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Mini-Review

Examining Fuel Use in Antiquity: Archaeobotanical and Anthracological Approaches in Southwest Asia

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Abstract: *This article considers the study of wood and dung fuel use in antiquity across Southwest Asia by anthracologists and archaeobotanists. In recent years, the socially conditioned nature of fuel use has been highlighted and many scholars are stressing the central importance of fuel to pre-modern societies as on par with subsistence and tool use. By elevating and unifying the study of ancient fuel through anthracological, archaeobotanical, geochemical, and micromorphological studies, detailed insights into cultural practices, decision making, and resource use in the past can be gained. We provide a brief review of studies examining ancient fuel use and reflect on the integration of wood and seed data where seed assemblages are indicative of dung fuel use.*

Keywords: Archaeobotany, Anthracology, Dung and wood fuel economy, Southwest Asia

In recent years, increased attention has been paid to ancient fuel economies within the archaeological literature. Veal (2013) provides a compelling argument for the central importance of fuel to the regional economy of the Mediterranean during the Roman period. This viewpoint can reasonably be extended to underscore the major significance of fuel to all pre-modern societies across the globe. Picornell Gelabert et al. (2011:375) argue that "firewood collection constitutes one of the most enduring categories of routine landscape practices on par with food procurement and dwelling" and that in order to fully appreciate the potential of archaeological charcoal assemblages, greater emphasis needs to be paid to socio-economic and cultural aspects of firewood to pre-modern societies (2011:382). Despite the importance of fuel in shaping and enabling cultural and socio-economic choices, relatively little attention has been paid to the use and management of fuel compared with research on subsistence and technology. This article provides a brief review of studies from the Old World highlighting behavioral, social, and functional insights that can be gained through archaeological analyses of fuel. We consider how the archaeological study of fuel use in Southwest Asia can build upon these studies by integrating analyses of wood, seeds, and dung spherulites from sites where dung is used as fuel.

Socially Conditioned Use and Preservation of Fuel

Plant remains can be preserved archaeologically through a number of processes, but are routinely preserved through charring, thereby providing an ideal means for preserving plant-based fuels. Studies of ancient fuel have generally been restricted to specialist studies of wood and shrubby plant remains by anthracologists (Asouti and Austin 2005; Chabal 1997) and seed assemblages preserved via burned dung fuel (and to a lesser degree wood remains) by archaeobotanists (Deckers and Riehl 2007; Miller and Marston 2012). Less common are fossil fuels such as peat (Braadbaart et al. 2012), burned bone from hearths (Théry-Parisot et al. 2005), and FTIR or micromorphological analysis of archaeological sediments (Matthews 2010). Recent discussions examining the social and environmental factors associated with fuel use such as those organized by Ethel Allué Martí, Llorenç Picornell Gelabert, and Marie-Agnés Courty at the recent 2014 UISPP (International Union of Prehistoric and Protohistoric Sciences) meeting may signify a positive shift towards a more unified approach.

Throughout prehistory the nature and intensity of fuel use and management changed in a dynamic relationship with shifting cultural and economic practices, settlement patterns, and population levels. Anthracologists, who traditionally identified charred wood to examine paleoecology, are now broadening their attention to the culturally conditioned nature of fuel use to consider communal choices, economic practices, and woodland resource exploitation and management (Théry-Parisot et al. 2010). The types of fuels selected generally reflect combined consideration of availability, ease of access, intended use, burning properties, as well as economic considerations and cultural preferences and prohibitions.

Prehistoric hunter-gatherers used wood fuel for cooking and heating, protection against predators, smoking meats, and processing hides, and sometimes relied heavily upon the collection of fallen dead wood rather than procured green wood (Asouti and Austin 2005). The ability to identify dead or rotten wood archaeologically allows for wood procurement strategies and fuel-related activities to be understood. In their ethnographic study of fuel use among Evenk Siberian reindeer herders, Henry and Théry-Parisot (2014) observed morphological differences between charred healthy, dead, and rotten *Pinus sylvestris* wood, allowing for hearth or site function to be considered. The physical characteristics and moisture content of wood determines its heating qualities as well as its suitability for smoking hides and repelling insects. Consequently, ethnographic studies of fuel use, and experimental studies that attempt to replicate preservation and document features that are discernible archaeologically, are broadening the range of questions that can be asked through observations of fuel (Braadbaart et al. 2012; Henry and Théry-Parisot 2014; Picornell Gelabert et al. 2011; Théry-Parisot et al. 2005).

Settled agriculturalists intensified wood fuel use to prepare plaster floors, heat baths, make glass, tiles, and bricks, and (from the Chalcolithic onward) to smelt metals. These practices increased the demand for high quality fuel dramatically, variably impacting forest cover and succession patterns (Asouti and Austin 2005; Veal 2013). Smelting often requires the combustion of prepared charcoal that yields higher temperatures. Distinguishing between the charred remains of untreated wood versus intentionally prepared charcoal remains important given the economic implications of this shift. Studies examining the reflectance of charred wood fragments demonstrate much potential for distinguishing between the two by estimating the temperatures reached within a fire (Veal 2013).

Examining Dung Fuel in Southwest Asia

In contrast to anthracology, archaeobotanists have traditionally focused on questions of subsistence but since the publication of Miller and Smart's (1984) study of dung fuel use at ancient Malyan, Iran, increasing attention has been paid to identifying dung fuel and assessing the relative importance of dung versus wood fuels across Southwest Asia. Not all seeds consumed by ruminants are digested and, once excreted in fresh dung, become charred and preserved when dung is burned as fuel; Charles (1998) provides guidelines for identifying burned dung. While archaeobotanists generally agree that both dung fuel and crop-processing activities contributed plant remains to many archaeological assemblages in Southwest Asia, opinions vary on the relative contribution of each.

Miller and Marston (2012) argue that dung fuel remnants contribute heavily to post-Neolithic deposits across Southwest Asia. They reason that increases in seed:wood mass ratios are associated with elevated dung fuel use and diminished wood availability. Researchers who adopt this view often focus on questions of changing landscapes and pasturing or foddering practices. Others argue that the presence of burned cereal grains, crop-processing debris, and small weed seeds predominantly reflect deposition of on-site crop processing activities. They often rely on ethnographic observations of crop processing and analyses of weed assemblages to determine whether discrete stages of crop processing are present, since physical characteristics of weed seeds (size, headedness, and weight) determine when in crop processing various weed species are selectively removed (Jones 1984). Such researchers focus on the nature, spatial patterning, and social implications of crop processing. Many accept that an intermediary view is also possible, whereby both depositional processes occur in tandem, since crop processing debris is often intentionally mixed with dung to prepare fuel cakes and fuel debris is likely to be mixed with household waste for disposal or reuse as a fertilizer.

Teasing apart the precise contribution of these depositional processes remains difficult but is essential in any archaeobotanical consideration of fuel choice and use. A clear understanding of archaeological context is critical to this debate: secured, sealed storage contexts, for example, are more likely to contain stored crops, whereas refuse pits are more likely to contain discarded fuel-related and/or household debris. Lessons from micromorphology combined with routine, rigorous analysis of weed assemblages to determine whether discrete processing stages may be present could help disentangle the processes. Matthews (2010:104) notes from her micromorphological analysis of sediments from early urban settlements across Southwest Asia that "dung can be unequivocally identified by the morphology, comminution and distribution of plant remains and groundmass in intact dung pellets" as well as the presence of distinctive calcareous spherulites excreted in dung which "can be readily identified, with little training, in smear slides under cross-polarised light at ×100" (Matthews 2010:105). Through the routine collection of small grab samples from sediment intended for flotation, archaeobotanists could use this approach to support claims for the presence or lack of dung alongside considerations of archaeobotanical data. This sampling method would have the added advantage of providing phytolith and starch grain samples for future subsistence studies.

Considering the Relative Use of Dung and Wood Fuels

Once the presence of dung fuel has been demonstrated, the factors that shape fuel selection can be considered. Miller has convincingly argued that increasing dung use often relates to increased aridity or phases of decreased wood availability (e.g., Miller and Marston 2012), but as Deckers (2011) rightfully argues, dung and wood fuel offer different heating properties and may be selectively chosen for practical rather than environmental reasons, complicating interpretations to some degree. Exploring this issue in more detail is important. Few researchers have integrated anthracological and archaeobotanical data (Naomi Miller, Katleen Deckers, and Simone Riehl being notable exceptions). Considering the two datasets side-by-side allows for a fuller understanding of fuel selection practices, but also presents methodological difficulties on how best to consider relative abundance and how to compare wood data from hand-picked samples to remains recovered via flotation. Currently weight measures of wood and seeds provide a simple and effective way to quantify and compare assemblages at the site level either regionally or between phases (Miller and Marston 2012). It remains difficult, however, to estimate the precise extent to which each fuel source contributed to individual burning events. There is no simple solution, but this does not mean that the endeavor should be abandoned entirely. Experimental studies that examine the differential preservation of wood and dung under comparable conditions, similar to those conducted by Braadbaart et al. (2012), would be useful, as would the regular integration of micromorphological analyses, assuming that the density of dung spherulites within a unit of sediment serves as a proxy for dung fuel use intensity.

Since archaeobotanical and anthracological studies are complementary, the detailed consideration of archaeobotanical data within the current anthracological framework has the potential to enhance our understanding of the complexities and culturally conditioned nature of ancient fuel management in both domestic and industrial spheres. By building a more unified approach to the study of ancient fuel and elevating the level of inquiry, the ability to understand ancient societies globally will be greatly enriched.

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