

Editorial

Anthracology: Charcoal Science in Archaeology and Palaeoecology

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Anthracology, the field of environmental archaeology concerned with the study and interpretation of wood charcoal macrofossils retrieved from archaeological sites and off-site palaeoecological contexts, is a well-established discipline with its own theoretical principles and methodologies within the domains of archaeological science and palaeoecology. This special issue of *Quaternary International* bears testimony to the maturity and achievements of the discipline. Titled **Anthracology: Charcoal Science in Archaeology and Palaeoecology**, it comprises select papers presented at *Anthraco2019 – 7th International Anthracology Meeting* held at the University of Liverpool Central Teaching Hub, 2-6 September 2019, under the auspices of the Department of Archaeology, Classics and Egyptology (Fig 1). Anthraco2019 hosted circa 100 oral and poster presentations organized in six thematic sessions. The thirty-three papers included in this special issue offer a representative sample of the dynamism of contemporary scholarship feeding into the archaeological and palaeoecological interpretation of wood charcoal: one of the most enduring (and archaeologically omnipresent) material residues of human-environment interactions from the Palaeolithic to the present era, originating from the human use of wood as fuel and raw material.

Anthraco2019 brought the current state-of-the-art in anthracology to a broad international audience of academic researchers, professional archaeologists and students of archaeology and human palaeoecology from the UK, continental Europe, the Middle East, Africa, China and the Americas. Kabukcu and Chabal (2021, this volume) open this special issue with the first comprehensive overview

of the theoretical and methodological principles of archaeological charcoal sampling, quantification and palaeoecological interpretation published two decades on from the [Chabal et al. \(1999\)](#) seminal reference chapter. In the intervening years, three more papers provided theoretically anchored reference points: [Asouti and Austin \(2005\)](#) presented the first account published in English of the Montpellier school methodological precepts for the palaeoecological interpretation of archaeo-anthracological assemblages, addressing then long-standing biases in Anglo-American scholarship vis a vis the perceived lack of quantification potential of archaeological charcoals and providing an ethnographically-informed framework for approaching the issue of fuel wood selection based on settlement type, subsistence practices, and vegetation cover and structure. [Picornell Gelabert et al. \(2011\)](#) focused on fuel wood selection; using an ethnographic case study from the Fang slash-and-burn cultivators of Equatorial Guinea alongside selected ethnohistorical and archaeological examples, they queried the complex interactions between cultural, ecological and economic variables in shaping firewood collection strategies. More recently, [Delhon \(2021\)](#) has provided a critical review of anthracological approaches to the impact of fuel wood selection on taxon representation. These papers, alongside [Kabukcu and Chabal \(2021, this volume\)](#), [Théry-Parisot et al. \(2010\)](#) on charcoal taphonomy, and [Kabukcu's](#) recent concise review of the historical development and methods of anthracology ([Kabukcu, 2018a](#)) represent key theoretical and methodological references for contemporary archaeo-anthracological research worldwide. A significant novelty briefly addressed by [Kabukcu and Chabal \(2021, this volume\)](#) relates to the contribution of multivariate methods (still a very under-explored field in anthracology) and the potential they offer for studying multi-site/period anthracological assemblages in regions characterized by heterogeneous vegetation mosaics, integrating anthracological and non-wood botanical data, the comparative analysis of short- and long-lived contexts (e.g., hearths vs. charcoal scatters) and the study of the use of different fuel types (e.g., wood vs. dung) (for recent applications see [Asouti et al., 2015, 2018; Kabukcu, 2015, 2017, 2018b](#)). Two further methodological papers by [Chabal and Heinz \(2021, this volume\)](#) and [Puech et al. \(2021, this volume\)](#) address the spatial representativeness of charcoal field sampling in Mediterranean (France) and tropical (south Africa) vegetation contexts respectively, through the lens of palaeoenvironmental reconstruction. In the field of wood anatomy and reference collections the paper

by von Baeyer and Marston (2021, this volume) provides a uniquely detailed account of the workflows and protocols used for digitizing the wood slides held in the Bailey-Wetmore Wood Collection of the Harvard University Herbaria, aimed at generating research-grade images enabling specimen level analysis by researchers worldwide. The methodological innovations section is completed by the first typological analysis of wood borer galleries and pellets observed in Roman charred timbers (Toriti et al. 2021, this volume) setting new standards in the study and understanding of the lifecycles of timber constructions. Alongside the contextual study by Mavromati (2021, this volume) of charred structural timber remains from the Bronze Age site of Akrotiri in the Aegean, the first of its kind in the Eastern Mediterranean integrating anthracological, spatial and architectural data, these papers expand significantly the scope of traditional studies of charred timber remains dealing with the cultural aspects of timber species selection.

Human palaeoecology *sensu lato* (i.e. the study of the palaeoenvironmental context of human habitation and human-environment interactions) has been a central concern of anthracology since the pioneer days of the discipline (Badal Garcia, 1992). The Anthraco2019 special issue reflects this with a selection of sixteen papers presenting a *tour de force* of case studies ranging from the Palaeolithic through to the modern era, and geographically from the Mediterranean basin, Africa and the Middle East through to western and central Europe, China, South Asia and the Americas. Building on previous taxonomic analyses Audiard et al. (2021, this volume) present carbon isotope data from *Pinus* sp. *sylvestris/nigra* single entity specimens from the Middle Palaeolithic sequence of Les Canalettes (Aveyron, France) which enabled a high-resolution reconstruction of climatic fluctuations. The authors infer from this evidence that fuel wood collection was non-selective through successive episodes of cave occupation, while habitation patterns and subsistence and lithic production strategies also remained stable through time despite climatic fluctuations. The study by Zwane and Bamford (2021, this volume) of a Middle Stone Age charcoal assemblage from Sibudu Cave (KwaZulu-Natal, South Africa) provides insights into the palaeoecological interpretation of a very diverse taxonomic spectrum with high proportions of brown and white rot infested wood, indicating very warm and wet climatic conditions between 73 and 72 ka. The study by Ntinou (2021, this volume) presents one of the few archaeo-anthracological sequences available from a circumscribed region (northeastern Peloponnese,

Greece) of the Eastern Mediterranean basin covering the late Pleistocene (~123-13 ka BP) through to the early-mid Holocene, which preserves an exceptional palaeovegetation archive for a region and timespan where comparable well-preserved pollen records are lacking. Carrión et al. (2021, this volume) deploy anthracological data from Cova des Moro (Mallorca, Balearic Islands) to demonstrate the antiquity of sclerophyllous thermo-Mediterranean vegetation in this region dating back to at least the first permanent human settlement of Mallorca in the 3rd millennium cal BC. Gómez et al. (2021, this volume) use anthracological, pollen and settlement data to reconstruct the *longue durée* of vegetation development, human impacts and fuel selection in the Central Pyrenees between the 9th and the 1st millennia cal BCE. Uzquiano et al. (2021, this volume) integrate anthracological and terrestrial and marine pollen records to reconstruct the mid-late Holocene vegetation of the Cádiz coast (southwest Spain) and how it was shaped through time by climate change, human impacts and fluctuating sea-levels. At the opposite end of the Mediterranean basin, in the western Negev Desert (Israel) Langgut et al. (2021, this volume) use pollen and charcoal data to reconstruct the practice of irrigated fruit-tree horticulture (grape, fig, olive, carob, almond/apricot, pomegranate, date palm and hazelnut) alongside conifers (pine, cypress and cedar) and other Mediterranean and exotic tree taxa during the Byzantine and early Islamic periods, with evidence for increasing human impacts on the landscape through time. In the presently largely deforested region of northern central Anatolia (Turkey) Marston et al. (2021, this volume) provide the first evidence that deciduous oak was the main source of domestic and industrial (metallurgy) fuel during the 4th millennium cal BC, using anthracological data from the late Chalcolithic site of Çamlıbel Tarlası. In the temperate regions of central and eastern Europe, the papers by Novák et al. (2021, this volume) and Moskal-del Hoyo (2021, this volume) provide the first definitive accounts of long-term vegetation development based on charcoal and pollen data from multiple sites in the lowland and hilly regions of the Czech Republic and the loess regions of southern Poland respectively, spanning the period from the early/mid to the late Holocene. Their results show the prevalence of open oak forest-steppe during the critical period of the expansion of Neolithic farming into central Europe, with subsequent shifts in woodland cover and composition across different parts of the region being attributed to the combined effects of climate change and human impacts on the landscape. Returning to Africa, the study by Höhn et al. (2021, this

volume) of mid-late Holocene anthracological assemblages from the southwestern Chad basin (northeast Nigeria) demonstrates that, unlike other regions in West Africa, the development of parklands associated with increasing human impacts on the landscape during the Iron Age was a late phenomenon, dated to the last 500 years, arising from the adoption of different agricultural strategies in the Chad basin. In South and East Asia, the papers by Allué et al. (2021, this volume) and Wang et al. (2021, this volume) showcase the significant promise of systematic applications of anthracological research for reconstructing long-term patterns of vegetation change and past wood uses despite the limitations of archaeological charcoal identification from floristically exceptionally diverse landscapes. In the Americas, the early Holocene fire history of the Yellowstone National Park, USA is revisited by Marguerie et al. (2021, this volume) demonstrating the utility of the taxonomic identification with the use of SEM of charcoal particles (180-250 μm) retrieved from lake sediments for reconstructing fire-induced vegetation change during this period. Slotten and Lentz (2021, this volume) present a case study from the Late Classic Maya village site of Joya de Cerén (El Salvador) demonstrating the use of a very diverse taxonomic spectrum throughout the lifetime of the settlement. The study by Robledo (2021, this volume) of late Holocene anthracological assemblages from the Ongamira valley (Córdoba, Argentina) shows that fuel selection was determined principally by species availability in the local vegetation, mapped on altitudinal variation in woodland composition as well as other routine production tasks (food collection, raw material provisioning for woodworking, pottery firing, etc.)

The anthracology of kilns and charcoal burning represents another major field of specialized studies within palaeoenvironmental research, particularly with regard to studying diachronic trends in woodland composition, succession and exploitation patterns. The paper by Deforce et al. (2021, this volume) presents a thorough review of the typology and radiometric chronology of charcoal kilns in the Low Countries (Belgium and the Netherlands) over a period of 2500 years, from the Roman to the Medieval era, anchoring future studies of vegetation, land-use and pre-industrial iron production in this region. Fouédjeu et al. (2021, this volume) address the challenges of studying the chronology, duration of use, vegetation context and lifecycles of 20th century charcoal kiln sites in the French Pyrenees by applying a novel interdisciplinary approach involving anthracology, tree ring analysis and

soil micromorphology.

Woodland management and fuel use studies have witnessed significant expansion in the last decade thanks to the pioneer research in the field of quantitative dendro-anthracology conducted by Alexa Dufraisse and her team at the UMR 7209 (MNHN/CNRS, Paris) (Dufraisse et al., 2018). The paper by Francis and Dufraisse (2021, this volume) presents the first application of a quantitative dendro-anthracological approach to British sites exploring patterns of oak use in early Medieval eastern England. Using similar methodologies, Alcolea et al. (2021, this volume) study the exploitation of Scots pine during the Mesolithic-Neolithic transition in the south-central Pre-Pyrenees of northeast Iberia (Spain). Picornell-Gelabert et al. (2021, this volume) deploy a multidisciplinary methodology (combining taxonomic, dendro-anthracological and archaeological pollen evidence) to study the distribution of Aleppo pine on the island of Mallorca, and the contribution of human selection to its establishment and spread following the onset of permanent human habitation on the island in the late 3rd millennium cal BC.

The special issue concludes with five papers examining cultural dimensions of fuel and wood uses. The paper by Aprile and Fiorentino (2021, this volume) presents an innovative application of archaeo-anthracology to the contextual analysis of fire rituals and associated funerary customs at the Eneolithic necropolis of Salve (Puglia, Italy). Vaz et al. (2021, this volume) use an integrated study of anthracological and non-wood charred plant remains to explore the use of plants in provincial Roman cremation rituals in the necropolis of Bracara Augusta (Braga, Portugal) set in the context of material culture studies and literary sources. Two further papers by Caruso Fermé et al. (2021, this volume) and Vidal-Matutano et al. (2021a, this volume) delve into the complexities of the study and archaeological interpretation of artefactual wood assemblages. Caruso Fermé et al. (2021, this volume) present a group of waterlogged wooden sickles retrieved from the submerged Neolithic site of La Marmotta in Italy. Vidal-Matutano et al. (2021b, this volume) present a detailed study of the taxonomic, technological (cut-marks) and morphometric attributes of desiccated wooden artefacts discovered in pre-Hispanic communal granaries at Gran Canaria (Spain). The last paper by Caruso Fermé (2021, this volume) examines the use of wood as raw material among the Patagonian hunter-gatherers of Argentina using archaeological, botanical and ethnohistorical evidence.

This editorial note would be incomplete without reference to three pioneers of charcoal science and highly esteemed colleagues who are no longer with us: Barbara Eichhorn, Fritz Hans Schweingruber and Cecilia Western (Fig. 2). This special issue of *Quaternary International* is dedicated to their memory and scientific legacy that will not be forgotten. **Barbara Eichhorn (1967-2020)** was one of the foremost experts in African archaeobotany and anthracology. Her untimely death left an irreparable void among our community of peers. Barbara's research was unparalleled for its exacting scientific standards, depth and diversity of expertise encompassing not only macrobotanical remains, but also phytoliths, residue analysis as well as field botany (for representative examples of her research see [Eichhorn et al., 2010, 2019](#) *inter alia*). **Fritz Hans Schweingruber (1936-2020)** was a world leading authority on wood anatomy and tree ring research. His monumental works on wood anatomy and taxonomic identification and on ecological wood anatomy ([Schweingruber, 1990, 2007](#); [Schweingruber et al., 2011, 2013](#) *inter alia*) are standard points of reference for students of wood anatomy worldwide. His "Wood Anatomy & Tree-Ring Ecology" course at the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) trained hundreds of participants since its inception in 2001. **A. Cecilia Western FSA (1917-2017)** was the first practitioner of archaeological wood and charcoal analysis in Southwest Asia, notably on materials from Kathleen Kenyon's excavations at Jericho ([Western, 1971](#)) where she initially worked as a conservator (1952-53) but also from Jerusalem, Petra, Beidha and several field projects in Syria, Libya and Italy. She held posts at the London Institute of Archaeology, the Forestry Institute in Oxford, the Manchester Museum and, from 1957 up to her retirement, as Head Conservator at the Ashmolean Museum in Oxford. Eleni Asouti owes a personal debt of gratitude to Cecilia Western. Her reference collection of wood slides and carbonized modern wood specimens from the Mediterranean region, deposited at the Institute of Archaeology (University College London) in 1984, enabled Asouti's PhD project at UCL. Her wood anatomy notebooks and descriptions of taxa remain a valuable resource for students of Near Eastern anthracology ([Asouti, 2009](#)).

In concluding this editorial we would like to express our heartfelt thanks to the other members of the Anthraco2019 scientific committee (Yolanda Carrión, Lucie Chabal, Dana Challinor, Alan Crivellaro, Katleen Deckers, Koen Deforce, Alexa Dufraisse, Isabel Figueiral, Girolamo Fiorentino,

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anthraco2019
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Fig. 1. Group of Anthraco2019 participants braving the wind and rain lashing the Liverpool conference venue (photo by Eleni Asouti; conference logo by Marvin Demicoli).



Fig. 2. From left to right: Barbara Eichhorn (Mali, 2005; photo by Katharina Neumann), Fritz Hans Schweingruber (Klosters, Switzerland, 2004; photo by Yolanda Carrión), A. Cecilia Western (private residence, England, 2004; photo by Eleni Asouti).