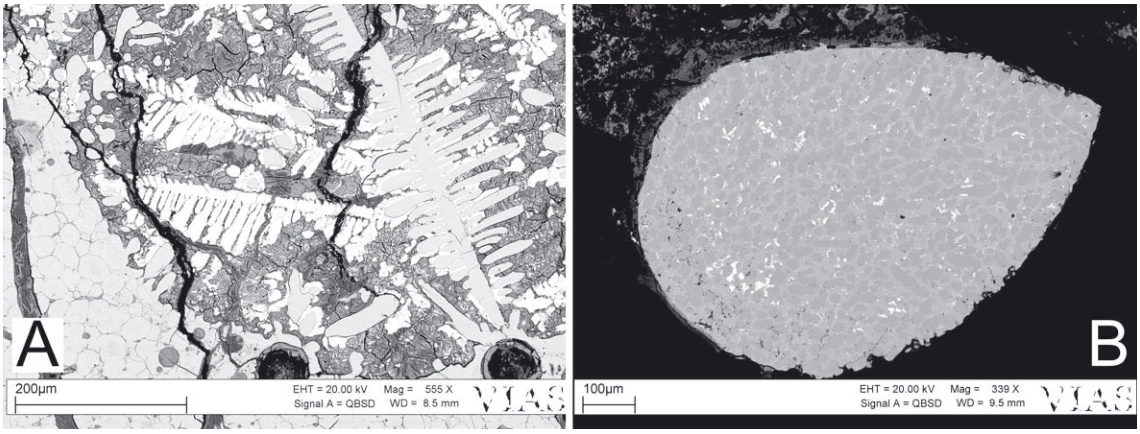

Fig. 3 A. The microstructure of the smelting debris is composed of different phases, in the left section copper sulphides (grey) are visible, meanwhile iron arsenides (white) in dendritic form can be observed in the right section, they are embedded in matrix dominated by iron, arsenic and other elements. B. The SEM-picture shows a cross-section of a crucible. The found copper prills have a very high arsenic content up to 20%. Dark grey= copper with low arsenic concentration; light grey= copper with high arsenic concentration; white=lead inclusions (© M. Mehofer, VIAS).

Crucible fragments

A cross-section of one of the excavated crucible fragments helped to complete the *chaîne opératoire* as it provided further useful hints. It contains copper sulphides with a varying, but generally low iron concentration.[26] These inclusions can also be observed in the metal objects[27] indicating to the additional presence of sulphur during the smelting process (beside carbonatic copper ores).

In the vitrified inner layers of some crucibles, several copper prills with a very high arsenic content (as γ-Cu_3As) of up to 18–20% were found (Fig. 3B) which might be relicts of an incomplete smelting process.

Production of arsenical copper

The analyses illustrate that copper sulphides and iron arsenides were present in the smelting debris and in the vitrified sections of the crucibles. These results correspond very well with the results from the metal artefacts, where arsenical copper with sulphidic inclusions are detected.

During the last years there have been intensive discussions on the various ways to produce arsenical copper, which is the dominant sort of copper during the 4th and 3rd millennia BC. Various scholars have argued for different methods.[28] In the following they will be summarised briefly. The first possibility would be that a mixture of copper ores with arsenic-bearing minerals (intentional or unintentional) was smelted in a crucible. This particular smelting process, the so-called 'co-smelting', produces arsenical copper in a single step. It is postulated for the Late Chalcolithic/Early Bronze Age sites of Tappeh Silak and other sites in Iran, as well as for the sites of e.g. İkiztepe or Murgul, Turkey.[29] Archaeometric research recently carried out on slags from Arisman, western Iran point to another possibility. These analyses provide evidence that 'speiss', an

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[26] Mehofer, in preparation.

[27] Mehofer, in preparation.

[28] E g. Heskel 1983; Rostoker et al. 1989; Lechtman – Klein 1999; Hauptmann et al. 2003, 211; Pigott 2008; Thornton et al. 2009, 314; Pernicka et. al. 2011; Rehren et al. 2012; see also Pernicka, this volume 447–462.

[29] Other sites with approx. contemporaneous dating and comparable finds are Arisman (Iran); Phaskalio Kavos (Cyclades); Poros Katsambas (Crete); Shar-i Sokhta (Iran); Teppeh Hissar (Iran); Lutz et al. 1991; Hauptmann et al. 2003, 211; Birtacha –Georgakopoulou 2007, 379–403;Thornton et al. 2009, 309–210; Rehren et al. 2012.

arsenic-bearing smelting product, was produced in a separate smelting process.[30] In a final step, this arsenic-rich speiss was then melted together with copper or copper ore in order to produce arsenical copper.

The detection of copper(iron)sulphides and iron arsenides in separate zones, in the aforementioned smelting debris (Tab. 1) may also suggest different interpretations. It is possible that during a 'co-smelting' process[31] the smelting conditions in the crucible were not suitable for oxidising the sulphur; therefore, copper sulphides and other phases were formed. A second explanation might be that the used copper (ore)[32] or the separately produced speiss (deriving from an arsenopyritic ore) still contained a small amount of sulphur,[33] which then formed the copper sulphides during the smelting process. Both scenarios would end in the observed smelting debris, but as the archaeometallurgical analyses are still in progress no definitive assignments[34] can be made. Nevertheless, we can state that arsenical copper was produced at the site[35] itself during the EBA 1.

Early Metalworking in Western Anatolia

It seems quite reasonable that the well-developed system of metalworking described above (including all stages of production) must be rooted in the 4th millennium BC (or even earlier). The mapping of metal artefacts dating before 4000 BC revealed that it is still difficult to find early evidence for metalworking in western Anatolia (e.g. by crucible finds) as pointed out by Ernst Chernykh[36] in a recent article on radiocarbon chronology and metallurgical provinces. In central and eastern Anatolia, we already have evidence for metalworking and processing dating to c. 5000 BC and before. These include copper beads from Aşıklı Höyük (PPNB), Çayönü Tepesi (PPNB), Nevali Çori (PPNB), Çatal Höyük (layer IV-IX), a hammered mace head from Çan Hasan 2b, a casted chisel and a flat axe found in layer XVI of Mersin-Yumuktepe, slag fragments found in Tepecik and Tülintepe (Altınova), as well as a copper ingot found in Değirmentepe.[37]

A closer look at the western Anatolian finds made it possible to identify several sites, where metal or metalworking took place before the middle of the 4th millennium BC (Figs. 4–5). The oldest metal artefacts from the western Anatolian region came from Haçilar (layer Ia–IIa ~ 6000 BC).[38] There, two copper beads from an unknown production place (concerning the provenance of the metal) were found. Subsequent metal objects and a crucible fragment from Orman Fidanlığı (layer VII)[39] are dated to the advanced respectively late 5th millennium BC. Furthermore, one can mention a fragmented metal ring[40] found in Emporio on Chios (layer IX–VIII). Interestingly, the excavator of Emporio, Sinclair Hood, believes that this object was part of a ring idol.

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30 Thornton et al. 2009, 311, 313, tab. 1 ; Pernicka et al. 2011; Rehren et al. 2012.

31 Lechtman – Klein 1999; Pernicka et al. 2011; Rehren et al. 2012; Horejs – Mehofer, in print.

32 Usually it is believed that the copper ore was collected from or near the surface, e.g. from the gossan of a sulphidic ore body. There the carbonatic copper ores are dominant but some sulphidic ores can still be present in this section.

33 Pernicka et al. 2011; Rehren et al. 2012.

34 Mehofer, in preparation.

35 Geological mapping of the surrounding hilly landscape of the Çukuriçi Höyük allowed us to observe various metallic mineral deposits such as lead-, silver-, gold- and arsenic bearing ores. This suggests that some of the metals used were present in the wider neighbourhood of the site. Further research to confirm, whether the ore deposits were in fact exploited and mined will be carried out in the future in co-operation with Danilo Wolf and Gregor Borg, University Halle. Kaptan 2008, 249, fig. 2; Lengeranlı 2008, 366, fig. 1; Wolf et al. 2012.

36 Chernykh et al. 2002; Chernykh 2011, 156, fig. 6.

37 Yalçin 2000, 17, 19, 22, fig. 1, tab. 2; see also Pernicka, this volume 447–462.

38 Yalçin 2000, 19, tab. 2.

39 Ay-Efe 2001, 139, 157, pl. 3d–e; Zimmermann 2011, 300; Zimmermann 2005.

40 Hood 1982, 657, 661, 664, fig. 295.17.

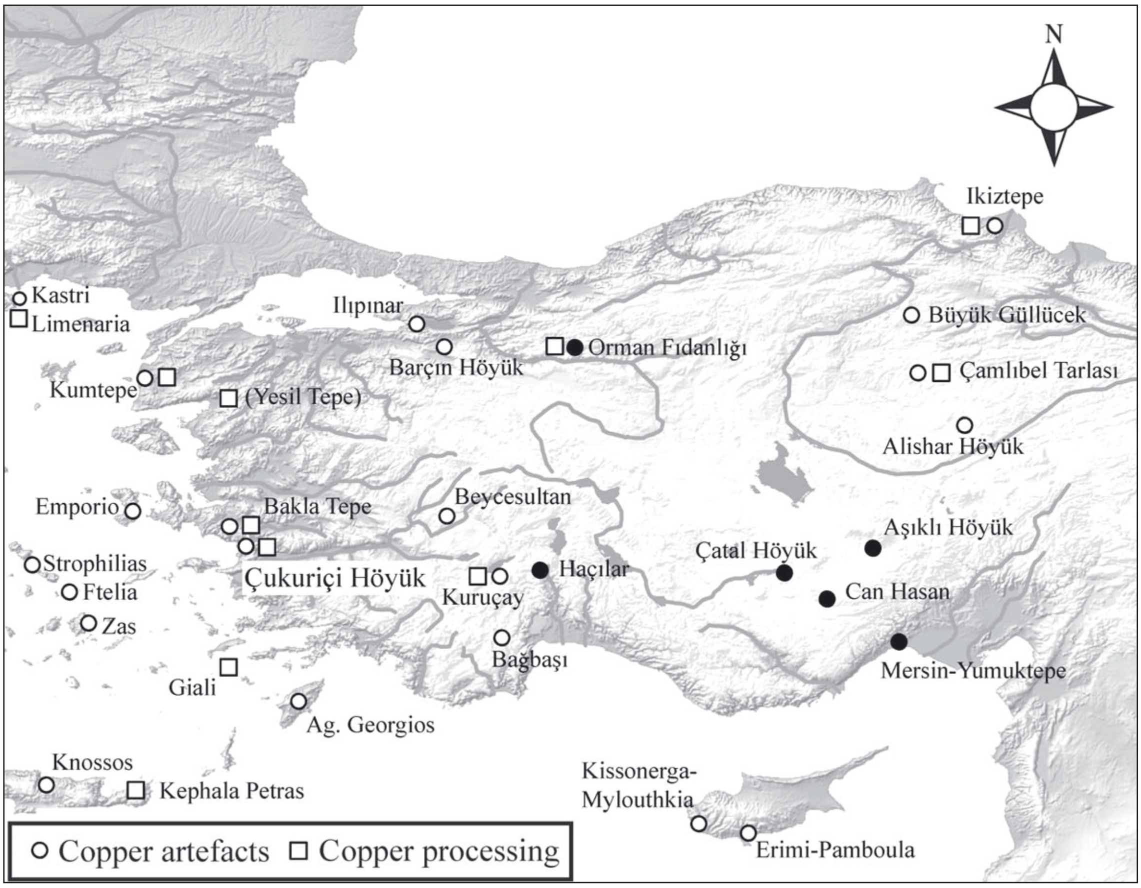

Fig. 4 Sites with copper finds or evidence for copper working dating to the 5th and 4th millennia BC in the Aegean and Turkey. The full dots mark sites, where metal or metalworking is known before the middle of the 5th millennium BC ( ) = dating or provenance unsecure (after Alram-Stern 1996; Sampson 2002; Zachos 2007; Zimmermann 2011) (© M. Mehofer, VIAS).

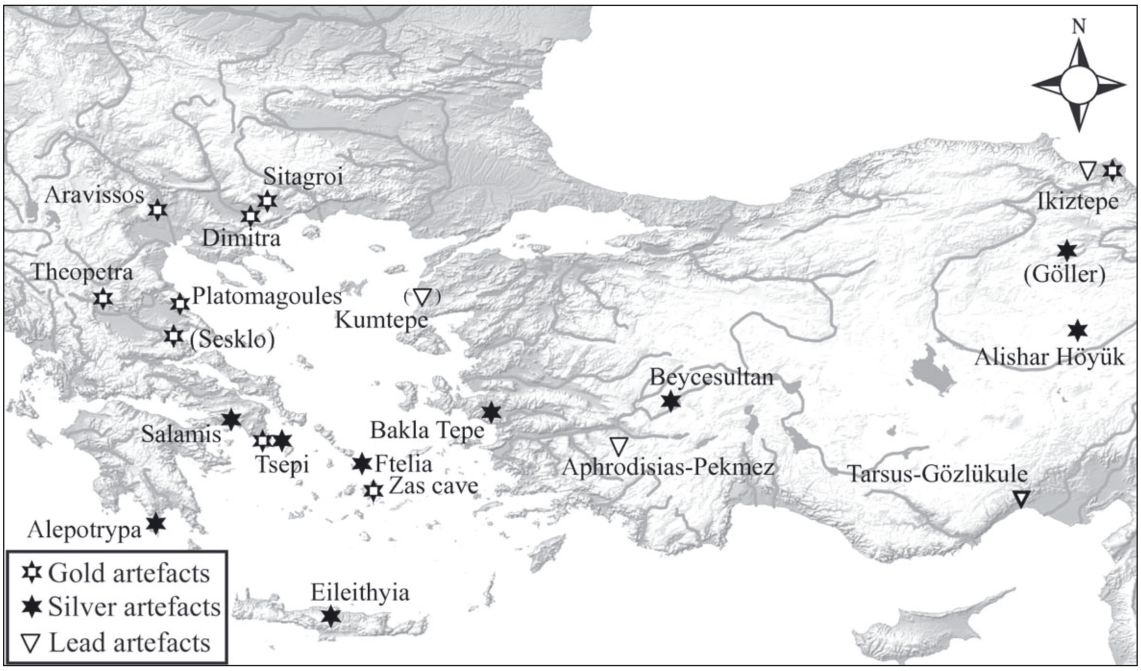

Fig. 5 The map show sites where objects made of gold, silver or lead were found in the regions under study. ( ) = dating or provenance unsecure (after Demakopoulou 1998; Zachos 2007; Pantelidou Gofa 2008; Zimmermann 2011) (© M. Mehofer, VIAS).

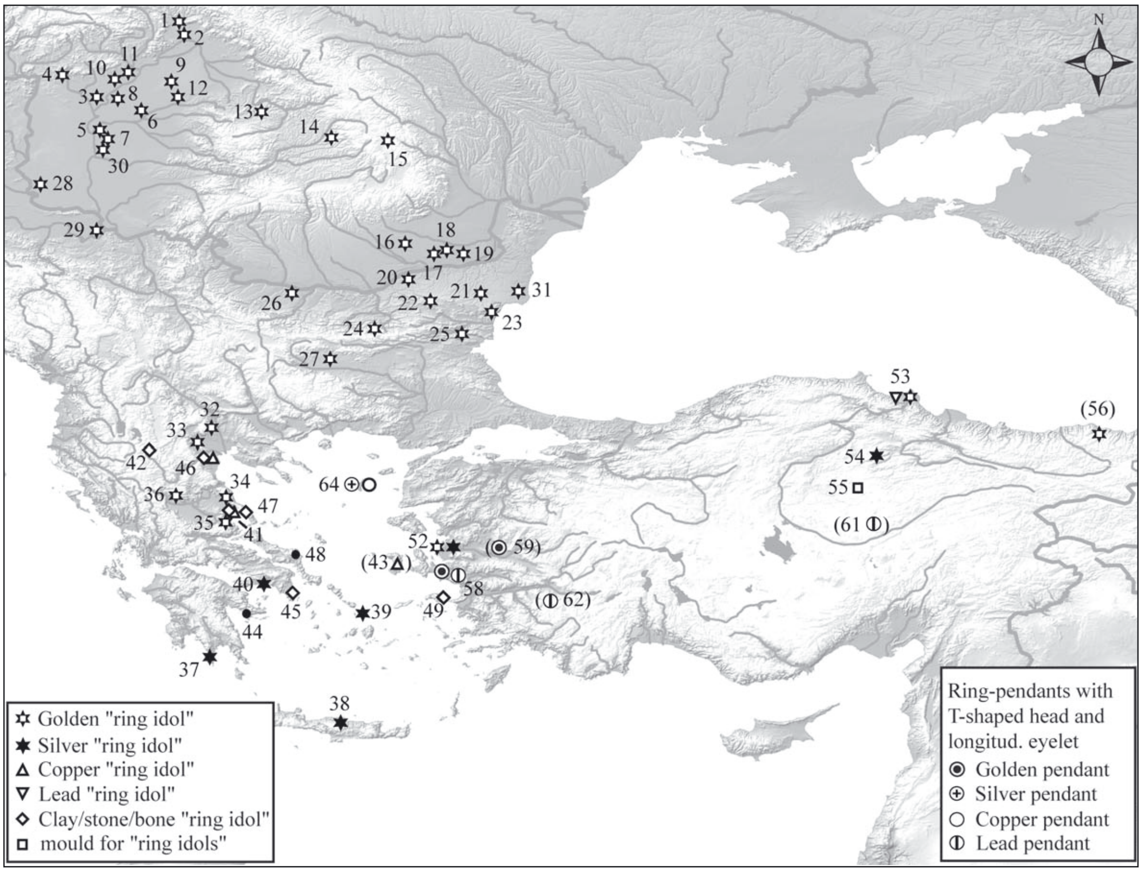

Fig. 6 Sites where 'ring idols' (Appendix, List 1), ring-pendants with T-shaped head and longitudinally orientated eyelets (Appendix, List 2), pottery fragments with 'ring idol' decoration or corresponding features (rock carvings) were found on the Balkans, Greece and Turkey. 1. Tibava; 2. Vel´ké Raškovce; 3. Jászladány; 4. Hatvan-Újtelep; 5. Pusztaistvánháza; 6. Magyarhomorg-Kónyadomb; 7. Magyartés; 8. Tiszaszőlős; 9. Hencida; 10. Tiszavalk-Tétes; 11. Tiszavalk-Kenderföld; 12. Oradea; 13. Moigrad; 14. Targu Mureş; 15. Traian; 16. Vidra; 17. Sultana; 18. Gumeniţa; 19. Vărăşti; 20. Ruse; 21. Dălgopol; 22. Radingrad; 23. Varna; 24. Chatnica; 25. Sava; 26. Sofronievo; 27. vicinity of Pazardžik; 28. Vajska; 29. Progar; 30. Hódmezővásárhely-Kishomok; 31. Durankulak; 32. Aravissos; 33. Palimbela - Kolindrou; 34. Platomagoules; 35. Sesklo; 36. Theopetra cave; 37. Alepotrypa cave; 38. Eileithyia; 39. Ftelia; 40. 'Euripides' cave near Salamis; 41. Dimini; 42. Dispilio, Kastri; 43. Emporio, Chios; 44. Franchthi cave, pottery fragments.; 45. Kitsos cave; 46. Makrygialos; 47. Pevkakia; 48. Strophilas on Andros rock carvings; 49. Tigani, Samos; 50. – 51. no find place (see Appendix, List 1); 52. Ege Gübre; 53. İkiztepe; 54. Göller; 55. Çamlıbel Tarlası; 56. vicinity of Trabzon; List 1; 57. no findplace (see Appendix, List 1), 58. Bakla Tepe; 59. vicinity of Sardis; 60. no findplace (see Appendix, List 1), 61. Alishar; 62. Aphrodisias-Pekmez, 63. see Appendix, List 1; 64. Poliochni. ( ) = dating, findplace or interpretation as 'ring idol/pendant' unsecure, 'ring idols/pendants' whose findplaces are not reconstructable are not displayed on the map. For the exact find contexts of the Greek examples see Appendix, List 1 (after Demakopoulou 1998; Maran 2000; Hansen 2007; Lichter 2006; Zachos 2007; Zimmermann 2007) (© M. Mehofer, VIAS).

The weapons found in the Chalcolithic cemetery of Ilıpınar (Phase IV)[41] form impressive evidence for metalworking during the first half of the 4th millennium BC. As a second important northwestern Anatolian site we can mention Barçin Höyuk, where a flat axe was found in Chalcolithic layers[42] yielding a radiocarbon date of c. 3800 BC. A slightly older date has been suggested for the finds from Aphrodisias Pekmez,[43] but its archaeological context is not secure and has to be discussed. The artefacts and crucibles from Beycesultan (level XXXIV) and Kuruçay (layer 6A, 6, 4)[44] can be

[41] Roodenberg 2008, 327, 329, figs. 8.5–7; 10.6–7; 12.6–8.
[42] This artefact is not made of locally available ores as will be shown below; Gerritsen 2010, 198, 224, fig 12.
[43] Schoop 2005, 157–159; Zimmermann 2011, 302.
[44] Lloyd-Mellart 1962, 19, 21, 112; Duru 1994; Duru 1996, 56, 125, pls. 159–161; Zimmermann 2011, 300–301.

seen as further evidence for the presence and knowlege of metalworking since the middle of the 4th millennium BC. Two very interesting pieces came from Ege Gübre, a site in the Izmir region. There, a golden and a silver 'ring idol'[45] were found in Chalcolithic contexts. The golden one is dated by ^{14}C analyses to the first half of the 4th millennium BC (cf. below). Finally, the excavations in Bağbaşı, Bakla Tepe, Liman Tepe, Çukuriçi Höyük, Yeşiltepe (with unsecured find context) revealed blow pipes, crucible fragments, furnace remains, slags and metal artefacts.[46] They all date to the second half of the 4th millennium BC and can be seen as evidence for metalworking in western Anatolia.

'Ring-Shaped Idols'

It is more than worth pointing out the two aforementioned 'ring idols' which were excavated in Ege Gübre by Haluk Sağlamtimur. The golden 'ring idol' was found in a deposit which formed part of Ege Gübre level II. The ^{14}C dates of this level give two dates between 4040–3950 BC and 3780–3640 BC.[47] The silver 'ring idol' was found in grave 4 which dates to the Chalcolithic period.[48] As they can be parallelised with examples which were found on the Balkans, they are the first 'ring idols' in 'classic ring-shaped style' which were found at the west Anatolian coastline dating before 3500 BC (cf. Appendix, List 1).

Generally, golden 'ring idols' can be found in the Balkans, in Greece, along the Turkish Black Sea coast and at the west Anatolian coastline (Fig. 6).[49] Unfortunately, many of these 'ring idols' come from unconfirmed find contexts (especially in Greece, see Appendix). Therefore their archaeological interpretation must be done with great caution.[50] One can observe that the 'ring idols' found in southern Greece were made of silver instead of gold, which hints to the early processing of silver in this region.[51] It should be mentioned that there are also certain examples which were made of clay, stone and/or bone; see the examples found at the Pevkakia Magoula, Dimini and from Makrygialos (Appendix, List 1).[52] Furthermore, there might be artefacts of this type which are not yet published or lacking a clear interpretation as 'ring idols'. For example, we can list the aforementioned ring fragment found in Emporio (Chios).[53] One can also find these symbols as part of rock carvings (Strophilas on Andros)[54] or as decorative items on pottery, e.g. from Dimini, Kastro Tigani, the Franchthi Cave[55] and one pottery fragment from Selsko.[56]

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45 Sağlamtimur 2007; Sağlamtimur 2011; Sağlamtimur – Ozan 2012, 228, fig. 6A; Keskin 2011, 199, 210, 221, no. 7, fig. 1, no. 7.

46 Erkanal 2008, 168; Kaptan 2008; Keskin 2011a,145; Zimmermann 2011, 302, note 38; Mehofer, in preparation.

47 Sağlamtimur – Ozan 2012, 240.

48 Sağlamtimur 2007; Keskin 2011, 199, 210, 221, no 7, fig. 1, no. 7; Sağlamtimur – Ozan 2012, 228, fig. 6A.

49 Bigli 1984, 70, 95, 265–266, fig. 18; Bigli 1990, 161, 218, 427, figs. 19; Parzinger 1993; Rudolph et al. 1995, 284, fig. 175; Alram-Stern 1996; Papathanasopoulos 1996, 336, fig. 290; Demakopoulou 1998, 62–67, nos. 56–74; Maran 2000, 185–188; Lichter 2006, 528–529; Hansen 2007, 282–287; Pappa 2007, 263, fig. 17; Zachos 2007; Zimmermann 2007, 27, fig. 1; Zachos 2010.

50 E.g. some time ago a huge amount of golden ring idols was confiscated by the Greek police from antiques smugglers; Maran 2000, 181, note 15; Zachos 2007.

51 Cf. the results from the rescue excavations in Merenda, Koropi, Lambrika and Laurion; Maran 2000, 185; see also Alram-Stern, this volume 305–328.

52 It would be interesting to know if some of these stone artefacts as those found in the layers Makrygialos really can be classified as ring pendants as described by Demakopoulou. Schliemann 1881, 479, fig. 157; Weißhaar 1982, 321, note 17; Felsch 1988, 116, note 516; Weißhaar 1989, 51, pl. 8.8; Hourmouziades 1996, 45, I4b; Demakopoulou 1998, 67, figs. 72–73; Pappa et. al. 1998, 67; Maran 2000, 185–192.

53 Hood 1982, 657, 661, fig. 295.17.

54 Televantou 2008, 49, figs. 6, 10; Nazou 2010, 9.

55 Höckmann 1969, 9. 12 fig. 2, pl. 1.6; Felsch 1988, 116, pl. 47.8; Demakopoulou 1998, 68, figs. 75–76; Vitelli 1999, fig. 64; Maran 2000, 161, note 60; Skafida 2008, 520, 530, figs. 7–9.

56 Tsountas 1908, 219, t. 21.2; Demakopoulou 1998, 68, no. 76; Skafida 2008, 521.

The fact that the ‘ring idols’ found in the vicinity of İkiztepe can be correlated with the exemplars found in the Balkans suggests a connection between these regions. The extent to which this exchange was operated is still not fully established or understood as recently pointed out by C. Lichter and T. Zimmermann.[57] Fortunately, a recent excavation in Çamlıbel Tarlası[58] revealed a mould for casting ‘ring idols’. U. Schoop dates the site between the early to the middle of the 4th millennium BC, which fits with the assumption that the ‘ring idols’ were no longer used after the middle of the 4th millennium BC.[59] This mould was used for casting ‘ring idols’ while most of the known examples are made of sheet metal.[60] It can be used to produce an idol with a T-shaped head and a single hole in the head whereas many of the exemplars found on the Balkans and in Greece have flat rectangular heads with one or two holes. The best parallel form of the casted ‘idol’ is found in İkiztepe,[61] but this idol seems to be made of sheet metal and not casted.

As described by J. Maran in an article on the Aegean Chalcolithic period,[62] ring pendants known from the western Anatolian coastline no longer exhibit the typical form of the ‘ring idols’. The upper part of these ring pendants, found in Early Bronze Age 1 contexts or even later, is remodelled in order to fix the pendant, for example, as part of a bracelet.[63] They have a longitudinally orientated eyelet and a more or less T-shaped head. However, the basic form is still connected to its Balkan ancestor (Appendix, List 2). These western Anatolian ‘derivatives’[64] were not only made of different metals like copper, silver and lead; they were also casted instead of being cut out of hammered sheet metal. These specific technological features can be assumed for two silver and copper pendants from Poliochni (phase ‘rosso’),[65] three from Bakla Tepe, one exemplar from Sardis (without context).[66]

The archaeological interpretation of all these western Anatolian ‘derivates’ is still under discussion as they generally date after 3000 BC. This is more than 500 years after the assumed end of use of the ‘Balkan style’ metallic ‘ring idols’.[67] In this context the two aforementioned ‘ring idols’ from Ege Gübre are of particular interest. They provide evidence that during the 4th millennium BC and before, this specific form was not only known in the Balkans, in Greece and in Northern Turkey but also in western Anatolia and might have influenced the development of these later dated ‘derivates’. Moreover one can mention that all the ‘ring idols’ found in Greece which come from regular excavations were found in caves or settlement contexts (and not in graves) whereas some of the well stratified ‘ring idols’ and pendants found in Turkey derive from grave and settlement contexts (see Appendix, Lists 1–2).

Provenance Studies and Lead Isotope Analyses

The evidence for extractive metallurgy (e.g. crucibles, blow pipes, slags) in western Anatolia is still limited. However, the archaeometallurgical analyses helped us to get a deeper insight. First off, all the

57 Lichter 2006, 527–529; Hansen 2007, 284, fig. 175; Zimmermann 2007, 27, fig. 1.
58 Schoop 2011, 59, fig. 9.
59 Maran 2000, 185; Lichter 2006, 529.
60 E.g. Maran 2000, 185–188; Lichter 2006, 528–529; Hansen 2007, 282–287; Kaltsas 2007, 39–41; Zimmermann 2007, 28–29, figs. 2–33.
61 Zimmermann 2007, 28, fig. 3.2.
62 Maran 2000, 188.
63 Cf. the reconstruction published in Keskin 2011a, 280, cat. no. 164.
64 Zimmermann 2011, 302.
65 Bernabó-Brea 1964, 663, 170, 3, pl. 177.25, 28; Maran 2000, 188.
66 Six pendants found at Crete possibly also form part of this specific group; they were found at the cemeteries of Livari Skiadi (EM IB–EM IIA) and Ayios Onoufrios; Evans 1895, 111, figs. 95–96; Maran 2000, 188; Zimmermann 2007, fig. 1; Erkanal 2008, 173, fig. 6; Keskin 2011a, 148, 280, cat. nos. 163–164; 281, cat. no. 165; Papadatos – Sofianou, in print.
67 Maran 2000, 185; Lichter 2006; Zimmermann 2007; Reinholdt 2008, 30–33; Zimmermann 2008, 473.

material from Çukuriçi Höyük repeatedly yields very interesting results.[68] The EBA 1 matte-speiss fragment and the metals mentioned above have lead isotope ratios, which plot within the same narrow range (Fig. 7). As the matte-speiss fragment is interpreted as debris of the production process of arsenical copper, it can be stated that arsenical copper and the metal artefacts were produced on the tell.[69] Furthermore, it is very interesting that the Late Chalcolithic objects also fall within this isotopic group. This allows drawing the conclusion, that during the LC and EBA 1 the metallurgists had access to the same mining area(s), probably in the wider region of the site itself. It is highly important to note that two of the LC metal objects, made of arsenical copper, have almost the same lead isotope ratios meaning that both were made of the same copper metal. These two pieces – a small awl and a small metal bar – were found in the same small trench together with vitrified clay (the possible remains of a furnace), accordingly, it is obvious that they were produced on the tell.[70] Therefore, we can state that the working of arsenical copper already began during the LC period at the tell.

Subsequently, the Çukuriçi Höyük data was combined with those from other sites in Anatolia and Greece (Fig. 8). The diagram shows that there is no correlation with the great ore deposits of Laurion in Attica and on Cyprus.[71] The copper mines in Middle and Eastern Turkey,[72] which provided copper for Hassek Höyük, Arlsantepe or Norşuntepe,[73] can generally be excluded due to their different lead isotope ratios and trace element contents. The data indicates a partial overlap with the lead isotope data gathered from ore deposits found in northwestern Anatolia,[74] but they do not correspond very well. Nevertheless, it seems reasonable to localise the mined ore deposits used to produce the Çukuriçi Höyük metals to somewhere in western Anatolia.[75]

The metal artefacts found in the Chalcolithic cemetery of Ilıpınar (Phase IV)[76] provide further useful hints concerning the provenance of the earliest metal used. For comparative purposes, available dates for artefacts found in northern Greece were included in the lead isotope diagrams. Z. Stos-Gale describes that some of the Late Chalcolitic metals from Sitagroi III have the same lead isotope ratios as some Bulgarian ore deposits[77] (Fig. 9) – the Rhodope Mountains and the Burgas Region. Meanwhile, others are isotopically consistent with ores from the Taurus Mountains, the Cyclades and Lavrion.[78] These observations are also important for the interpretation of some northwest-Anatolian artefacts. The most interesting fact is that nearby all of the analysed objects from Ilıpınar

[68] The analyses were carried out at the Curt-Engelhorn Centre for Archaeometry in Mannheim.
[69] Mehofer, in preparation.
[70] Mehofer, in preparation.
[71] The ore deposits of Laurion are particularly interesting due to lead and silver production that took place there (this is also mentioned for other deposits in the Aegean). Researchers have repeatedly suggested that they were also used for copper mining. Concerning the discussion of the copper mining potential in Lavrion see e.g. Gale et al. 1985; Pernicka 1987, 671, 702; Stos-Gale 1992, 165; Pernicka 1995; Gale et al. 2004; Muhly 2005.
[72] The ore deposits of Alihoca, Bakir Daği, Derealan-Bakır Çay, Ergani Maden, Eseli Maden, Gümüş, Gümüşhane-Hazıne Mağara, Helva Maden, Işık Dağ-Maden Boğazı, Karadağ, Karoli, Keban-Fırat Batı 1, Keban-Bamaş, Keban-Kalhane, Keban-Keban Dere, Keban-Sirt, Kedak, Kısabekır, Kürtün Çayirçukur, Küre, Mamlis, Menteşe, Siirt-Madenköy, Sizma-Bakırlık, Ortabaraka, Piraziz-Madenköy, Pirajman, Tekmezar, Tirebolu-Haşit Köprüibaşi, Yakadere-Tepeyurt Kıltençik Dere, Zankar. Seeliger et al. 1985, 641, tab. 1.
[73] Seeliger et al. 1985, 642, tab. 2; Schmitt-Strecker et al. 1992, 112, tab. 2; Hauptmann et al. 2002, 49, 56, 62, tabs. 6, 9.
[74] This comprises the ore deposits of Avcilar, Balya, Camyurt, Doğancılar, Gümüşköy Kozcağiz, Serçeören Köy and Tahtaköprü. Begemann et al. 2003, 193, tab. 4.
[75] Mehofer 2011, 51.
[76] Begemann et al. 1994, 204, 213, tab. 2.
[77] A similar provenance is discussed for some artefacts found in EBA II–III contexts in Kanlıgeçit near Kırklareli. Pernicka et al. 1997, 117, 135, 147, 158–159, 161–168, tabs. 5–6; A1–A5; Stos-Gale 2003, 328; Yalçin 2012, 187.
[78] Further Greek artefacts with an early dating fall in line with the previously described observations. Two objects from Dimini are said to be made of metal from the Black Sea region and the Taurus Mountains while the objects found in Ftelia (Mykonos), in the Cyclopa cave on Giali, in the Tharounia Cave (Euboea) and Kephala-Kea have been associated with ore deposits at Kythnos, Siphnos, Seriphos, Lavrion and the Taurus mountains. McGeehan-Liritzis – Gale 1988; Stos-Gale 2003, 328, tab. 8.3.2–3.

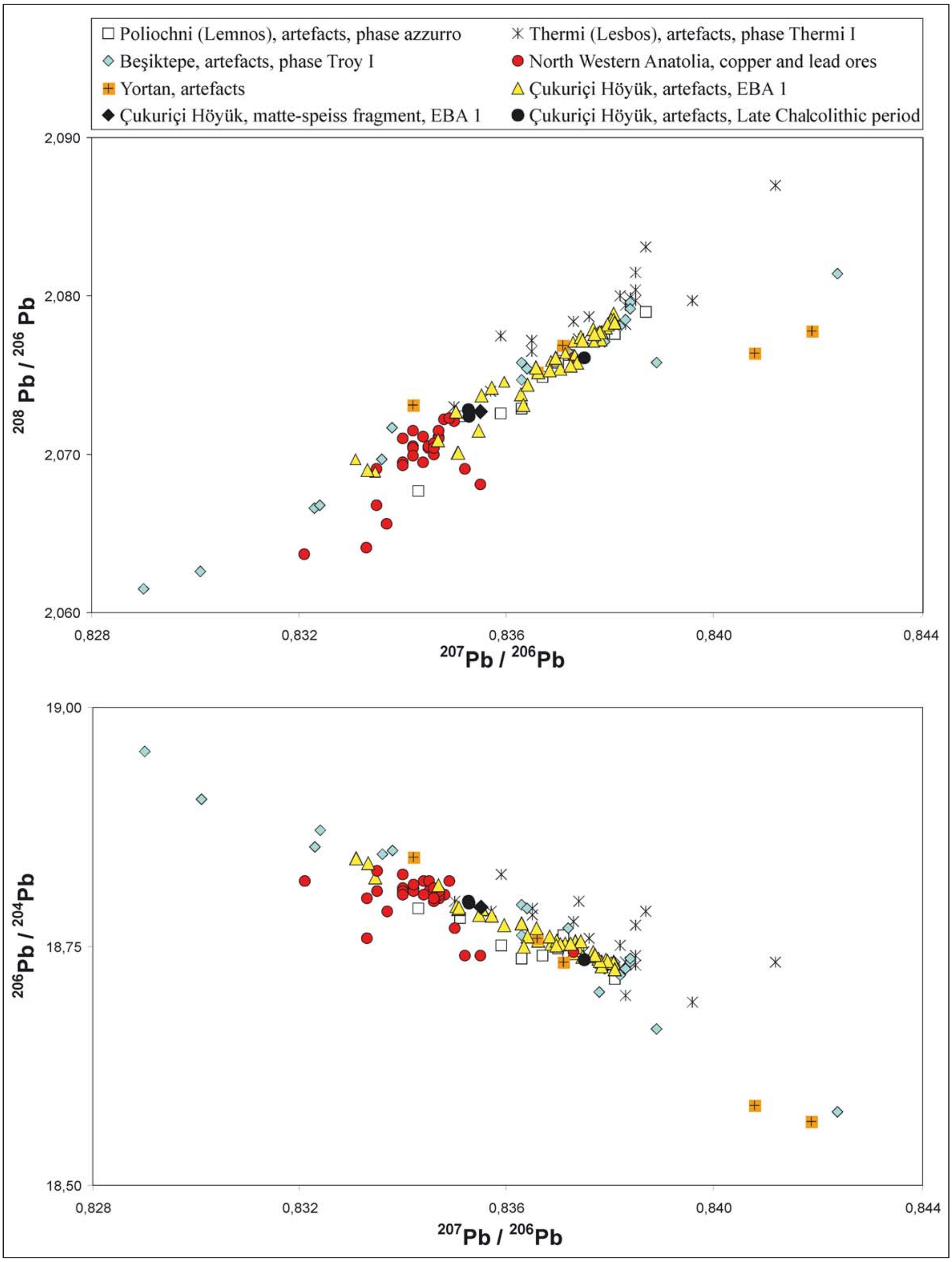

Fig. 7 In the diagram the lead isotope ratios of Çukuriçi Höyük objects dating to Late Chalcolithic period (black circles) are combined with those dating to the EBA 1 (yellow triangles). It can be observed that they plot within the same narrow range which hints to the conclusion that the copper used came from the same mining areas. It further illustrates that the objects found at the Çukuriçi Höyük coincide with objects found at Beşiktepe (blue diamonds) as well as objects found in Poliochni and Thermi (black stars and open squares); (for data see Fig. 8) (© M. Mehofer, VIAS).

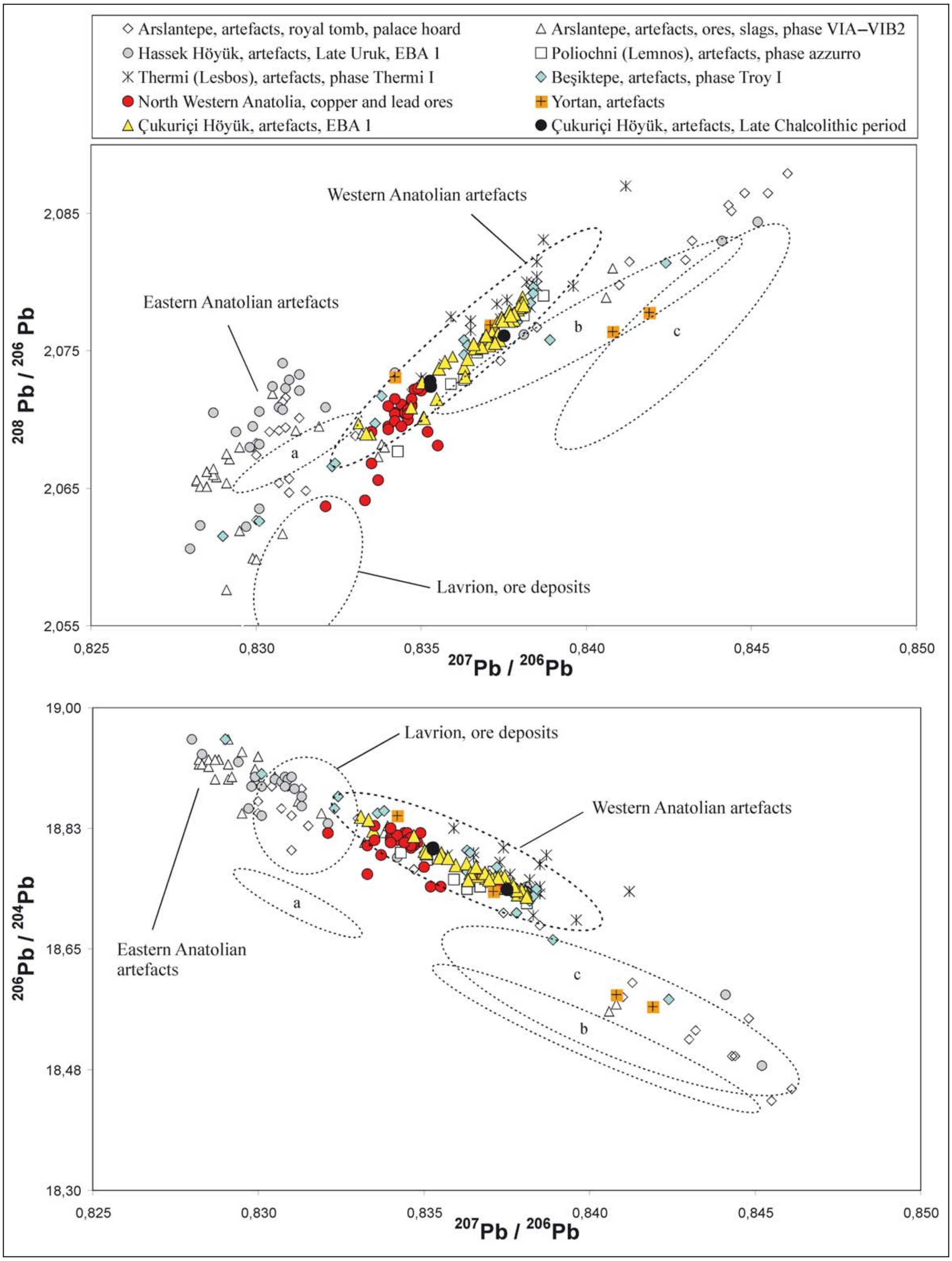

Fig. 8 The diagram presents the lead isotope ratios of the objects dating to the EBA 1, compared to published lead isotope ratios of copper and lead ores from Cyprus and Lavrion (outlined by ellipses). It suggests a partial overlap with northwestern Anatolian ore deposits (red dots) meanwhile they do not coincide with Middle and East Anatolian objects (open diamonds and triangles, grey dots), a, b, c, ... Cyprus, ore deposits, (Data: Pernicka 1984, 579, tab. 4; Gale et al. 1985, 157, 161, 167; tabs. 3, 5, 6; Seeliger et al. 1985, 641, tab. 1; Pernicka et al. 1990, 269, tab. 4; Schmitt-Strecker et al. 1992, 112, tab. 2; Stos-Gale 1992, 174, tab. 1; Begemann et al. 1994, 214, tab. 3; Hauptmann et al. 2002, 49, tab. 6; Begemann et al. 2003, 193, tab. 4) (© M. Mehofer, VIAS).

have the same lead isotope ratios and trace element contents like the later dated objects found in Poliochni, Thermi, Beşiktepe or the Çukuriçi Höyük. The finds from these sites are also made of arsenical copper and were produced from locally available ores and metals.[79] Only two of the metal finds from Ilıpınar – a dagger and a knife[80] – do not fall in line with this observation,[81] therefore, these artefacts or at least their metal must be an import to the region. Their lead isotope ratios plot in a range where we can observe not only some eastern Anatolian ores and artefacts but we can also find a concentration of Late and Final Chalcolithic Bulgarian objects and ores. Their analytical results would, therefore, allow for two interpretations. One the one hand, it is possible that the metal or the artefacts were produced in eastern Anatolia. One the other hand, these results would at least allow for the possibility that the metal for these daggers could have come from an ore source which has to be located in the Balkans.[82] Quite rightly, Begemann and his co-authors point to the fact that comparable Balkanic artefacts and ores, as well as the northwestern Anatolian ores, have a lower arsenic concentration[83] than the Ilıpınar objects making it difficult to link them together. This problem might be solved in the future as new research revealed that the arsenic was probably intentionally added as alloying element.[84] If this specific technique was already known in the 4th millennium BC in the regions under study, then this must be in the focus of future research.

Coming back to the discussion on the provenance of the early copper artefacts it is worth pointing out a flat axe found in Barcın Höyük, which can be parallelised with the axes from Kuruçay. Like some of the Ilıpınar finds, it also has a different trace element content and lead isotope ratios.[85] This would mean that it was not produced with 'west-Anatolian' ores and, therefore, it (or its metal) is an import to this region. The provenance of the metal itself to date is unknown. Finally, if the assumption that nearly all objects from Ilıpınar were produced from western Anatolian ores holds true, then we can postulate that extractive metallurgy was already known since the second quatre of the 4th millennium BC[86] or even before in the region under study.

Conclusions

The connection and influence of the Balkans (and Balkan metallurgy) on Greece and the northern Aegean regions has a long history[87] within the scientific literature (cf. the ring pendants).

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79 Horejs–Mehofer, in print.

80 These early daggers from Ilıpınar have blades with lentoid or rhombic cross sections and a triangular hilt plate. Comparable pieces, in size and shape, are known from Beycesultan (Level XVIII), İkiztepe or Çamlıbel Tarlası Phase (phase VI) meanwhile daggers with triangular shaped blades are known from various Greek sites like Alepotrypa or Aghia Marina; Stronach 1962, 281–282, fig. F.8.1; Zachos 2007, 177–179, fig. 11.6a–d, f–g; Schoop 2011, 62, fig. 14.

81 These are the objects Ilıp 88/38 (HDM 1388) found in grave UP (V-13 076) and Ilıp 88/40 (HDM 1393) found in grave UA (V-13 1 2 010); Begemann et al. 1994, 213–214, tabs. 2–3.

82 Within a recent article on early metal daggers Thomas Zimmermann postulated that certain typological forms (type Bodrogkeresztùr, Type Usatovo I-3, type Cucuteni Ost, Type Nerušaj) found in the Balkans might have influenced the development of metal daggers in northwestern Anatolia and Ilıpınar. This would fit to the previously described observations which are based on the analytical results. However, it has to be pointed out that daggers made of obsidian or flint are long known in Turkey as demonstrated by the famous flint daggers found in Çatal Höyük, which date to the 7th millennium BC. These and other stone daggers could also have served as models for the later metal daggers. Zimmermann 2006, 254–255, figs. 4–5; Zimmermann 2008.

83 Begemann et al 1994, 208.

84 Thornton et al. 2009, 311, 313, tab. 1; Pernicka et al. 2011; Rehren et al. 2012; see also Pernicka, this volume 447–462.

85 The nickel, silver and antimony contents are lower than those of the west Anatolian finds; meanwhile the arsenic content reaches 3.58%, which falls in line with the northwestern Anatolian artefacts. Gerritsen et al. 2010, 209, 212, tabs. 1–2.

86 Begemann et al. 1994, 204.

87 Renfrew – Slater 2003, 316; Hansen 2007; see also Alram-Stern, this volume 305–328.

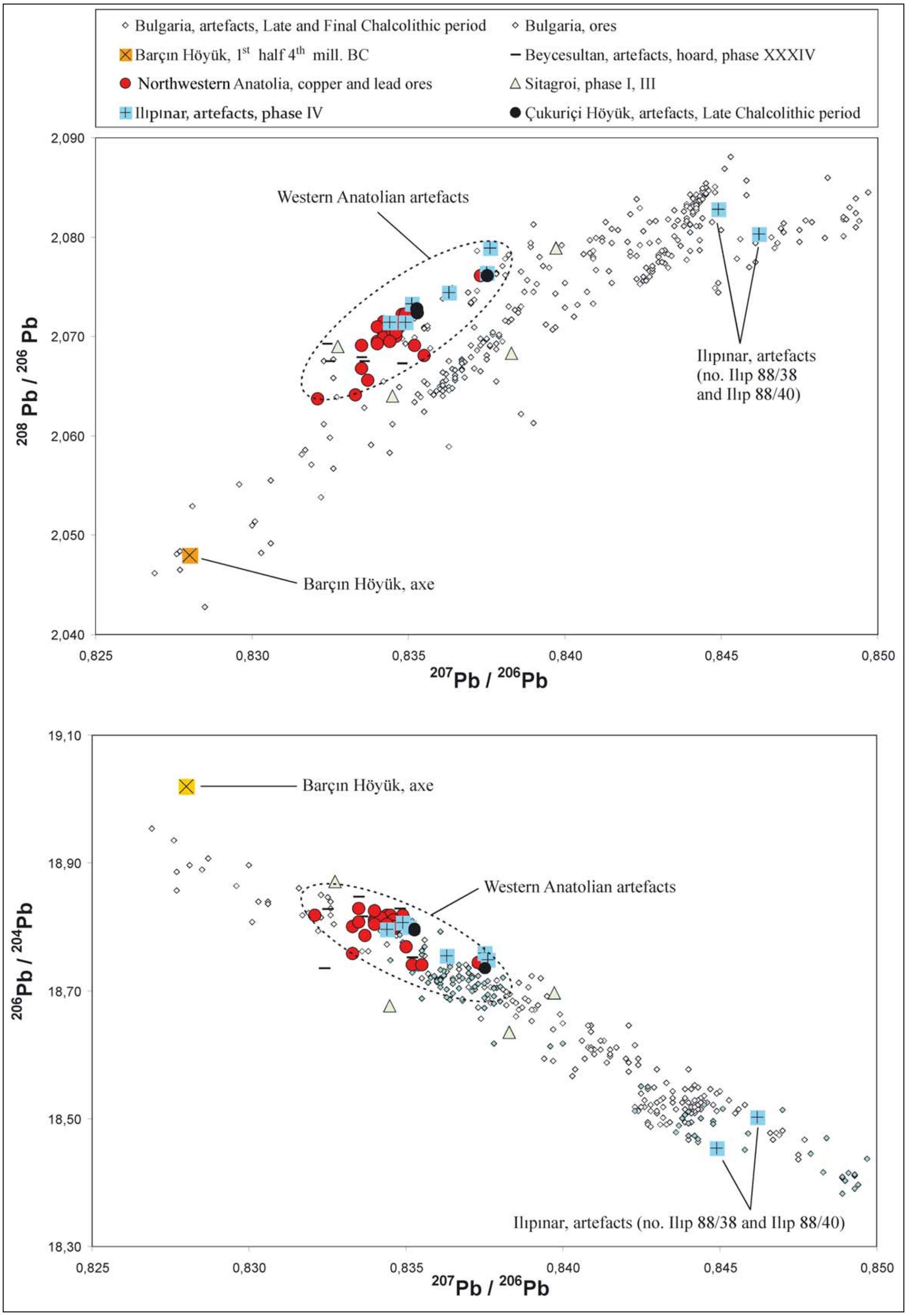

Fig. 9 In the diagram the analytical data of artefacts from the 4th and 5th millennia BC are combined. It can be observed, that two of the Ilıpınar objects (Phase IV) and an axe found in Barcın Höyük have lead isotope ratios which are not consistent with those of northwestern Anatolian ores or artefacts (Begemann et al. 1994, 214, tab. 3; Pernicka et al. 1997; Begemann et al. 2003, 193, tab. 4; Gerritsen et al. 2011, 212, tab. 2) (© M. Mehofer, VIAS).

These relations should be discussed for northwestern Anatolia. Having these possible Balkanic relations in mind it would be more than interesting to analyse the finds with early dates from Orman Fidanlığı and Haçilar to get information on the origin of the copper used on these sites.

If we summarise the described observations, it can be stated that it is not possible to find clear evidence for extractive metallurgy before 4500 BC in western Anatolia, which dates much earlier than the Balkan metallurgy. The crucible from Orman Fidanlığı[88] seems to be the oldest evidence for metalworking by pyrotechnical processes in western Anatolia. For the time span of 4000–3500 BC, we can mention the axe from Barcın Höyük, an import to the region, and objects from Ilıpınar, where most of the finds already have a 'local' lead isotope signature, which would make them the oldest artefacts produced of local ores. The subsequent finds would be the artefacts and crucibles from Beycesultan and Kuruçay. Finally, from the middle of the 4th millennium BC onwards metalworking reaches the West Anatolian coastline and is also observed in Greece and the Aegean.[89] With the beginning of the 3rd millennium BC, evidence for extractive metallurgy becomes denser in Anatolia and in the neighbouring regions.

These observations show that from a metallurgical point of view it is still difficult to close the gap between Europe and western Anatolia. Especially, for the period before 3500 BC or even 4000 BC, the archaeological and analytical evidence for the smelting of copper ores in western Turkey is limited. On the one hand, this may be caused by the state of research in the area under study; on the other hand, other explanations[90] are also possible. However, with the beginning of the 3rd millennium BC the exchange of new metal technologies between Europe and Anatolia seems to be established. This is demonstrated by specific silver-copper alloys or the spread of the new copper-tin alloy – the bronze.[91] Finally, we are still in need of well stratified sites with metallurgical remains and especially of more analytical data since these are a powerful research tools to make such correlations visible.

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[88] To date, the artefacts of Orman Fidanlığı are not analysed; therefore, no statements concerning the provenance of the metal used could be made.
[89] Parzinger 1993, pls. 227–230; Alram-Stern 1996, 181; Zachos 2007; Todaro – Di Tonto 2008, 183; see also Alram-Stern, this volume 305–328.
[90] Renfrew 1969; see Pernicka, this volume 447–462.
[91] Pernicka et al. 2003, 168, fig. 15.

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Appendix

List 1: Sites with 'Ring Idols' and Ring Pendants on the Balkans, in Turkey and Greece

Carparthian Basin and the Balkans

1. Tibava; 2. Vel´ké Raškovce; 3. Jászladány; 4. Hatvan-Újtelep; 5. Pusztaistvánháza; 6. Magyarhomorg-Kónyadomb; 7. Magyartés; 8. Tiszaszőlős; 9. Hencida; 10. Tiszavalk-Tétes; 11. Tiszavalk-Kenderföld; 12. Oradea; 13. Moigrad; 14. Targu Mureş; 15. Traian; 16. Vidra; 17. Sultana; 18. Gumeniţa; 19. Vărăşti; 20. Ruse; 21. Dălgopol; 22. Radingrad; 23. Varna; 24. Chatnica; 25. Sava; 26. Sofronievo; 27. Surroundings of Pazardžik; 28. Vajska; 29. Progar; 30. Hódmezővasárhely-Kishomok; 31. Durankulak (after Hansen 2007, 284, fig. 175, 504–515).

Mainlaind Greece and the Aegean

Golden 'Ring Idols'

32. Aravissos, Pella: 1 golden 'ring idol', 2 golden artefacts, without context (Demakopoulou 1998, 62, nos. 58–60; Zachos 2007, 174).

33. Paliambela, Pieria: 1 fragmented golden 'ring idol', found in settlement layers, dating: Late Neolithic period (Greek chronological system) (Kotsakis – Halstead 2002, 414, fig. 11).

34. Platomagoules, Magnesia: 1 golden 'ring idol', without context (Demakopoulou 1998, 62, no. 56 ; Zachos 2007, 174).

35. Sesklo, Magnesia: 1 golden 'ring idol' (now lost), 1 pottery fragment decorated with painted 'ring idol' motives (Tsountas 1908, 219, tab. 21/2; Demakopoulou 1998, 68, no. 76; Zachos 2007, 171; Skafida 2008, 521).

36. Theopetra Cave, Kalambaka: 1 golden 'ring idol', comes from an excavation, but not securely stratified (Demakopoulou 1998, 62, no. 57; Zachos 2007, 174).

Silver 'Ring Idols'

37. Alepotrypa cave, Mani: 1 silver 'ring idol', (together with 9 silver artefacts, 1 necklace), no context published (Demakopoulou 1998, 65, nos. 64–66).

38. Eileithyia cave, Aminissos, Crete: 1 silver 'ring idol' (Demakopoulou 1998, 64, no. 63).

39. Ftelia, Mykonos: 1 silver 'ring idol' (Sampson 2002, 124).

40. 'Euripides' Cave near Salamis, Attica: 1 silver 'ring idol', 1 silver ring, without context (Demakopoulou 1998, 64, no. 62; Zachos 2007, 174).

Other Finds (Copper, Clay, Stone, Decoration)

41. Dimini, Magnesia: 1 copper pendant, 3 'ring idols' made of stone, 3 pieces of painted pottery with 'ring idol' motives (Demakopoulou 1998, 66, nos. 67–89, 68, no 75; Zachos 2007, 172; Skafida 2008, 529, figs. 7/530; 8–9).

42. Dispilio, Kastoria: 1 'ring idol' made of stone (Demakopoulou 1998, 67, no. 74).

43. Emporio, Chios: 1 fragmented copper ring interpreted as 'ring idol' (?), found in the settlement (layer IX–VIII) (Hood 1982, 657, 661, fig. 295/17).

44. Franchthi Cave: pottery fragment with painted ‘ring idol’ motives (Vitelli 1999, fig. 64).

45. Kitsos cave, Attica: 1 ‘ring idol’ made of stone (Demakopoulou 1998, 67, no. 71).

46. Makrygialos, Pieria: 1 fragmented copper pendant (settlement context: Makrygialos II), 2 further stone artefacts interpreted as ‘ring idols’, settlement finds (Demakopoulou 1998, 67, nos. 72–73; Pappa 2007, 263, fig. 17).

47. Pevkakia, Magnesia: 1 ‘ring idol’ made of clay, settlement context (Demakopoulou 1998, 66, no. 70).

48. Strophilas, Andros: rock carvings with ‘ring idol’ motives (Televantou 2008, 49, fig. 6, 10; Nazou 2010, 9).

49: Tigani, Samos: 1 pottery fragment with plastic ‘ring idol’ decoration (Felsch 1988, Taf. 47.8)

Unknown Provenance

50. Collected near Ptolemaida: 1 golden ‘ring idol’. Reinholdt lists this object as surface find, to date it was only mentioned in the local newspaper (Reinholdt 2008, 31, note 104).

51. Convolute of 55 golden artefacts with 32 golden ‘ring idols’, without context (Demakopoulou 1998, 51–62, nos. 3–55; Zachos 2007, 174).

Turkey

Gold, Silver and Lead ‘Ring Idols’

52. Ege Gübre: 1 golden ‘ring idol’ was found in a deposit in Ege Gübre level II, 1 silver ‘ring idol’ was found in grave 4 at this site, dating: The golden ‘ring idol’ was excavated within a deposit of Level II of Ege Gübre. The ^{14}C analyses give two dates for this Chalcolithic level, in particular 4040–3950 BC and 3780–3640 BC. Grave 4 also dates to the Chalcolithic period (courtesy of Haluk Saglamtimur, Ege University Izmir; Keskin 2011, 199, 210, no. 7; 221, fig. 1, no.7; Sağlamtimur – Ozan 2012, 228, fig. 6A, 240).

53. İkiztepe: 2 golden ‘ring idols’ (1 without head, 1 with T-shaped head), 1 lead ‘ring idol’ with T-shaped head, found in graves, dating under discussion (Chalcolithic period) (Bigli 1984, 265, fig. 18; Bigli 1990, 161, 427, fig. 19; Zimmermann 2007, 28, fig. 3.1–3).

54. Göller near Oymaagaç (context unsecure): 1 silver ‘ring idol’ (Lichter 2006, 528; Zimmermann 2007, 29, figs. 4, 1).

Other Finds (e.g. Mould or from Unknown Context)

55. Çamlıbel Tarlası: 1 mould for ring pendant with T-shaped head found in a settlement, dating: early to the middle of the 4th millennium BC (Schoop 2011, 59, fig. 9).

56. ‘group of jewellery no. 1’, unknown provenance, (Turkey?), said to come from the region of Trabzon, no context: 12 golden ‘ring idols’, jewellery, carnelian bracelets (Rudolph 1995, 27, fig. 30.1, E; Lichter 2006, 528; Zimmermann 2007, 28, figs. 3, 4–6).

57. Turkey, no context: 1 golden ‘ring idol’, formerly said to be found in Kalınkaya (Lichter 2006, 528; Zimmermann 2007, 28).

List 2: Ring-Pendants with T-Shaped Head and Longitudinally Orientated Eyelet

Turkey

Golden Ring Pendants

58. Bakla Tepe, Turkey: 1 golden pendant with T-shaped head and longitudinally orientated eyelet, 2 lead pendants with T-shaped perforated head and longitudinally orientated eyelet, found in graves, dating: EBA 1–2 (Erkanal 2008, 173, fig. 6; Keskin 2011, 148, 280–281, no. 163–165).

Other Finds (e.g. Context Unknown or Interpretation as Part of this Group Insecure)

59. vicinity of Sardis: 1 golden pendant with T-shaped perforated head and longitudinally orientated eyelet, no context (Zimmermann 2007, 29, fig. 4.2).

60. 'group of jewellery no. 2', unknown provenance (Turkey or Mesopotamia?), 4 golden ring pendants with T-shaped head and longitudinally orientated eyelet, bracelets, ear-rings, precious stones etc. (Rudolph 1995, 35, 42, 43, fig. 2, I).

61. Alishar, 1 ring pendant with T-shaped head made of lead, found in a grave, dating 'Copper age' (von der Osten 1937, fig. 197, c753).

62. Aphrodisias-Pekmez: 1 lead pendant without T-shaped head, interpretation as part of the 'ring pendant/idol' group questionable, found in a settlement area, new research dates the find to the end of the 5th millenium BC (Reinholdt 2008, 131, fig. 17.10; Keskin 2011, 221 fig. 1.8; Zimmermann 2011, 301, fig. 2.9).

63. 1 vessel with plastic 'ring pendant' decoration, private collection, no context (Höckmann 1984, 133, fig. 7.3; Keskin 2011, 210, no. 23).

Greece

Silver and Copper Ring Pendants

64. Poliochni, Lemnos: 2 ring pendants with longitudinally orientated eyelet found in the settlement, 1 made of silver, 1 made of copper, dating: phase 'rosso' (Bernabó-Brea 1964, 663, pls. 170.3; 177.25, 28; Maran 2000, 188).

List of Participants

Eva Alram
OREA Institute for Oriental and European Archaeology
Austrian Academy of Sciences
Dr. Ignaz Seipel-Platz 2
1010 Vienna
Austria
eva.alram@oeaw.ac.at

Stephan W. E. Blum
Eberhard-Karls-Universität Tübingen
Institut für Ur- und Frühgeschichte und Archäologie des Mittelalters
Abt. Jüngere Urgeschichte und Frühgeschichte
Projekt Troia
Schloß Hohentübingen / Burgsteige 11
72070 Tübingen
Germany
stephan.blum@uni-tuebingen.de

Donald Easton
12, Weltje Road
London W6 9TG
United Kingdom
donaldfeaston@hotmail.com

Alfred Galik
Inst. of Anatomy, Histology and Embryology
Department of Pathobiology
Univ. of Veterinary Medicine Vienna
Veterinärplatz 1
1210 Vienna
Austria
Alfred.Galik@vetmeduni.ac.at

Ivan Gatsov
New Bulgarian University
21 Montevideo Str.
1618 Sofia
Bulgaria
igatsov@yahoo.com

Christoph Gerber
Institut für Ur- und Frühgeschichte und Vorderasiatische Archäologie
Ruprechts-Karl-Universität Heidelberg
(Geschäftszimmer / E-Mail: Daniela.Wacker@zaw.uni-heidelberg.de)
Marstallhof 4
69117 Heidelberg
Germany
Christoph.gerber@zaw.uni-heidelberg.de

Sevinç Günel
Hacettepe Üniversitesi
Edebiyat Fakültesi
Arkeoloji Bölüm Başkanı
Beytepe / Ankara
Turkey
sgunel@hacettepe.edu.tr

Svend Hansen
Deutsches Archäologisches Institut
Eurasien-Abteilung
Im Dol 2-6
14195 Berlin
Germany
svend.hansen@dainst.de

Barbara Horejs
OREA Institute for Oriental and European Archaeology
Austrian Academy of Sciences
Dr. Ignaz Seipel-Platz 2
1010 Vienna
Austria
barbara.horejs@oeaw.ac.at

Ourania Kouka
Department of History and Archaeology
Archaeological Research Unit
University of Cyprus
P.O.Box 20537
1678 Nicosia
Cyprus
ouraniak@ucy.ac.cy

Raiko Krauß
Institut für Ur- und Frühgeschichte
und Archäologie des Mittelalters
Schloß Hohentübingen
Burgsteige 11
72070 Tübingen
Germany
raiko.krauss@ifu.uni-tuebingen.de

Mathias Mehofer
Archäometallurgie
VIAS Vienna Institute for Archaeological Science
Archäologiezentrum
Franz Klein-Gasse 1
1190 Vienna
Austria
Mathias.Mehofer@univie.ac.at

Petranka Nedelcheva
New Bulgarian University
21 Montevideo Str.
1618 Sofia
Bulgaria
pepini@gbg.bg

Hussein Othmanli
Institute of Soil Science and Land Evaluation
University of Hohenheim
Emil-Wolff-Str. 27
70599 Stuttgart
Germany
husseinothmanli@hotmail.com

Mehmet Özdoğan
Prehistorya Anabilim Dalı
Room 106
Edebiyat Fakültesi
İstanbul Üniversitesi
İstanbul 34132
Turkey
C.mozdo@gmail.com

Yiannis Papadatos
University of Athens
Faculty of Philosophy,
Dept of History and Archaeology
University Campus
15784 Athens
Greece
gpapadat@arch.uoa.gr

Ernst Pernicka
Curt-Engelhorn-Zentrum Archäometrie gGmbH
an der Universität Heidelberg
D5, Museum Weltkulturen,
68159 Mannheim
Germany
ernst.pernicka@cez-archaeometrie.de

Konstantin Pustovoytov
Institut für Bodenkunde und Standortslehre
Universität Hohenheim
Emil-Wolff-Str. 27
70599 Stuttgart
Germany
Konstantin.Pustovoytov@uni-hohenheim.de

Agathe Reingruber
Eurasien-Abteilung des DAI
Im Dol 2-6
14195 Berlin
Germany
agathe.reingruber@dainst.de

Simone Riehl
Institut für Naturwissenschaftliche Archäologie, Universität Tübingen
und Senckenberg Center for Human Evolution and Palaeoenvironment (HEP)
Rümelinstraße 23
72070 Tübingen
Germany
simone.riehl@uni-tuebingen.de

Vasıf Şahoğlu
Ankara University,
Faculty of Languages, History and Geography (DTCF),
Department of Archaeology
TR06100, Sıhhiye
Ankara
Turkey
sahoglu@ankara.edu.tr

Ulf-Dietrich Schoop
University of Edinburgh
School of History, Classics and Archaeology
William Robertson Wing
Old Medical School
Teviot Place
Edinburgh
EH8 9AG
Scotland, United Kingdom
Ulf.Schoop@ed.ac.uk

Peter Tomkins
Riddersstraat 14
3000 Leuven
Belgium
pdtomkins@yahoo.co.uk

Zoï Tsirtsoni
CNRS-UMR 7041 Archéologies et Sciences de l'Antiquité
Maison d'Archéologie et d'Ethnologie R. Ginouvès
21, allée de l'Université
92023 Nanterre cedex
France
zoi.tsirtsoni@mae.u-paris10.fr

Rıza Tuncel
Eastern Mediterranean University
Faculty of Arts and Sciences
Department of Arts, Humanities and Social Sciences,
Famagusta
Cyprus
riza.tuncel@emu.edu.tr

Lynn Welton
Department of Classics, Near Eastern and Religious Studies
University of British Columbia
1866 Main Mall
Vancouver, BC
Canada V6T 1Z1
lynn.welton@ubc.ca

Bernhard Weninger
Universität zu Köln
Institut für Ur- und Frühgeschichte
Weyertal 125
50923 Cologne
Germany
b.weninger@uni-koeln.de