AN INTERPRETATION OF BUILDING STRUCTURES AND THEIR IMPLICATIONS FOR SOCIAL STRATIFICATION AT THE SITE OF BAN NON WAT, THAILAND: A GIS ANALYSIS OF PREHISTORIC POST-HOLES

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In order to understand prehistoric behaviors through the field of archaeology, it may first be necessary to determine the social structure, as well as the political and economic growth of that society over time. Culture change may be displayed in a number of ways, including changes in pottery type, the presence or absence of materials such as copper and iron, or mortuary context and practices. According to Flannery (2002), social and economic evolution may be displayed in the archaeological record by changes in the shape and size of domestic structures. Excavations at the site of Ban Non Wat have revealed occupations covering a span of over 4000 years, ranging from the Neolithic to the Iron Age. During these excavations, thousands of post-holes were evident in the stratigraphic context of the site. Using a GIS (Geographic Information Systems) application, a general overlay of post-hole patterns per occupation level can be examined. By then deducing which of these post-holes had been dug during later occupations, patterns and changes in structure types over time can be investigated. This paper examines the apparent structural transformations at the site of Ban Non Wat, and compares them to other indications of social, physical, and economic change that have previously been revealed.

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INTRODUCTION

Ban Non Wat is one of several Iron Age "moated" sites located in the upper Mae Num Mun Valley floodplain of the Khorat Plateau in Northeast Thailand (Figure 1). "Moated" sites in this area are highly distinguishable by their large, "tell" like, mounds of accumulated occupational material, surrounded by rings of encircling earthworks. In comparison to other moated sites in the Mae Nam Mun Valley, Ban Non Wat is considered a medium mound, measuring only 500 m in diameter (Boyd et al.1999). The "moats," which encircle the mound, are believed to have been constructed during the Iron Age (300 B.C. – A.D. 300) for reasons of water management, rather than defensive purposes. This area has been under study by the Origins of the Civilization of Angkor Project since 1992, beginning with three years of site survey. Excavations have been conducted at the sites of Noen U-Loke, Non Muang Kao, Ban Lum Khao, and Ban Prasat, as well as several others (Higham and Thosarat 2006). The "Origins of Angkor" research project, which began excavations at the site of Non Muang Kao in 1995, was initially intended to understand further, the social and political context that may have led to the foundation of the polities of Angkor and Zhenla (Boyd et al.1999). Excavations in the Upper Mun Valley have produced extensive data, which has been vital in the progression of Southeast Asian archaeological research. Ages of the sites excavated in the Upper Mun Valley range from approximately 1750 cal. B.C. to historic periods around A.D. 500. Most of the sites located in this area consist of late Bronze Age to early Iron Age occupations, some dating back as far as the early Bronze Age, approximately 1280 cal. B.C (Boyd et al. 2009:25). Few sites in the area have shown material culture dating back to the Neolithic period. Ban Non Wat is one of these sites.

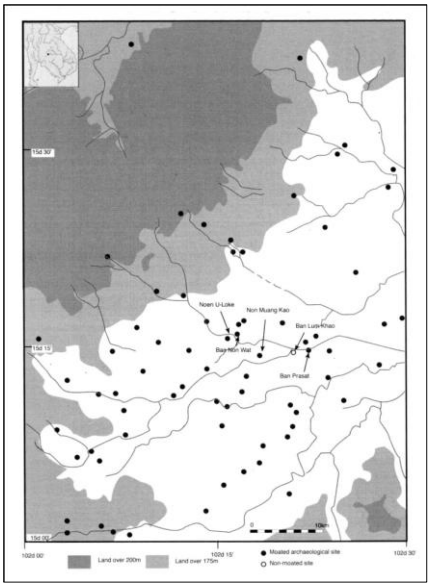

Figure 1. Location of Ban Non Wat (Boyd et al. 2009)

Excavations at the site of Ban Non Wat have been ongoing since 2001, and have been vital to understanding prehistoric occupations in Southeast Asia. The original excavation plans were not intended for the site of Ban Non Wat, however. The "Origins of Angkor" project was planning to continue excavations at the non-moated site of Noen U-Loke. Due to disputes with the village headman concerning proper payment for access to the site, the project moved to investigate the mound in the village of Ban Non Wat, located in the Huai Yai Valley (Boyd et al. 2009). Initial excavations revealed a rich occupation at the center of the mound, which had been continuously occupied since prior to the early Neolithic period. Recent conversations at this site suggest that occupations may go back as far as 3500 B.C., which would constitute as the oldest dates received from any site in the area. Ban Non Wat occupations have been broken down into twelve distinct phases ranging from early Neolithic periods, into the Bronze Age, and throughout Iron Age occupations (Boyd et al. 2009). Artifact and burial analysis is ongoing, and is sure to produce large amounts of site data. Further analysis also has yet to be conducted on the floral and soil samples that have been collected from excavations all over the site.

Much of the research previously conducted at sites in the Upper Mun Valley has been focused on burials and the artifacts discovered within mortuary context. Burial practices and artifact context can be very informative indicators of social structure, ritual practices, and chronological developments within a society. In order to properly understand any group of people however, we must be able to examine numerous elements within that society's social structure. By using Flannery's (2002) hypothesis concerning the shape and size of building structures in association to social organization and storage in Mesoamerica and the Near East, we may be able to identify changes in these variables over time at Ban Non Wat. Considering the expansive occupations at this site, an analysis of this kind would create an ideal model for comparison to other moated sites in the area.

It is my intention to paint a better picture of the social structures of the prehistoric peoples of Ban Non Wat, as they may have developed over time. By recognizing the possible building structures that had once existed at this site based on post-hole patterns, and then analyzing the changing patterns over numerous occupations, we may begin to develop a better understanding of the possible social hierarchies and cultural evolution that occurred at this site.

METHODS

Excavations

During the 1997 – 1998 seasons, the "Origins of Angkor" project conducted an examination of moats at six sites in order to examine stratigraphy, lithology, and morphology of the features. Trenches were excavated by backhoe, dug perpendicular to the trend of the moats starting from the edge of the site outwards (Boyd et al.1999). Further excavations at the site of Ban Non Wat

were conducted in 2001 consisting of three separate units. The largest of these, classified as square (A), was dug as close to the immediate center of the mound as possible (Figure 2). This excavation was a large block consisting of forty-seven 4 by 4 m squares, eight 4 by 3 m squares, and one 2 by 3 m extension of the northern bank. Square (Y) consisted of an 8 by 4 m block to the northeast of A. Square (X) was excavated as a 4 by 4 m unit on the southern edge of the mound. During this process, a total of 906 m^2 was uncovered, and nearly 3,000 m^3 of cultural material removed (Boyd et al. 2009). Excavations have generally concluded at the site of Ban Non Wat; however, a large amount of artifact and data analysis has yet to be completed. All date ranges described for the layers of square (A) are based on radiocarbon dating conducted at the University of Oxford laboratory.

Excavations were conducted in 10 cm units (spits) until a stratigraphic change was evident. Features exposed in corresponding layers were outlined, mapped, excavated and recorded by color, type, and texture. Soil samples from these features were also removed and bagged for analysis at a later date. Artifacts were systematically removed and catalogued with their own unique sequential number, then recorded in a central register. The scraping of walls was conducted in order to record stratigraphy for interpretation (Boyd et al. 2009). All levels of the excavation were thoroughly mapped, measured, and recorded. These measurements also included the depth of each layer, recorded using a standing tape measure and digital reader. To date, a total of eleven units of various size have been thoroughly excavated, each with complete mapping and layer depth measurements.

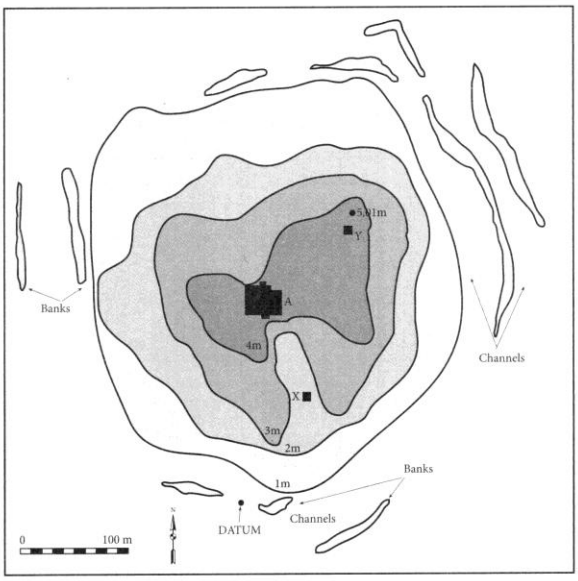

Figure 2. Location of Square (A)(Boyd et al. 2009).

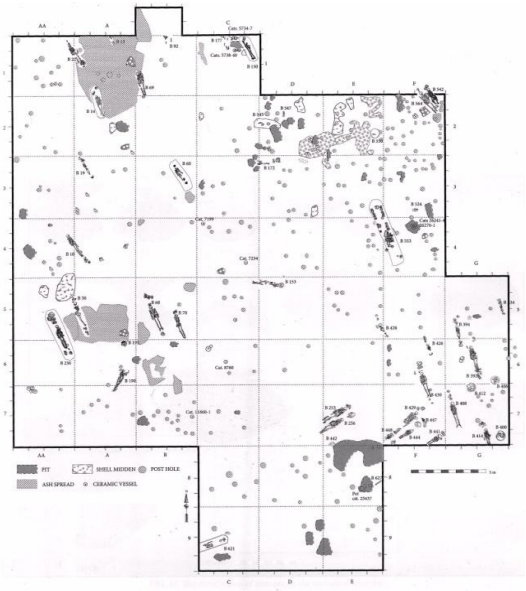

Figure 3. Layer Diagram(Boyd et al. 2009).

During the original excavations of the main square in 2001 (A), separate diagrams labeling burials, post-holes, pits, and all other cultural activity was recorded for each of the visual occupation layers of the site (Figure 3). Seventeen separate layer diagrams for this excavation were recorded; each then separated into 56 sections consisting of 4 by 4 m squares.

Spatial Analysis

For the purpose of this study, all layer diagrams were digitized into a Geographic Information Systems (GIS) database; these include locations of post-holes, burials, and pits previously recorded. In order to properly maintain scale, digital layer representations were geo-referenced by matching control points with another digitized image. This image, which was previously geo-referenced to an existing aerial photograph, displayed the approximate locations of excavation squares A, X, and Y. All images were referenced using the WGS 1984 Universal Transverse Mercator (UTM) coordinate system, originally associated with images acquired from the Thailand Fine Arts Department located in Phimai, Thailand. All data acquired for this study

is presented with the permissions of Drs Nigel Chang and James Moloney of James Cook University, and by the Origins of The Civilization of Angkor Project. The Thailand Fine Arts Department provided all other data utilized for the study, including aerial photographs.

Coordination for layering and geo-referencing was conducted using ArcGIS v9.3 (ESRI) software. Conversions of images from vector to raster data was performed using the ArcGIS v9.3 Spatial Analyst extension. After the initial digitization, layers were overlain using ArcGIS v9.3. Post-holes were then queried and grouped by total area. This based on the assumption that buildings had been constructed with posts that were relatively the same size. This process created a much clearer picture of probable structural patterns at each level. Following these processes, it was possible to distinguish post-holes, which were new to each layer, from those that had extended down from earlier levels of the occupation. Excluding the pre-existing post-holes, visual patterns were connected to display possible structural patterns for each level of occupation. As post-holes begin in a new layer, it is reasonable to believe that these posts were used to support some type of structure dating to that specific occupation. Post-hole patterns were then examined, allowing comparisons between structures on different occupation levels to be investigated; thus increasing an understanding of possible structural change through time. Noted changes of the square (A) layers were tested against Flannery's (1972) hypothesis of the effect on structural change and storage, to the social organization of prehistoric settlements.

With the examination of post-hole patterns associated with each layer of occupation, we can then begin to produce a clearer picture of the lives and social structures of the prehistoric peoples of Ban Non Wat, more than we can with burial context alone. Models resulting from this study are not definite however, and would have to be tested repeatedly against other contexts of occupational sites residing in the Upper Mun Valley.

Figure 4. Post-holes in Layer Context (Boyd et al. 2009).

BACKGROUND

The Khorat Plateau

The Mekong River and its tributaries bound the Khorat Plateau to the North and East. The plateau consists of two major drainage basins; the Songkhram to the North, and the Mun-Chi to the South. Separating the Khorat Plateau from the Chao Phraya Valley to the West is the Phetchabun Range. Moorman et al. (1964) revealed five principal landforms on the Khorat Plateau: floodplains, low, middle, and high river terraces, and some igneous outcrops in the south. The low terraces are notably the best for growing rice. Middle and high terraces do not bode well for farming because the soils are too porous (Higham 1989). The plateau gradually slopes from west to east, where floodplains become narrower and narrower. Under normal conditions, the low parts of this floodplain already bear permanent lakes and swamps. Historically, these areas have faced severe flooding during the wet season. This area is heavily affected by monsoon rains, and has a very sharp distinction between the wet and dry seasons (Higham 1989). Seasonal winds move down on Thailand from the northeast between October

and April. This pattern then switches, as ocean temperatures rise in May, and winds flow to the country from the southwest.

Site Chronologies

Hunter-gatherer sites in Southeast Asia are typically expressed as rock shelters and coastal habitation sites. Due to the rise in sea level approximately 4,000 years ago, these groups were forced to move inland, following rivers and tributaries to resource rich areas. Large majorities of formerly coastal sites have been drowned by the sea and are now buried under a thick layer of marine clay (Higham 1989). Time periods for prehistoric settlements in this region have been chronologically ordered using a variation of Christian Jürgensen Thomsen's Three Age System. Early sedentary occupations have been assigned to the Neolithic, or "New Stone" period, ranging from approximately 2500 B.C. to 1500 B.C. Bronze Age occupations date from 1500 B.C. to 400 B.C. and Iron Age occupations range from approximately 400 B.C. to A.D. 400. Associations with these periods are based on the presence, or lack of, metal alloys found in the archaeological context. Bronze Age occupations are associated with the existence of copper at a site, while the appearance of iron tools coincides with Iron Age occupations (Boyd et al. 2009). For dating purposes, these time periods have also been subsequently divided into the early and late Neolithic, Bronze, and Iron Age periods.

Archaeology of Southeast Asia

The areas first excavations in Southeast Asia began 1902, when Henri Mansuy described the archaeological sequence at the site of Samrong Sen, a site formerly recorded by Dr. Corre in 1879. It was from this mounting interest in the cultural heritage of the area, that the founding of

the École Française d'Extrême Orient was established in 1898. This institution was the driving force in Southeast Asian archaeology, producing large amounts of information on cultural heritage, monument descriptions and measurements, and the translations of all Sanskrit inscriptions found (Higham 1989).

Aerial photographs of the Khorat Plateau taken by Williams-Hunt (1950) displayed a number of relatively round "moated" sites located in the Mun and Chi River Valleys (Figure 5) (Boyd et al. 1999). Following these identifications, numerous sites of significance were excavated in Southeast Asia during the 1960s; most with sequences dating to the Bronze and Iron Ages. Few sites in the area contain Neolithic occupations, but even fewer provide solid sequences that would allow full archaeological study. These shortcomings were due to bioturbation factors, lack of context with Neolithic burials, or problems with chronological dating methods. Discovering these types of sites also involves a little bit of luck, as most Neolithic sites are deeply buried under later occupations (Higham and Thosarat 2006).

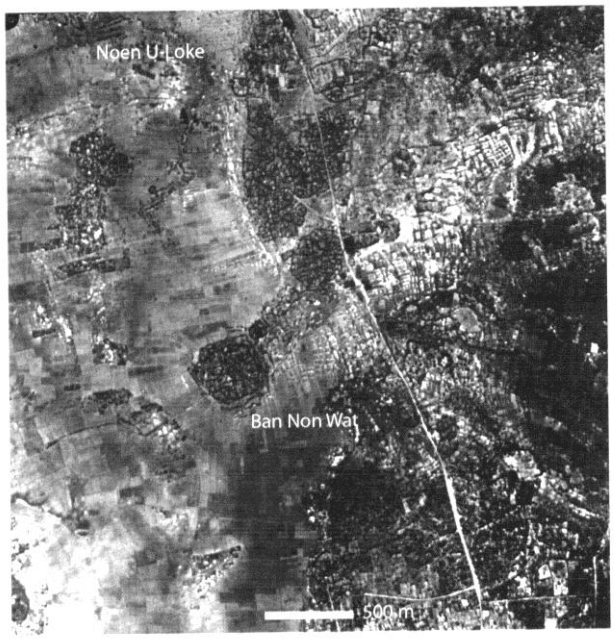

Figure 5. Aerial Photo of Ban Non Wat (Boyd et al. 2009).

The Origins of Angkor

The Origins of the Civilization of Angkor Project began in 1992 with the intentions of tracing the course of prehistoric cultural complexity that may have led to the transition of early states (Higham and Thosarat 2006). It was believed that the exploration of "moated" sites in the Mun and Chi Valleys would be able to provide evidence for the development of centralized political and social organization, identifying possible precursors to the emergence of the polities of Zhenla and Angkor (Boyd et al. 1999). This project was designed with the intention of testing the notion that social and political transitions owed their development to the process known as Indianisation; a theory, which states that cultures of Southeast Asia had been severely influenced by traders, attempting to trade with China, as they established outposts in the area. The theory of Indianisation gave little to the possibility of these transitions being directly stimulated by indigenous social change (Higham and Thosarat 2006).

After three seasons of site survey, the first excavations conducted for the "Origins of Angkor" project were located at the village of Ban Lum Khao, a non-moated site in the Upper Mun Valley, Nakhon Ratchasima Province, Thailand (Higham and Thosarat 2005). Excavations conducted during the 1995 and 1996 seasons revealed a late Neolithic Age settlement, which came to an end approximately 1280 cal. B.C. Bronze Age occupations at the site spanned a range of 1280 B.C. to 400 B.C. There was no individual or group wealth identified in context with the Bronze Age cemetery at this site. The moated site of Noen U-Loke, excavated in 1997 and 1998, displayed an Iron Age settlement dating approximately 400 B.C. to A.D. 300. Burials at this site displayed large amounts of grave goods in context with the deceased (Higham and Thosarat 2006:98). Given the burial context presented at these two sites, dating social change

proved quite difficult. Excavations proceeded in 2001 at the site of Ban Non Wat, which was originally expected to show similar results with that of Noen U-Loke, located a mere 2 km away (Higham and Thosarat 2006).

Ban Non Wat

Excavations at the site of Ban Non Wat have revealed several occupations that had not been as badly disturbed by bioturbation and farming as were previous excavations in the area. This discovery provides archaeologists with an invaluable opportunity to observe social and cultural changes over a continuous span of nearly 4,000 years.

Over the first seven seasons of excavation at the site of Ban Non Wat, 637 graves had been identified. Thirteen were discovered in a flexed (fetal) position, which is characteristic of indigenous Southeast Asian hunter-gatherer groups (Higham and Higham 2009). Materials placed in burial context included ceramic vessels with complex incised designs, shell ornaments, pig skeletons, and freshwater bivalve shells (Higham and Higham 2009). Flexed burials, associated with late hunter-gatherer groups, date between 1750 cal. B.C. and 1050 cal. B.C. Neolithic-1 (Neo1) burials display radiocarbon dates of 1650 cal. B.C. to 1250 cal. B.C., and consist of extended supine inhumation graves. Other burials that date in this range consist of lidded jars containing mortuary remains. Neolithic-2 (Neo2) burials were generally orientated on an east/west axis and showed much poorer grave wealth than that of the previous layer. Neo2 burials dated from 1250 cal. B.C. to 1050 cal. B.C., and were frequently accompanied by cord-marked vessels and freshwater bivalves (Boyd et al. 2009:25) (Table 1).

Cultural Period	Date in Calibrated Radiocarbon Years (BC)
Flexed burials	1750-1050
Neolithic 1	1650-1250
Neolithic 2	1250-1050
Bronze Age 1	1050-1000
Bronze Age 2	1000-900
Bronze Age 3	900-800
Bronze Age 4	800-700
Bronze Age 5	700-420
Iron Age 1	420-100
Iron Age 2	200-AD 200
Iron Age 3	AD 200-400
Iron Age 4	AD 300-500
Early Historic	500-

Table . Dates Ranges from Ban Non Wat and Ban Lum Khao (Boyd et al. 2009)

Bronze Age occupations at the site of Ban Non Wat have been categorized into five distinct phases. All are associated with the presence of copper materials, yet show variable types of tools and pottery. Bronze Age-1 burials (BA1), dating from approximately 1050 cal. B.C. to 1000 cal. B.C., are associated in context with small ceramic vessels. BA 1 burials at this site show a very similar resemblance to those at the late Neolithic site of Ban Lum Khao (Boyd et al. 2009). Bronze Age-2 burials (BA2), 1000 cal. B.C. to 900 cal. B.C., display a dramatic change in wealth and status. Some burials in the BA 2 phase were notably exhumed and then reburied with skulls balanced on top of their long bones. Exhumed burials may possibly reflect the high ritualistic or social status of these individuals (Boyd et al. 2009:25). Some BA2 graves contained up to 50 or 60 ceramic vessels as well as copper-based axes, chisels, points, and numerous anklets and rings (Higham and Higham 2009). Some skeletal remains from this phase had also been wrapped in fabric and contained within wooden coffins (Higham and Higham 2009). Many burials contained exotic shell and marble ornaments, as well as shell beads; these

had been draped over the entire body and occasionally sewn into the individual's clothes. Some of the wealthier individuals at this level were buried with up to 22 shell earrings each; these could also be termed as elite individuals (Higham and Higham 2009). The Bronze Age-3 (BA3) phase consisted of 13 rich burials, normally situated on a Northeast to Southwest axis. Dates for BA3 burials ranged from 900 cal. B.C. to 800 cal. B.C., and were associated with marble bangles, well-crafted ceramics, and numerous marine shells. Some burials associated with BA3 also contained socketed bronze axes (Higham and Thosarat 2006:98). Mortuary context of the Bronze Age-4 (BA4) phase was noticeably poorer, showing a very rare presence of any bronze at all. Burials of this phase are dated from 800 cal B.C. to 700 cal. B.C., and were normally buried with their heads orientated to the Northwest. Similar burials are associated with the Bronze Age-5 (BA5) phase, which ranged 700 cal. B.C. to 420 cal. B.C. Many spindle whorls, used for weaving, and lumps of grey clay, accompanied these remains (Higham and Higham 2009).

The Iron Age in Southeast Asia is associated with the presence of iron tools. Iron Age-1(IA1) burials at the site of Ban Non Wat date from 420 cal. B.C. to 100 cal. B.C., and contain iron tools, glass earrings, agate ornaments, spears (both bronze and iron), and pots filled with fish remains (Higham and Higham 2009). Iron Age-2 (IA2) phase burials are distinguishable by their presence of Phimai Black ceramics, as well as exotic hard stones and glass ornaments. Burials from the IA2 phase displayed a high level of disturbance by bioturbation and recent activities in the area (Higham and Higham 2009).

Based on mortuary context from the sites of Ban Non Wat and Ban Lum Khao, two peak periods of wealth are apparent. These two periods of possible change in the social stratification of the site appear to have occurred during the early Bronze Age (BA2 and BA3), and again during the late Iron Age, IA2 (Higham and Thosarat 2006). This development in the late Iron

Age seems to coordinate with the construction of the circular "moats," which likely functioned as a method of water control. Unlike other Bronze Age sites in Southeast Asia however, Ban Non Wat excavations display great mortuary wealth during the Bronze Age periods. This seems to be somewhat of an anomaly. Normal associations with Bronze Age burials in Southeast Asia reveal little or no signs of social stratification reflective of social or economic success (Higham and Thosarat 2006).

GIS in Archaeology

Geographic Information Systems (GIS) have been in use since the 1960s, but have only been utilized in the field of archaeology over the past thirty years. A GIS is a computer system designed for the intended purpose of capturing, storing, querying, analyzing, and displaying geospatial data (Chang 2010). The Geographic Information System (GIS) is composed of four components: hardware, software (Visual Basic, ArcGIS, etc.), an operator, and infrastructure (Chang 2010).

The concern of anthropology with behavior and material culture is naturally tied to the spatial analysis of people and their things over natural and cultural landscapes (Green 1990). Using GIS in the field of archaeology allows spatially referenced information to be portrayed as a visual representation of archaeological data. This view enables archaeologists to think about and interpret spatial relationships in many different ways. GIS has already been applied in several different fashions within the field of archaeology. The more widely used applications of GIS in this field include predictive modeling of site locations, and 3D reconstructions of environments, sites, and artifacts. The combination of remote sensing and GIS capabilities has begun to open many avenues for archaeologists that may have been previously unobtainable.

Theoretical Model

Kent Flannery's (1972) article discusses the implications of structural change at several sites in Mesoamerica and the Near East. Here, Flannery examines the change from circular structure, "compounds," to the rectangular structures at "villages." In this article, Flannery discusses the relationship of three main variables: agriculture, sedentary life, and villages. He argues that "sedentary life" probably had more to do with "the installation and maintenance of permanent facilities, and the establishment of hereditary ownership of limited areas of high resource potential (Flannery 1972)." He also states that "group ideology probably changed from a small pattern defended core to a large undefended periphery emphasized in concepts of descent (Fla nnery 1972)."

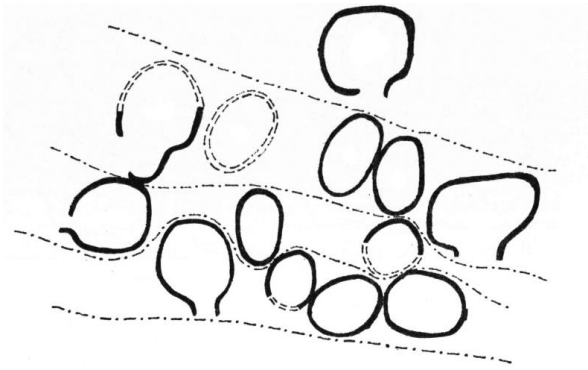

Figure 6. Hut Foundations at Nahel Oren, Israel. Level II
(Flannery 2002, from Stekelis and Yizraely 1963)

Flannery's initial investigations identify several critical aspects of Neolithic "circular" compounds. These compounds are arranged in a circular fashion, surrounding a cleared, open space in which food is stored and shared by all residents. Many of the circular compounds examined in his study date between 9000 B.C. and 6500 B.C., and were typically constructed using stone foundations (Figure 6). Flannery continues his article by describing some features of

rectangular structures. Here he states that most probably were meant to accommodate families, built large enough to house three or four people. These structures would have included their own storage facilities, either inside or next to the house, and would have made adding and subtracting rooms easier for its residents. Flannery believes that this architecture led to systems of social and political organization, based on production of each individual unit (Flannery 2002). He also states that there is a widespread belief by archaeologists that a village's size is a function of its agricultural potential. Flannery states this as incorrect, as ethnographic data shows that size may be directly linked to the village's inability to keep the peace when it grows too large (Flannery 2002). He suggests as well, that the presence or lack of real authority was what restricts an agricultural society from growing, instead of the general belief by archaeologists that these societies were limited by their tools and technology (Flannery 2002).

RESULTS

Layer 5.3

Post-holes located within layer 5.3, the bottom most layer of the excavation, may be associated with the hunter/gatherer groups that had initially moved inland from coastal areas. Patterns show what appear to have been two large, overlapping, circular structures located at the northern end of the square; each measuring approximately 8 to 9 m^2 (Figure 7). Located within the eastern circle appears to be smaller, interconnected half-circles, each providing a slight barrier from the other. A few buildings constructed using small to medium sized posts are apparent in the southwest portion of the square. One very large, rectangular structure, appears to have been erected over almost half of this area, covering the northwest quarter, and extending past the

excavation. As the extent of this structure is unknown, total area is unclear. It does appear however, that its total area is greater than 30 m^2. Although the purpose for this structure is unknown, it may have served as a canopy for the area; this as an effort to combat the effect of harsh tropical weather on the smaller circular buildings below. An infant burial located at the south end of this layer has been dated to that of hunter/gatherer societies (Boyd et al. 2009). The only other burial evident at this layer is associated with a very deep BA4 grave.

Layer 5.2

A larger number of post-holes exist on this level than that of 5.3. Like that of the prior, layer 5.2 is also associated with that of hunter/gatherer societies, and shows patterns of small intertwined circular structures (Figure 8). Some of these intertwined structures display a walkway like corridor pattern. These may have resulted from inhabitants building onto a previous structure, instead of erecting a completely separate one. Another reason for these types of corridors could be an apparent battle against the heat of their environment, in an attempt to keep shaded at all times. One large circular pattern is evident at the north most edge of the excavation, yet its extent is unknown. The larger posts that dominate this layer show evidence of one or two rectangular structures, possibly built for storage purposes. Burials from several time periods are intrusive to this level, most associated with the late Neolithic and early Bronze Ages. One very elaborate burial, associated with BA2, was discovered in a generally open area in the south central locality of the square. Another associated with BA2, listed as one of the deepest burials in the square, was contained within a wooden coffin. Five of the six BA1 burials discovered in the excavation of square (A) were located at this level. Stone Adzes and clay anvils dominate the artifact assemblage of 5.2 (Boyd et al. 2009).

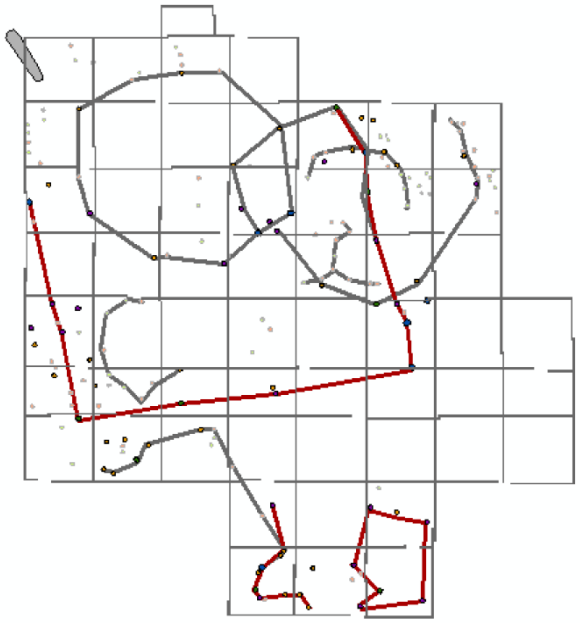

Figure 7. Layer 5.3
(Digitized from Boyd et al. 2009).

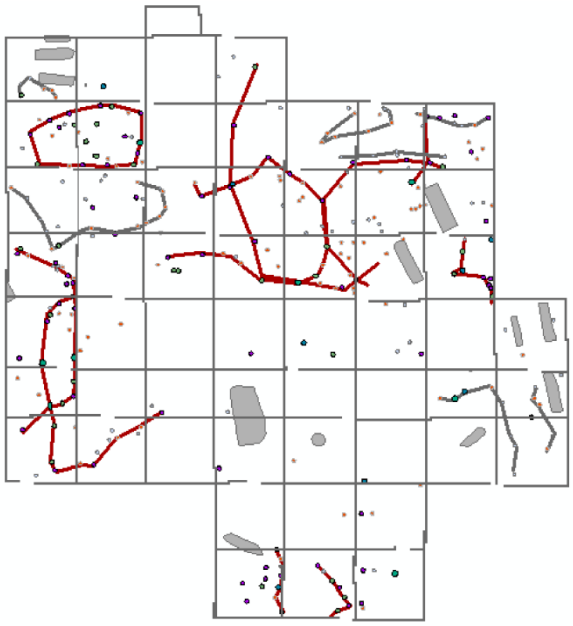

Figure 8. Layer 5.2
(Digitized from Boyd et al. 2009).

Layer 5.1

Several different structural patterns are displayed at this level. Structures in layer 5.1 can be associated with hunter/gatherer groups and a late transition to the early Neolithic-1(Neo1) period (Figure 9). This layer, similar to that of 5.2 and 5.3, displays evidence of the same large, open area in the south central location of the square. Surrounding structures appear larger than that of the later occupations, yet with a similar interconnected pattern. Larger post structures consist of areas ranging from approximately 6 to 8 m2. Medium-sized rectangular structures existed in the south and westerly locations of the square. The rectangular structure to the west may have been an extension of a previous, smaller storage area that is evident within its boundaries. This level contains the largest number of elaborate BA2 burials (15), half of all the BA2 burials discovered in square (A) (Boyd et al. 2009). Neo1 and the BA2 graves dominate layer 5.1.

Figure 9. Layer 5.1
(Digitized from Boyd et al. 2009).

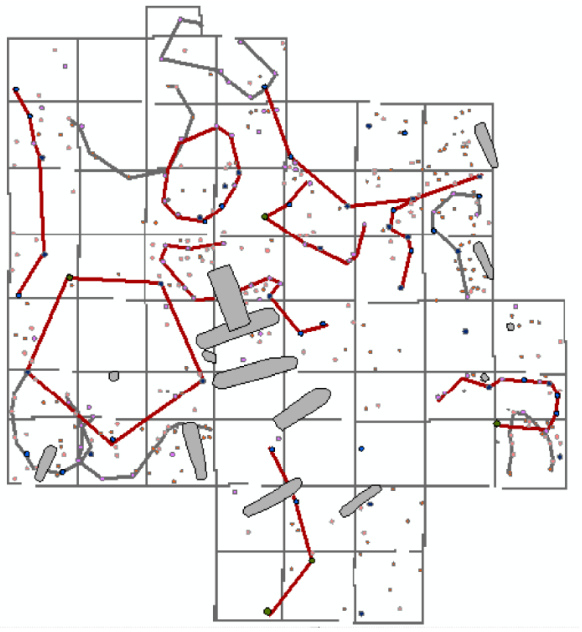

Figure 10. Layer 4.8
(Digitized from Boyd et al. 2009).

Layer 4.8

More structures are apparent in layer 4.8 than in that of all deeper levels (Figure 10). This layer is also associated with the transition from the extended burials of hunter/gatherer societies to that of the Neo1 period. A large circular structure is apparent in the northeast corner of the square; its continuing extent is unknown. Based on the location of the larger post-holes in this layer, a medium-sized circular structure (6 to 7 m²) may have existed on the eastern half of the area. Small circular structures continue to exhibit an interconnected nature, with a possibility of corridor like avenues comparable to that of layer 5.2. Neo1 and Neo2 graves are abundant in this layer, making up 89 percent of all burials excavated in 4.8. Many of the artifacts found in this layer consist of stone Adzes and flakes from the Adzes discovered *in situ* with Neolithic midden deposits (Boyd et al. 2009).

Layer 4.7

The beginning transition from the Neo1 to the Neo2 period seems to have taken shape during this occupation. Neo1 type burials all but disappear from the mortuary context of the excavation at this level (Figure 11). There is also a steady decline in the number of Neo2 burials found at this level than were associated with layer 4.8. A large, rectangular post-hole pattern is displayed in the northwest area of square (A), covering approximately 11 m^2. Smaller post-holes in this layer display similar intertwining structures to those presented in later levels, however larger and less circular patterns also seem present. Another formation consisting of larger post-holes appears at the southern extent of the square. An interesting feature of this structure is presented as reinforcement posts may have been placed next to larger posts, supporting what would have been the northern wall of the structure. The extent of this construction is unknown, yet the reinforcement may suggest previous damage to the original building, or a possible attempt to increased wall strength; this either for containing something within, or keeping something out of the structure. Artifacts at this level consist of stone Adzes and Bronze Age pottery, which may have been placed graveside as a part of mortuary ritual (Boyd et al. 2009).

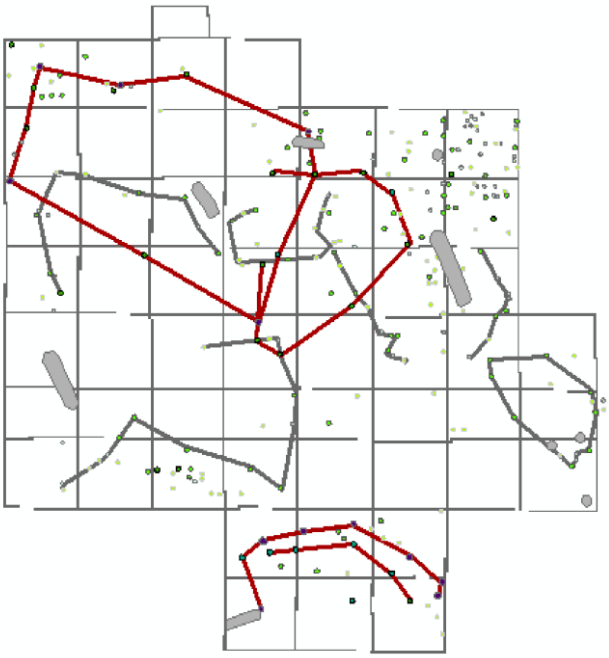

Figure 11. Layer 4.7
(Digitized from Boyd et al. 2009).

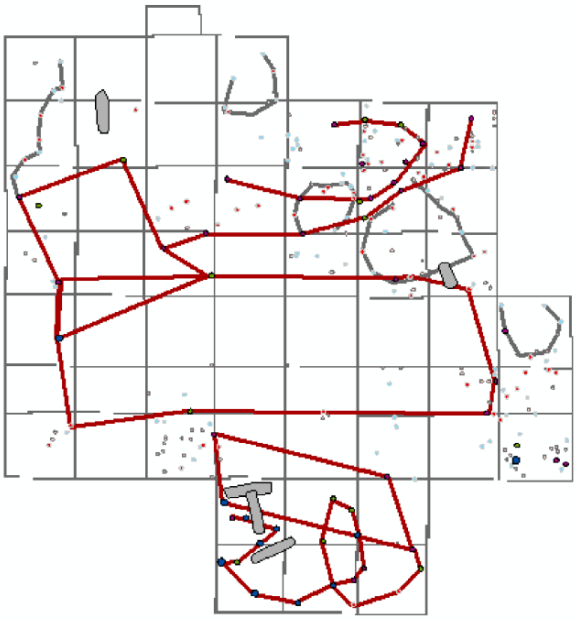

Figure 12. Layer 4.6
(Digitized from Boyd et al. 2009).

Layer 4.6

The construction of a very large rectangular building is apparent at this level (Figure 12). This structure lies in an east/west orientation at the very center of the excavation square, and consists of an area of approximately 12m². Very few post-holes were located within the structure, yet many smaller structures seem to have been constructed around it. Another rectangular pattern is displayed attached to the northwestern corner of the prominent large structure. This attached structure has an area of approximately 8m², and could possibly have been some type of entrance to the larger building. Rectangular and circular, large post patterns, display a structure existing at the supreme southern extent of the excavation square (A). These circles indicate the possibility of an extension to the rectangular structure. Other patterns at this layer suggest the same interconnectivity as previous, yet are apparently more open and directive than those of the later levels. This layer continues to display patterns of small circular structures, possibly storage

areas for the larger buildings. Layer 4.6 burials date from BA2 and later, placing the occupation for the layer in the early and middle BA1 periods (Boyd et al. 2009).

Layer 4.5

Two large, and possibly connected, rectangular structures are evident in this layer, which is associated with a BA2 occupation (Figure 13). These structures are positioned in a northwest to southeast orientation, and appear to be attached to smaller intertwined buildings, similar to all later occupations. The smaller post-hole patterns are few and circular in shape. These appear to be located in larger numbers to the east of the large rectangular structures. Pottery placement at this level correlates with BA3 vessels, yet could have been disturbed and changed in context. A small furnace, probably for heating copper to melting point, was also found at this level (Boyd et al. 2009). Nearly all burials found in 4.5 are associated with the BA3b period or later, with only one burial assigned as BA2. It is possible, as shown by a greater variance in BA3b graves throughout the layers, that burial context is more likely to have been disturbed through the later periods.

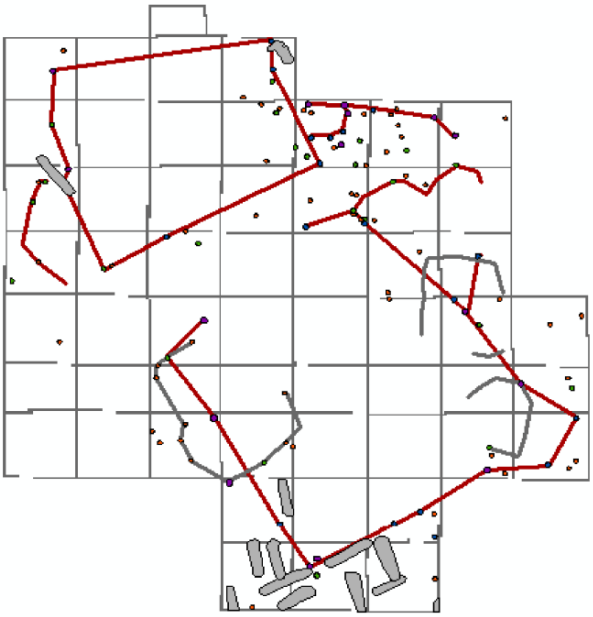

Figure 13. Layer 4.5
(Digitized from Boyd et al. 2009).

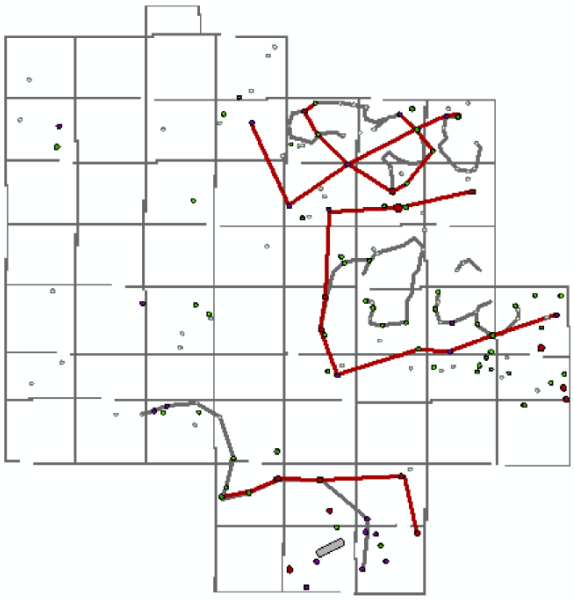

Figure 14. Layer 4.4
(Digitized from Boyd et al. 2009).

Layer 4.4

Layer 4.4, assigned to the transition between BA2 and BA3, displays the shifting of structures away from the western portion of the excavation square (Figure 14). A large variability of post-holes exists in this layer, yet some patterns are evident of smaller rectangular structures located in the northeast and southwest corners of the square. The appearance of small, connected, circular structures still exist at this level, yet seem to be decreasing in size. A larger, interconnected circular pattern is evident at the southern border of the excavation square, with the extent of the structure unknown. Post-hole patterns also suggest what appears to be the corner of a larger, rectangular structure located on the northern border of the square. Burials for this layer are associated with that of BA3b and later. Artifact assemblages reveal fewer anvils and burnishing stones than that of early Bronze Age occupations (Boyd et al. 2009).

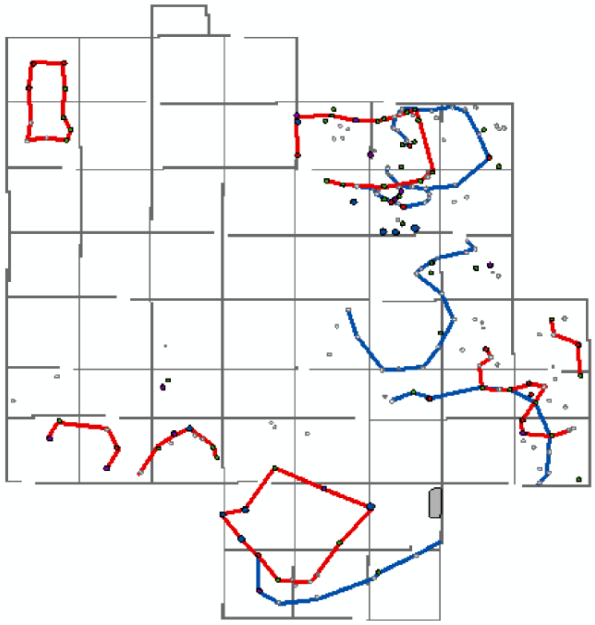

Figure 15. Layer 4.3. (Digitized from Boyd et al. 2009)

Layer 4.3

This level, associated with BA4 or BA5 occupations, shows a depletion in rectangular structures in the area (Figure 15). Smaller, rectangular patterns are displayed in the northwest and southern portion of this level, but are reduced in area to between 5 and 6m². Small circular patterns are evident to the eastern and southern portions of the excavation as well, yet still appear in a connected fashion. The northwestern half of 4.3 appears abandoned, with the exception of a very small rectangular structure located in the northwest corner. It is a distinct possibility that the main occupation focus at this layer shifted from this part of the mound to another, but for the content of this research, is not a major concern. As with layer 4.4, burials found in context of this layer are associated with BA3b or later, outside of the research topic.

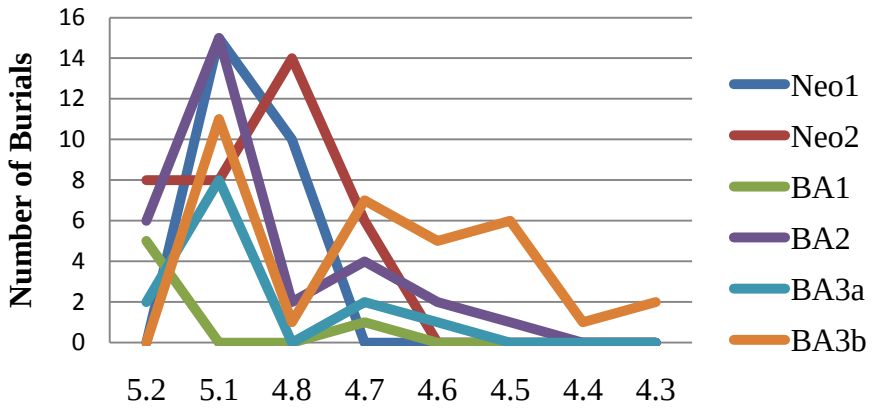

Figure 16. Burial Associations per Layer.

DISCUSSION

Tropical Environments

An analysis of post-hole patterns within a tropical environment may prove more difficult than those conducted within more temperate zones. Several differing structures were possibly erected for purposes other than habitation and storage; these to include lean-tos and the construction of canopy cover for shade and protection from further elements. The seasonal monsoon rains in Southeast Asia probably had proven troublesome for past inhabitants, which may explain the combination of large and small post-holes found within the layers. The appearance of these larger posts surrounding typical small post patterns could indicate a structure with the sole purpose of raising a group of small, circular buildings off the ground; this to prevent against problems of flooding. These types of patterns could also indicate a large canopy cover for the smaller structures as previously stated.

Neolithic Age Transition

Layers 5.1 (Figure 9) and 4.8 (Figure 10) are associated with the transition from hunter/gatherer groups to the Neolithic period. An increase in the number of post-holes represented per layer is apparent from the deepest layer of the site (5.3), and into the Neolithic period transition (4.8). Structures increase only slightly in size, as well as in the amount of interconnectivity between them. Throughout this transition a general site pattern seems to be followed, as the same area in the south central location of the excavation square is left generally clear from structures. We also see a slight introduction to rectangular structures in layer 5.1, which then diminishes in number and size as the occupation moves further into the Neolithic. These could possibly have represented storage structures, based on the small size of their patterns.

Bronze Age Transition

Post-hole patterns of layer 4.7 show a change to larger, rectangular buildings developing toward the end of the Neolithic period (Figure 11). The Bronze Age transition in layer 4.6 focuses on a large, rectangular structure orientated at an east/west axis in the center of the square (Figure 12). According to Loeb and Broek (1947), longhouses have appeared regularly throughout the historic record of Southeast Asian societies. They did not however appear to be associated with the Thai, only with related groups in the mountains of Indo-China. Longhouse structures are stated to generally measure up to 100 feet and would be divided into family or clan sections. The structure in layer 4.6 appears to measure approximately 79 feet long and 30 feet wide. This building may not represent the structures mentioned by Loeb and Broek as there are very few noticeable post-holes located within it. Other rectangular structures appear during this Bronze Age transition as well, expanding in size and number. These layers continue to display patterns

of underlying, interconnected, circular structures which are found throughout the occupation of the site. A pattern of rectangular structures continues into the BA2 and BA3 associated occupations. For these layers, a decline in the size of the structures, as well as a noticeable migration away from the northwest quarter of the square is presented. The possibility of a transition back to circular structures is apparent for layer 4.3, which is associated with a BA4 occupation.

CONCLUSION

An attempt to study post-hole patterns at Neolithic sites in Southeast Asia can prove slightly problematic. The lack of comparable studies in this area, or these types of environments, allows for flawed interpretations based strictly on studies of other sites and environments. Flannery's studies had been conducted on sites located in the Near East and Middle East; all of these consisting of stone foundations. He also explains how this same model may not be able to explain structure patterns at all sites because agriculture and the emergence of village began at different times in different areas of the world, for different reasons (Flannery 1972). As research continues in the area, this model will be able to be further tested for viability at prehistoric agricultural sites in Southeast Asia.

Implications for Social Change

An apparent wealth to society is expressed through the elaborate Bronze Age burials associated with the occupations at levels 4.5 and 4.4. Post-hole patterns at these levels reveal rectangular structures, which began to develop earlier in the late Neolithic and Bronze Age occupations. Smaller, interconnected, circular patterns seem to be associated with these buildings, as

illustrated in layer 4.4, and may have been used for privatized storage. Flannery's hypotheses concerning structural change in habitation buildings prior to changes in social stratification seem to bear true for the early occupations at Ban Non Wat. Although it is difficult to associate structures with storage facilities based on a lack of feature analysis presented within them, we can begin to conclude that storage was indeed shared prior to changes in habitation structures, yet more research would have to be conducted to back up this claim. Another possible association can be made with structure size and the decline in burial wealth displayed during occupations following BA3. There may have been several other factors for this decline however, these to include population size and site set-up.

Future Studies

In order to appropriately conclude the changes in structure patterns as they relate to social stratification, further studies must be conducted at the site of Ban Non Wat, as well as other sites in the Upper Mun Valley. The excavation of square (A) at the site of Ban Non Wat was the largest conducted at the site. An expansion of that excavation however, would allow more post patterns to be observed and produce a better general idea of site layout. During excavations, complete post-hole measurements in diameter and location would diminish the possibility of data error in these studies, creating more confidence in visual patterns. As stated before, further research must be conducted on prehistoric habitation structures in similar environments. A better understanding of construction methods may also be helpful in identifying how these post patterns were formed. These types of structural studies are also acceptable to bias. Therefore, it may be appropriate for several interpretations of post-hole patterns to be conducted. To combat these biases, further analysis of layers must be conducted with no prior knowledge of associated levels

or dates. The spatial analysis of post-hole patterns, when paired with data retrieved from features within and outside of the structures, would allow a much greater interpretation of cultural and social evolution in Southeast Asia.

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