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Review of Ban Chiang, Northeast Thailand, volume 2A: background to the study of the metal remains Joyce C. White and Elizabeth G. Hamilton, editors University of Pennsylvania Museum of archaeology and anthropology, Philadelphia University museum monograph 1,492,018

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In 1973, the University of Pennsylvania's Pen Museum joined with Thailand's Fine Arts Department to establish the 'Northeast Thailand Archaeological Project' (NETAP), a collaboration aimed at excavating the prehistoric site of Ban Chiang, located in Udon Thani Province on the Khorat Plateau. The main impetus for the project was the prior discovery of evidence of what was then thought to be very early (4th millennium BCE) metallurgy at the site of Non Nok Tha, also located in northeast Thailand. These early efforts set into motion a series of subsequent excavations, surveys, multi-disciplinary analyses, as well as a stream of publications on the prehistory of the region, with current scholarship showing little evidence of abating. Most certainly, such sustained fieldwork and the large amount of scholarship published in English helps explain the fact that many archaeologists working in other regions of the world are acquainted with the prehistory of Thailand. Having said this, it is worth noting that part of that interest revolves around several contentious issues, the most prominent of which is the timing of the earliest copper-base metallurgy in Southeast Asia - and not the now discarded notion of the independent invention of metallurgy in Southeast Asia. The debate, which extends back many decades, continues to be defined mainly by disagreement between Joyce White - one of this volume's two authors - and Charles Higham, well-known for his field research in northeast and central Thailand beginning in the late 1960's (Higham 2011, 2015a, b; Higham et al. 2011; White 2013, 2017; White and Hamilton 2009). While vigorous scholarly

debate is always welcome, one cannot ignore its more adverse impact in this particular case, with even White admitting that "the adversarial tone of many of the discussions about the appearance of bronze in the region has had a prolonged dampening effect on scholarly discourse among Southeast Asian archaeologists who have witnessed it, and the acrimonious tenor has undermined the contributions of this and other important sites for Southeast Asian archaeology" (p.14).

This volume does not limit itself to the dating controversy, however. Co-authored by Joyce White and Elizabeth Hamilton - with different chapters written by one or both of them -, the book serves instead as the theoretical, methodological and technical background to the fuller presentation and discussion - in the series' later volumes (2B and 2C) - of early metallurgy in Thailand and other parts of Southeast Asia. As such, it reviews and contextualizes several important issues pertaining to the production and interpretation of metal objects in the past. It considers how and why metallurgy was incorporated (or not incorporated) into local systems, how bronze production (from ore extraction to casting) was organized, what the impact of metallurgy may have been on society at the local level, and whether associations exist between the development of metallurgy and variables such as warfare, the level of socio-political complexity, and the nature of craft specialization. Because most of the chapters include references to Southeast Asia, the volume also serves as a valuable introduction to the topic of early metallurgy in the region. Notably, however, even as the authors provide the background for a general critique of traditional notions about early metallurgy in prehistory, many sections of the volume also ascribe some of these same ideas to Higham, thus extending the better-known debate about chronology to other issues in Southeast Asian prehistory, such as how, why and when metal age societies changed.

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Authored by White, Chapter 1 ('Ban Chiang, Northeast Thailand, and the Archaeology of Prehistoric Metallurgy') locates the topic of early metallurgy in Southeast Asia within its historical and disciplinary context. White focuses on that history's many methodological and theoretical points of contention - some of which have yet to be resolved - and points out that such debates have been guided by the archaeological paradigms popular in earlier European scholarship. Thus, the non-systematic recovery of stone and bronze artifacts by European - especially French - scholars during the late 19th century soon led to attempts at defining a Three Age System (of stone, bronze, and iron) which embodied notions of progress but which for a long time remained hobbled by findings of co-occurring stone and bronze artifacts at sites such as Samrong Sen. Throughout, bronze remained a focus of particular interest. By the early decades of the 20th century, some had already commented on the apparent simplicity of Southeast Asia's early bronzes in comparison to those found in prehistoric Europe, with others also suggesting that metallurgy had entered the region from the northwest. While the subsequent discovery of complex bronzes associated with northern Vietnam's Dongson Culture provided some well-needed absolute dates tied to China's southern expansion in the last centuries BCE, assumptions about the importance of diffusion from assumed advanced cultures as the main driver of culture change - as opposed to internal processes - painted the rest of Southeast Asia as the home of simpler societies who took from their trading contacts with Dongson Culture only what they needed to develop modest bronze repertoires suited to their more limited needs.

As in other parts of the world, the radiocarbon revolution overturned many assumptions about the timing and source of technical developments in prehistoric Southeast Asia. Beginning in the 1960's, dates pointed to the emergence of bronze metallurgy during the 2nd millennium BCE, preceding even Dongson Culture. Crucially, however, the debate about the more precise timing of the first bronzes in Southeast Asia continues to this date, with White proposing a date closer to 2000 BCE and Higham suggesting the mid to late 2nd millennium BCE. White provides an outline of the debate, reviewing the pros, cons, and results of the many chronometric methods used so far in the dating of metal age sites in Southeast Asia, including the radiocarbon dating of charcoal, bivalve shells, and rice temper, as well as thermoluminescence dating. Beyond recognizing that no single dating technique has yet been shown to conclusively resolve the persistent disagreements about chronology, White also maintains that research should not ignore non-chronometric issues, such as the routes along which metallurgy was transmitted to Southeast Asia, the socio-political features of those localized groups which adopted and developed bronze metallurgy, the social and economic impact which such developments had at the local level, and the intra-regional dynamics which framed the production

and exchange of materials needed in the manufacture of bronzes. As mentioned earlier, debates regarding these other topics have to some extent paralleled the chronometric disputes in ways that map quite well onto the views of the two main opposing camps. White devotes the rest of the volume to providing the disciplinary, theoretical and methodological background to these on-going debates.

In chapter 2 ('Ban Chiang, Ban Tong, Ban Phak Top, and Dong Klang: Summary of Excavations and Sequences'), White reviews the history of fieldwork at four sites in northeast Thailand, with a focus on relative and absolute dating methodologies and interpretations. Two seasons of excavations (1974-75) at two locations on the mound of Ban Chiang uncovered a total of 130 square meters, representing no more than 0.16% of its surface area. Smaller excavations ranging between 9 and 13 square meters were conducted in 1975 at three other sites in northeast Thailand: Ban Tong, Ban Phak Top, and Dong Klang. The deep stratified deposits - reaching 4 meters in depth at Ban Chiang - yielded large numbers of artifacts, features and burials (142 at Ban Chiang, 2 at Ban Tong and 17 at Don Klang). Along with reviewing the terminology used during the excavation process and post-fieldwork analyses (feature, layer, level, bag #, find #, depositional context, period, and burial phase / subphase), White provides information on behavior and lifeways. For example, we learn that houses were raised on stilts (and thus that house remains with clear activity areas were rare); that the inhabitants practiced 'residential burial'; and that burials were small and shallow, with the source of the grave cuts often difficult to identify. Still, the chapter says little about the social and political life of Ban Chiang's inhabitants, focusing instead on matters of chronology

White, who did not participate in the original excavations at Ban Chiang, spent many years ordering the excavation data into a relative chronology which relies in part on ceramic typology and which recognizes the need for "two separate although related chronologies, one for the burials and one for the non-burial deposits" (p.27), a choice based on the fact that these different remains were associated with different formation processes. The result of these efforts is summarized in Figures 2.7 and 2.8, which display in table format the association between periods (lower early; upper early; middle; late; protohistoric; historic and modern), levels, and burial phases / subphases at Ban Chiang and the other three sites. White then considers the issue of absolute dating, focusing especially on some well-known limitations of radiocarbon dating, such as the movement of artifacts between contexts, the 'old wood effect', diagenesis, and methodological variation among different laboratories tasked with the dating of samples. More specifically, she mentions that dates obtained from charcoal, rice temper and phytoliths are sometimes 'too old', while shell and bone dates may be 'too young'. Although White judiciously views "... the absolute dating of Ban Chiang and other

late Holocene sites in Thailand as unresolved and a work in progress” (p.40) and proposes that “... Southeast Asian archaeologists must eventually undertake ... a collaborative, multi-institutional multidisciplinary assessment of all [regional] chronological data” (p.40), her review of the dating of shell and bone materials over the past decades is more subjective in its critique of Higham’s dating methods and interpretations, which she suggests have lacked rigor, with flawed data furthermore reducing the effectiveness of his Bayesian modeling. White ends the chapter by proposing a tentative “working chronology”: Lower Early Period (2100 – 1500BCE), Upper Early Period (1500 -900 BCE), Middle Period (900 – 300 BCE), Late Period (300 BCE – 200 CE).

Co-authored by White and Hamilton, Chapter 3 (‘Debunking the Conventional Paradigm: Metals and Prehistoric Society’) offers a critical re-evaluation of traditional thinking about the social, political and economic dimensions of early metallurgy. The so-called ‘Conventional Paradigm’ discussed by the authors encompasses several attributes which also reveal themselves more broadly in recent archaeological practice: universalist thinking, which assumes the applicability of traits across cultures; a single shared path to increasing technological complexity; normative reasoning, which generalizes from small samples and ignores variability; essentialism, in which something is assumed to be true because it is inherent to the category; and the idea that technological change drives culture change. The authors then proceed to identify what they see as numerous flaws and inconsistencies in the Conventional Paradigm as these apply to early metallurgy. Relying on archaeological, ethnographic and historical evidence, they reject – or at least question – several traditional assumptions. These include, among others, the association between early metallurgy and societal violence; the universalist sequence of stone to copper to bronze to iron (in fact, the use of native copper by hunter-gatherers in North America never led to smelting); the association of each stage with specific societal levels, such as the long-held identification of bronze as a marker of ‘civilization’; the idea that early bronze metallurgy was carried out by full time itinerant specialists; the functionalist notion of early metallurgy emphasizing the utilitarian value of objects over their ritual functions or aesthetic appeal; and the strongly held view that the earliest and simplest metal objects served as prestige goods and that the rise of elites was linked to the control of metallurgy and the display of its products.

While the authors do recognize that “... technologies tend to build upon prior knowledge and do not randomly appear and disappear like fads”, and furthermore that “without managerial development ..., the product range may lack objects at the largest and most elaborate end of the spectrum” (p.72), they point to the significant level of cross-cultural variability in the trajectories, role and impact of early metallurgy. Such unevenness, they propose, is best explained when one

recognizes the roles which local agency (a ‘bottom-up’ approach) and the local conditions (‘context’) play in guiding developments. Their brief review of metallurgical traditions and trajectories throughout the world illustrates this variability and rejects some tenets of the Conventional Paradigm. Thus, Harappan civilization, a highly stratified society, relied heavily on native copper in the production of tools and weapons, while copper smelting is evident in some hunter-gatherer societies, such as the Karelian and other cultures located east of the Urals. Even the often-assumed technological sequence of “unalloyed native copper, to smelted pure copper, to unintentionally alloyed arsenical copper, to deliberately alloyed tin bronze” (p.72) is now disputed by evidence for early experimentation in the choice of ores and alloys. Most significantly, this challenge to the idea of a strict association between a group’s level of socio-political complexity and the type and technical complexity of its metal objects remains a central point of the chapter.

The second half of the chapter continues with a critical review of the Conventional Paradigm in archaeology, pointing to its reliance on a range of “common logical fallacies”, which are termed normative, boundary, conflation, inferential, dichotomous, progressive, hindsight, and projection (Table 3.1). The critique calls into question assumptions of distinct universalist stages progressing along unilinear evolutionary paths, and urges the decoupling of social, economic and technological forms within each stage. As for metallurgy, the authors mention emerging trends which place more emphasis on locally contextualized “transmission” and “adoption” rather than on traditional concerns with lower resolution forces such as “migration” and “diffusion”. The role played by variable contingent processes in metallurgy also helps explain their rejection of the Three Age System (Neolithic to Bronze to Iron age), which here again shoehorns what are complex and variable developments into what are in fact porous categories, as when an archaeologist certifies a stage as ‘Bronze Age’ only with the recording of metalworking installations and bronze containing graves, thus ignoring earlier periods when as-yet-to-be discovered copper-base artifacts first appear (even if present at a single site). In response to such limitations, they propose that researchers focus on more localized “metallurgical provinces” (as opposed to a single worldwide “Bronze Age”), and put forward a new periodization scheme for Southeast Asia which does not use the term “age” and which drops the upper case letter. Thus, their proposed “pre-metal” period (represented by agrarian societies before the initial appearance of copper-base artifacts) is followed by a “metal period” comprised of a “bronze period” (lasting until the appearance of iron), itself followed by an “iron period” (lasting until the appearance of written records).

In Chapter 4 (‘The New Archaeometallurgy Paradigm’), White and Hamilton propose that the study of technology is best achieved through an approach which they label

'Anthropology of technology', a "not-so-new" paradigm (p.92) which addresses the limitations of the 'Conventional Paradigm', particularly its reliance on the notion of unilinear technological 'progress' and the role which independent invention, diffusion and migration played in the initial development and transmission of technical knowledge and practice. Central to the new paradigm is the recognition that developments in technical fields – metallurgy in this case – play out under the influence of their respective social and symbolic context, influences which impact not only the timing, rate and direction of such developments, but also the use to which metal objects are put. A corollary of studying localized instances of early metallurgy within their respective dynamic social settings is that although "At the very grand scale of technological development on the globe over thousands of years, the progressive narrative that forms the core of the Conventional Paradigm is an observable phenomenon . . . , on the scale of individual societies in particular places and times, explaining technological change primarily in terms of progressive developments is rarely a good fit" (p.91).

Much of the chapter is devoted to discussing and illustrating several core concepts in the 'Anthropology of technology' approach: 1. Materials properties; 2. Technological systems; 3. Life history frameworks; 4. Technological choices, styles, and traditions; and 5. Technological change. The detailed review of these concepts and their varied applications reveals the many contributions made by material scientists and anthropologists - archaeologists and ethnographers - to an emerging view of production that recognizes its roots in both technical matters and the social lives of artisans and users. The authors discuss a number of findings and insights - some supported by ethnographic or experimental evidence – regarding the operation of such "socio-technical systems" (p.93). We are told that 'performance' is not limited to purely utilitarian concerns and that it also encompasses both aesthetic (e.g. sound and color) and symbolic needs, which themselves can change over the course of an artifact's life. The authors also discuss the need to investigate the ways in which the multi-step production of an artifact is itself embedded in, and limited by, existing social and labor relations. The relevance to archaeometallurgy is underscored by the fact that the production of metal objects involves the sequential completion of numerous and separate technical steps, along with the observation that "there are no ethnographic examples of single-actor metal production" (p.100).

Close attention should also be paid to the physical location of each step involved in the production of an artifact – the 'chaîne opératoire' -, as the spatial patterning of manufacturing activities is also determined by the broader social structure. Moreover, in countering the Conventional Paradigm, the authors point out that no single path dictates how, when and why a specific technology is adopted by a group, or how and why that technology then spreads – or does not spread – through

the group in its original or altered form. Even as they recognize the use of knowledge transmission models such as 'communities of practice' and 'learning frameworks', they also acknowledge the role which less tangible factors such as personal preference, curiosity and even randomness play in guiding the development of local technologies. Noting that "... it is almost certain that the bronze-making technological system was transmitted from outside of Southeast Asia as an intact complex (i.e. not locally copied from trade goods) ..." (p.113), the authors end the chapter with an appeal to scholars of the region to look beyond the Conventional Paradigm's oversimplified notions of diffusion and directionality to investigate the "processes and mechanisms of innovation and adoption" as these apply to the emergence and development of early metallurgy in Southeast Asia.

In chapter 5 ('Metals in Economic Contexts'), White and Hamilton discuss the economic dimensions of early metallurgy, reviewing in turn the production, consumption, trade and exchange of metal objects and their ores. As in previous chapters, they rely on the work of scholars from varied disciplines, in this case archaeologists, ethnographers, economists, and material scientists, including many whose work focuses on materials other than metals. These insights and experimental results allow the authors to argue against many of the earlier ideas put forward to account for the economic roles and underpinnings of early metals and metal production. These include the assumptions that the production of metal objects was from the beginning framed by the market forces of efficiency, supply and demand, or regulated by elites under whose control full-time craftsmen toiled to produce utilitarian and/or prestige goods. Although alert to the limitations of the above views, the authors acknowledge the technical complexity of early metallurgy, its reliance on exchange and trade networks, along with its socio-economic impact. Thus, the many steps involved in the production of even simple metal objects - ore mining, smelting, alloying, and casting – each required a specific skill set and were often carried out in locations that were geographically distant from one another. Furthermore, wealth differences in grave goods – including metal objects – are evident in the archaeological record of the (non-state) 'middle-range' societies which inhabited metal age Southeast Asia. Importantly, the authors identify such metal objects as 'valuables' which were unevenly distributed throughout society rather than 'prestige goods' restricted to the elite.

With the above in mind, they bring up several concerns and observations. They point out that the producers of metal objects in middle-range societies – including those of metal age southeast Asia – were likely 'part-time independent' specialists (i.e. not 'attached' to the elite), a type of production which "turns out to be remarkably common among societies all along the complexity range" (p.121). Moreover, they argue against the assumption that early metal production in pre-industrial economies was solely guided by optimization and

efficiency concerns. Instead, objects likely fulfilled other important functions, such as serving as identity markers, ritual implements, and as exchange items for the purpose of creating and maintaining social ties, both within and between social groups. Regarding the latter, it is worth noting the emphasis placed by the authors on 'reciprocal exchange' as a mechanism used by middle-range societies to sustain inter-societal relationships. What is unclear to this reviewer is the role which different types of reciprocity – direct barter vs (delayed) gift exchange – would have played in the exchange of not only the final metal products but also the ores and ingots in early Southeast Asia. Referring to Brian Hayden's research on the economics and politics of pre-state societies, the authors also propose that both individual social groups and regional exchange systems in metal age Thailand were marked by the presence of (laterally differentiated) heterarchies and (limited) vertical hierarchies. Thus, some wealthier corporate groups within single communities might have had access to more bronze objects, while areas within the regional system responsible for producing and making available ores, ingots or finished products would also have benefited. The authors' core argument nevertheless remains, namely that market forces would have played a negligent role in what was fundamentally a system driven by social forces, especially the need to establish and maintain peaceful relations among all those who collaborated in the production of metal objects.

Written by Hamilton and White, Chapter 6 ('Geomorphology of Metal Resources in Mainland Southeast Asia') locates Thailand's Khorat Plateau – where the site of Ban Chiang is located – within its broader geographical and geological settings. The chapter includes reviews of Southeast Asia's physical geography, plate tectonics, metallogenesis (ore formation), and the location and characteristics of ores relevant to this study. Although some may find the discussions of geological features and processes to be quite technical, the overall geological and metallurgical picture drawn by the authors points to several findings of relevance to an understanding of early metallurgy in Thailand. To begin, the text and maps indicate the location, spatial extent and orientation of various large-scale geological features, including terranes, faults, belts, and sutures. Importantly, "metal ores often form in geological fold belts created by collisions of tectonic plates, including smaller portions of plates called terranes" (p.143). The authors also review the known modern sources of different metals throughout mainland Southeast Asia, including ores of copper (chalcocite, malachite, cuprite, azurite and chalcopyrite), tin (cassiterite), lead (galena), iron (pyrite), and antimony. The maps indicating the location of copper and tin ores reveal interesting patterns, such as the large number of tin sources within the 'Burma Malay belt' extending south from northern Thailand to the Malay Peninsula; and of copper sources in the Loei and Lower Mekong belts.

One interesting feature revealed by the ore distribution maps is the striking absence of metal sources in northeast Thailand's Khorat Plateau, which is enclosed by several ore rich geological belts and faults. As evident from the maps, however, the different metallic ores present in these surrounding areas were located no more than a few hundred kilometers from Ban Chiang, leading the authors to state that: "Unlike much of the world, making bronze in Southeast Asia did not require vast long-distance trade networks to obtain tin, lead, or copper; obtaining these materials was within the reach of small communities without elite organization" (p.164). Having said this, the authors also point to the caveat that the present distribution maps of ores in Southeast Asia, which are almost exclusively based on known modern sources, do not necessarily correspond to the location of early mining sites. Thus, small sources of ores exploited during prehistoric times may have been exhausted early on or may not have been recorded by geologists, not to mention the likelihood that many of these early sites were destroyed by more recent mining activities. The analysis of artifacts found at Ban Chiang and Don Klang has shown that their lead isotope signatures do not match those at Sepon (Laos) or Phu Lon (Thailand), two prehistoric sites where the mining of copper ore has been recorded, pointing to the need for more archaeological and geological research to be conducted in mainland Southeast Asia before the sources of copper at Ban Chiang and nearby sites can be located.

In Chapter 7 (Chaines Operatoires and the Study of Archaeology Metals'), Hamilton provides a clear and informative technical overview of the complete sequences of steps (the 'chaines operatoires') involved in the production of copper, tin bronze, and iron artifacts. The chapter is divided into 'primary metal production' (the extraction of metal from ores) and 'secondary production' (the production of metal objects), each of which involves its own set of specialist skills and procedures. For most of these steps in the production sequence, Hamilton reviews the relevant archaeometallurgical (including experimental and ethnographic) literature, much of it pertaining to work carried out in other regions of the world, and discusses the details, benefits, limitations, and archaeological signatures of each process, along with the chemical and physical characteristics of the relevant ores, alloys and finished products. Thus, the manufacture of copper and bronze objects begins with the extraction of copper, tin, lead, arsenic and antimony ores, which itself comprises the following activities: prospecting, mining, beneficiation, roasting, charcoal preparation, the smelting process and structures (e.g. furnaces vs crucibles; tuyeres vs blowpipes vs bellows; slagging vs non-slagging smelting; and the co-smelting of different ores), culminating in the production of ingots. The post-smelting manufacture of copper and bronze artifacts consists of further activities carried out in sequence: refining the copper (from the smelted copper), alloying, casting, cold and

hot working, quenching, and the aesthetic finishing of the objects. A final section reviews the many steps involved in the production of iron and steel artifacts, along with each step's archaeological signatures.

At various points throughout the chapter's technical review of copper, bronze, iron and steel production, Hamilton makes several observations which provide insights into the broad economic and social dimensions of metallurgy, or more specifically inform the reader of its development in Southeast Asia itself. For example, we are told that "As a rule, refining appears to have been done elsewhere than smelting" and that "refining the copper was the task of the metalsmith rather than the person who smelted the ore" (p.177), indicating different skill sets and locations for each activity. In reference to prehistoric Thailand, Hamilton points to the absence of "copper-smelting furnaces with a fixed superstructure" (p.175) and of tuyeres at "copper-producing sites" (p.177). Even to those unfamiliar with the field of archaeometallurgy, such findings, along with the many other technical details which Hamilton offers in the chapter, leave in no doubt the fact that the manufacture of metal objects in the ancient world was a complex undertaking requiring high levels of expertise at each step of the process.

Referring to the entire monograph of 4 volumes (2A-D), White lists the following as the 4th and last objective of the study: "to contribute to the on-going debate between Joyce White and Charles Higham regarding the importance and interpretation of prehistoric metallurgy at Ban Chiang specially and in Thailand and Southeast Asia generally." While this may be so, there is no denying that volume 2A sometimes feels like an extension of the on-going debate between these two established scholars, with details of the disagreement occasionally serving – more subjectively - to bolster the views of White and Hamilton on methodology and interpretation in archaeometallurgy. The volume's approach also feels

anachronistic at times, as it assesses data collected over four decades ago through the lens of theoretical debates with similarly lengthy histories. Still, it would be unfair to conclude on such notes. As White points out, this state of affair in part reflects the fact that archaeology in Southeast Asia remains theoretically underdeveloped, justifying references to well-worn theoretical constructs. Furthermore, while the volume does not resolve – or pretend to resolve - the issue of chronology in early Southeast Asia, neither is it defined by it. Instead, it offers the necessary background to the further discussion of the debate in later volumes, while also serving as a clear and thorough introduction to the topic of early metals in Southeast Asia, one that is well suited to students interested in the prehistory of the region, the technical aspects of metal production, as well as the increasingly important role which the field of archaeometallurgy plays in our understanding of the past.

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