From Excavation to Online Exhibition: A 30+ year Journey at La Mula-Sarigua

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Abstract: The goal of this paper is to "highlight" the results of 30+ years of research on one archaeological site (La Mula-Sarigua [LMS]) in the Gran Cocle Region of Panama. Such work has taken place in three phases: (1) major field and laboratory efforts (1983-1988 culminating in a dissertation which dealt with inequality, and a number of related issues); (2) focus on refining analyses of lithics and ceramics to interpret the nature of technologies, such as specialization (1990-2011), and (3) a digital archive initiative with an online presence (2015-present).The latter is an attempt to make the archaeological resources from LMS publicly available for future research and teaching independent of the physical objects, records and institutions.
Keywords: Archaeology; Panama; lithics; digital databases; R.G. Cooke.

De la excavación a la exhibición en línea: un viaje de más de 30 años a la Mula-Sarigua
Resumen: El objetivo de este trabajo es "resaltar" los resultados de más de 30 años de investigación en un sitio arqueológico (La Mula-Sarigua [LMS]) en la Región Gran Coclé de Panamá. El trabajo se ha llevado a cabo en 3 fases: (1) trabajo de campo y laboratorio (1983-1988 culminando en una disertación que trataba de la desigualdad y una serie de problemas relacionados); (2) enfoque en los análisis de refinación de líticos y cerámicas para interpretar la naturaleza de las tecnologías, como la especialización (1990-2011) y (3) una iniciativa de archivo digital con una presencia en línea (2015-presente). Este último es un intento de hacer que los recursos arqueológicos de LMS estén disponibles públicamente para futuras investigaciones y enseñanzas, independientemente de los objetos físicos, los archivos y las instituciones.
Palabras clave: arqueología; Panamá; lítica; bases de datos digitales; R.G. Cooke.

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Introduction

In this paper, the results of over 30 years of field and laboratory research from the archaeological site of La Mula-Sarigua (LMS), Gran Cocle Region of Panama, are discussed (Figure 1). It seems fitting to present these results in a volume dedicated to Richard Cooke as he has made significant contributions to my work at LMS, particularly in analyzing ceramic assemblages. Richard's expertise, however, does not begin and end with this specialty. All one should do is browse a recent abbreviated bibliography of him to realize that he has tremendous control over a myriad of topics (see https://stri.si.edu/scientist/richard-cooke/bibliography). Most would agree that it is almost impossible to interpret the archaeological record from Panama, and even beyond, without referring to his work.

The research that I have conducted at LMS (PR-14) since the 1980s has taken place in three phases. The first began in 1983 with two major components: an extensive field survey and evaluation program to determine site size by time period followed by intensive laboratory analyses of ceramics, lithics, fauna and flora from all time periods (13,000 years ago to contact). This phase concluded with a dissertation.

The primary goals of the dissertation were to identify socioeconomic patterns and to explain change(s) in those patterns during the 1st millennium B.C. This was best accomplished by examining those regional patterns which preceded and followed the 1st millennium B.C. For example, lithic production prior to the 1st millennium B.C. was neither specialized nor consistent. Following the 1st millennium B.C. specialized production of relatively uniform stone tools was commonplace – a general indicator of complexity. This latter pattern appears to have begun in the 1st millennium B.C. at LMS where there was the use of standardized techniques of manufacture and a high degree of consistency in the size and shape of some tool types, most notably unifacial points and celts.

The second phase of research focused on conducting lithic experiments, refining ceramic typologies, and interpreting ancient technologies, such as specialization (1990-2011) (Hansell, 1990, 1992, 2008b, 2009, 2011). And the third was the initiation of a digital archive program (2015-present) (Hansell, 2017). Although Richard and I did, in part, work together on the first "2" phases we did not collaborate on the latter. Nonetheless, we came to a similar solution relative to the disposition of archaeological resources and their availability for future investigators, i.e., the creation of digital databases. The significance of this trajectory is that combined or consolidated once online our results, can serve as a permanent research and teaching collection independent of the location of the institutions, physical objects, and records.

Historical Background

La Mula (HE-30 [PR-14]) and Sarigua (HE-16) were first described by Willey and McGimsey (1954). At that time, La Mula occupied badly eroded slopes of the mainland and overlooked a large alvina. A sur-

Figure 1: Map of Panama with the archaeological site of La Mula-Sarigua placed. Source: "Sarigua Panama" (Google Earth, 2018).

face examination revealed shallow pits of shell with pottery covering an area of ca. 50 ha "suggestive of an extensive prehistoric village" (Willey and McGimsey, 1954). Small test pits were made in some of the shell pits but nowhere was deep refuse encountered hence excavations were not conducted.

For Willey and McGimsey Sarigua (HE-16) was a small (0.14 ha) shell midden atop a clay hummock and adjacent to weathered outcrops of the mainland. Two excavations revealed plastically decorated pottery to a depth of 60 cm along with shell and 10 animal bones.

LMS's true archaeological significance was not realized until 1982 when it was briefly reinvestigated by the Proyecto Santa Maria (PSM) directed by Cooke and Ranere (1984, 1992). This reinvestigation included a walking reconnaissance, a 5m^2 total surface pickup and 3 small excavations (Figure 2).

An analysis of materials recovered indicated:

1. The site minimally covered 65 ha.
2. Much of the eroded surface was deflated leaving cultural remains and clusters of remains behind as a lag deposit but that significant portions of the site were not eroded. In contrast to Willey and McGimsey (1954), the PSM's excavations suggested stratified cultural deposits as deep as 50cm below the present surface.
3. A radiocarbon date of 870 + 50 B.C. (Beta-6016) was obtained.
4. Based on style, ceramics were predominately of types dating from the 1st millennium B.C.

Figure 2: Aerial view of La Mula-Sarigua looking south, 1983. Foreground = alvina

5. Lithics were abundant with chipped and ground stone tools spanning the early ceramic and later periods.
6. Organic remains (fauna and flora) were well preserved.
7. On the basis of ceramic types it was clear that La Mula and Sarigua were contemporary. Given the spatial and temporal relationship of the 2 sites, we feel that they should be described as one large complex, La Mula-Sarigua, rather than as 2 isolated entities.

The PSM reassessment was sufficient to establish LMS as the earliest known large agricultural community and, perhaps, regional center in Panama.

Both of the above short field inquiries at LMS, i.e., that of Willey and McGimsey, and Cooke and Ranere, were restricted to the eroded portion of the site (compare Figure 3 left and right views). Further, materials were collected in only small sections along this exposed stretch and they were selective in nature. No attempt had been made to determine the overall extent of the site in uneroded areas (Figure 4).

Figure 3: La Mula-Sarigua eroded surfaces, 1983. Left - looking south; right - looking north.

Phase I (1983-1988)

Major Field and Laboratory Work. With an NSF Dissertation Improvement Grant (BNS-8312909), a Short-term Fellowship from the Smithsonian Tropical Research Institute and an Educational Research Grant from the Smithsonian Institution, fieldwork was implemented under my direction in 1983 and 1984. Guided by aerial photographs and a walking reconnaissance, it was discovered that the region was naturally bound to the north, east and west by streams, swamps and an alvina (presently shrimp tanks) (see Figure 5; compare with Figure 2). The east-west distance was 2000 m. To the south the site was land bound. It could be further divided into eroded / visible and vegetated / uneroded surfaces. The north-south distance was 1600 m. Ultimately a 2 km x 2 km region was surveyed (in both eroded and uneroded contexts).

In our field program, we (1) shovel tested the uneroded portions of the site to locate site boundaries and determine the location / nature of buried deposits; (2) collected samples from the eroded surface to delineate the distribution / density of surface materials and features, as well as to determine the function and age of these materials / features; and (3) excavated a small number of units in order to determine the presence / absence of buried cultural deposits in surface features to delineate subsurface features and site stratigraphy, to collect samples in datable contexts, and to analyze artifacts, faunal and floral remains, human remains and sediments.

Many were involved in the Phase 1 analyses of the archaeological remains. But, by far, the greatest contribution came from Richard who spent tremendous amounts of time and effort over a 3+ year period analyzing the fauna and ceramics. In fact, Richard (along with Anthony Ranere) played critical roles throughout the field and lab aspects of this project from suggesting I work at La Mula-Sarigua in the first place to conferring and working with me on site. The ultimate outcome of this work was a dissertation which dealt with socio-economic change in the 1st millennium B.C. This change involved the first appearance of large sites, differential distribution of and access to a variety of resources (natural and/or cultural), craft specialization (discussed below), differential treatment of the dead and regional exchange.

Figure 4: La Mula-Sarigua uneroded/vegetated surfaces, 1984

While the 1988 manuscript focused on the 1st millennium B.C. occupation, additional short excursions on the site by Ranere and Cooke (1988-2005) and extensive analyses on the lithic and ceramic components revealed that LMS was occupied at least as early as 13,000 years ago, and then repeatedly thereafter (Hansell, 1998, 2006, 2008a; Hansell and Ranere, 2003; Figure 6).

Origins and Development of Occupation at La Mula-Sarigua: A Brief 11,000-year Overview

The site's earliest occupants used locally available chalcedony sources to manufacture Clovis spear points, an artifact type associated with mammoth, mastodon and other extinct fauna in North America. La Mula-Sarigua (LMS) was regularly reoccupied by groups of hunter-gatherers (who also began growing some crops by 9,000 years ago) until 2,500 years ago, when the first large (ca. minimally 65 ha) permanently occupied agricultural village in Panama was established. While the site was also occupied during later periods by farmers, the earlier (ca. 2,500-1,800 years ago) agricultural period is particularly important since it serves as the period "type" site for the description of stone tools and pottery types for the entire Gran Cocle Region.

Phase 2 (1990-2011)

This phase focused on refining the ceramic chronology in order to determine the occupational sequence at LMS (and elsewhere in the region, e.g., Cerro Juan Diaz) (e.g., Cooke, 1980, 1995, 2001; Cooke and Sanchez, 1997; Sanchez, 1995; Sanchez and Cooke, 2000) and on conducting lithic experiments to determine specialization (Hansell, 1990, 1992, 2008b, 2009, 2011).

Figure 5: Aerial view of La Mula-Sarigua looking north, 2018. Source: “La Mula-Sarigua Panama.” 8°02’11.05 N and 80°29’34.09” W. (Google Earth, 2018).

Refining the Ceramic Chronology

To create a regional ceramic typology, Richard Cooke and Luis Alberto Sanchez have spent a number of years working out the characteristics associated with a variety of ceramic assemblages which span the period from approximately 5000 B.P. to 400 B.P. (Cooke, 1980, 1995, 2001; Cooke and Sanchez, 1997;Sanchez, 1995; Sanchez and Cooke, 2000). While I worked with Richard and Luis for two summers (2005 and 2006) in order to create a type collection for LMS, it was them who almost single-handedly pulled this diverse collection together. It would have been impossible to tease out the developmental history of LMS based on ceramics without their efforts. (See Figure 7 for examples of ceramics from LMS).

A number of archaeological investigations have taken place in the Gran Cocle Region over the past 25 years. I do not know of one investigator who has not relied on the in-depth ceramic work of Cooke and Sanchez (e.g., Berrey, 2014; Haller, 2004; Iizuka, 2013; Isaza, 2007; Locascio, 2010; Mayo, 2006; Menzies, 2009; to name a few).

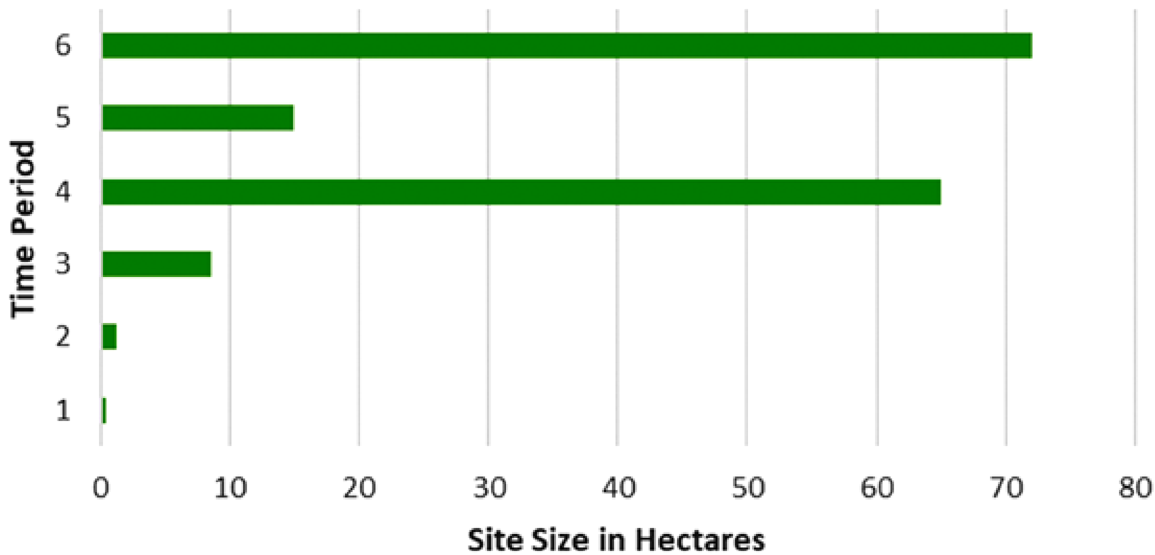

Figure 6: Site size by time period. Period 1 = Paleoindian, 2 = Early Pre-Ceramic, 3 = Early Ceramic, 4 = Middle Ceramic A (1st millennium BC), 5 = Middle Ceramic B, 6 = Late Ceramic.

Ancient Technologies as Earmarks of Specialization and Social Complexity

Arguably, craft specialization is a significant indicator of social complexity. Although Cooke (1977), Ranere (1980), Ranere and Cooke (1996), and Hansell, Cooke and Ranere (2005) have alluded to some ground stone tools in Western Panama (the Bugaba Phase) and the Gran Cocle Region of Panama being the product of specialists, rigorous studies which attempt to demonstrate that such is fact are rare in Panama and the rest of lower Central America. To address this deficit I conducted quantitative and experimental analyses on two LMS formal tool types (pointed flakes and celts – tools thought to represent the work of specialists from the 1st millennium B.C. component) (Figure 8). Herein I focus on the celt evidence.

My objective in analyzing the celts was to determine uniformity / standardization in production. The assumption is that the more uniform a particular tool class is, the more skill and/or knowledge required for its creation. Uniformity can then be used as a proxy for specialization – a proxy which can be estimated by measuring the attributes thought to be significant in the manufacturing of specific tools forms, particularly those of size and shape. Along with quantitative methods, it is also important to determine technology and functionality as both have implications for interpreting / masking standardization.

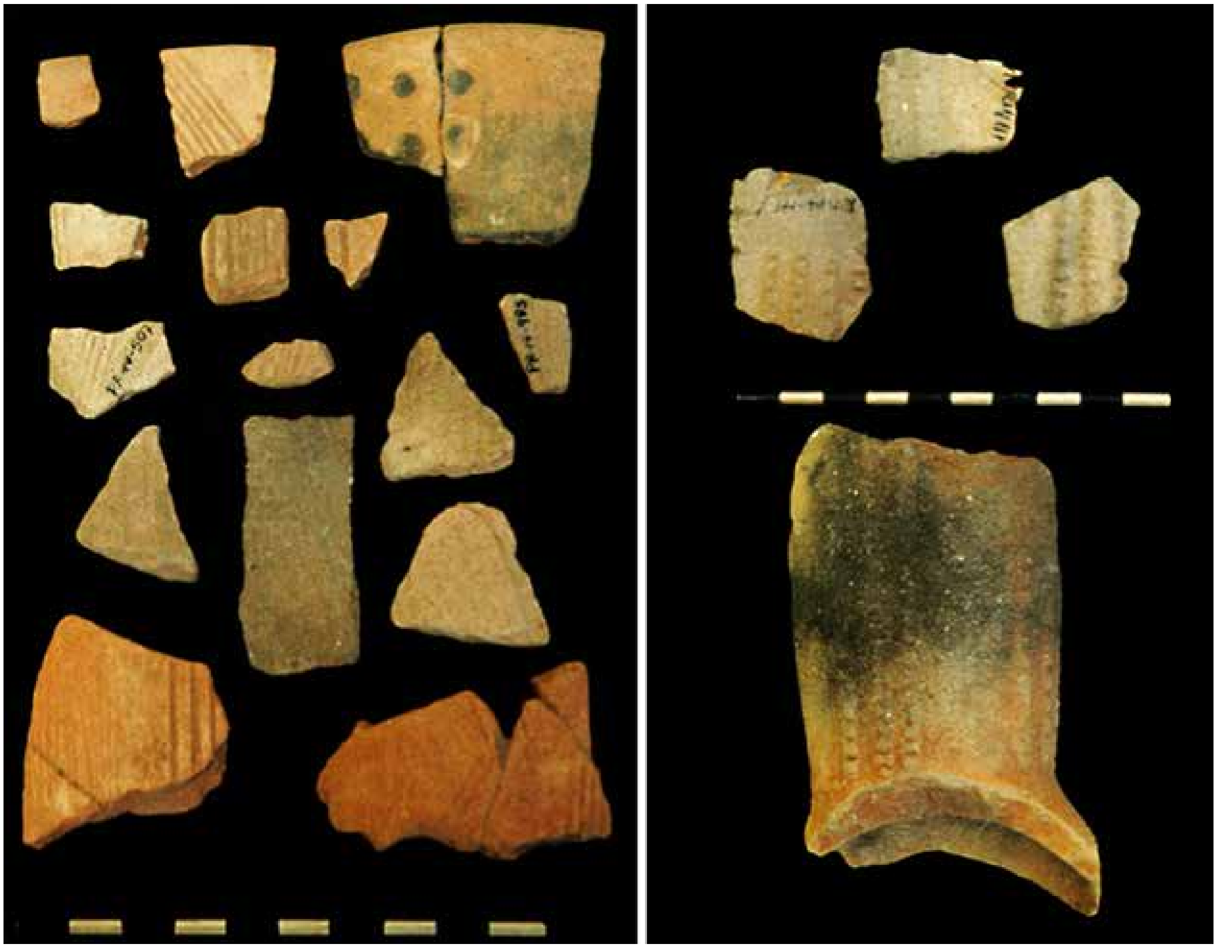

Figure 7: A partial type collection developed to assess chronology at LMS.

Methodology

Each celt / tool was examined for the presence / absence of use-wear.

1. By reference to our regional lithic chronological classification system a list of technological and functional attributes, e.g., length, width, thickness, etc., was drawn up, measurements taken and recorded to describe, analyze and interpret the specimens.

2. Descriptive statistics, such as measure of central tendency and dispersion, were calculated to examine patterns by attribute. To visualize the results we used simple line graphs, stem and leaf plots, box plots and histograms.

3. In addition, the "standardization" study drew upon (1) blanks and

debitage from a highland celt quarry/ workshop (SE-71) and (2) cores, blanks, debitage and finished products from experiments conducted to reconstruct the manufacturing sequence of the celts.

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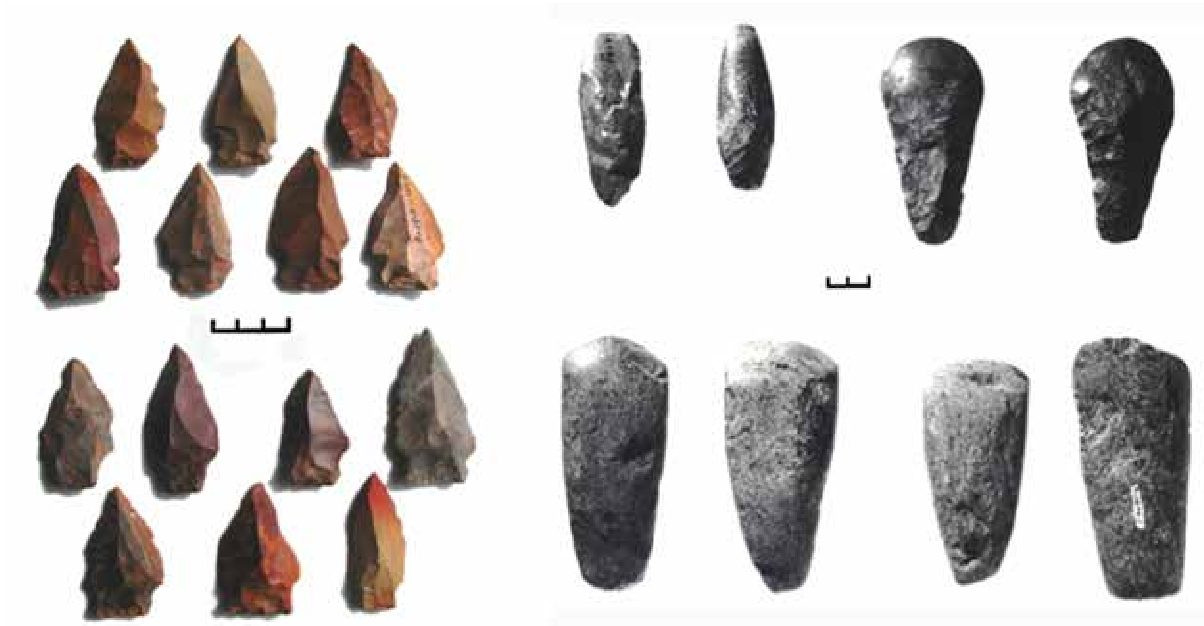

Figure 8: Left, unifacial points; right, celts

LMS Results

Five (5) whole and 149 celt fragments were recovered. All were composed of andesite tuff or dacite not locally available. Celt manufacturing strategies involved shaping by chipping, pecking, grinding, and polishing.

In addition to length, width and thickness, a series of calculated variables have been derived from the data, particularly bit and butt width and thickness. At least one of these elements is recordable on ALL celts regardless of fragmentation. They, therefore, become important in assessing specialization in production.

Frequency distributions for the calculated attributes basically display unimodality and low variability, i.e., standardization (Figure 9).

Highland Celt Workshop (SE-71)

The small highland workshop contained primarily basalt materials; the assemblage is dominated by thinning flakes – all are materials that would have been held over a ¼" mesh (see Table 1). At least two of the cores /failed celt preforms (?) have been used as hammers.

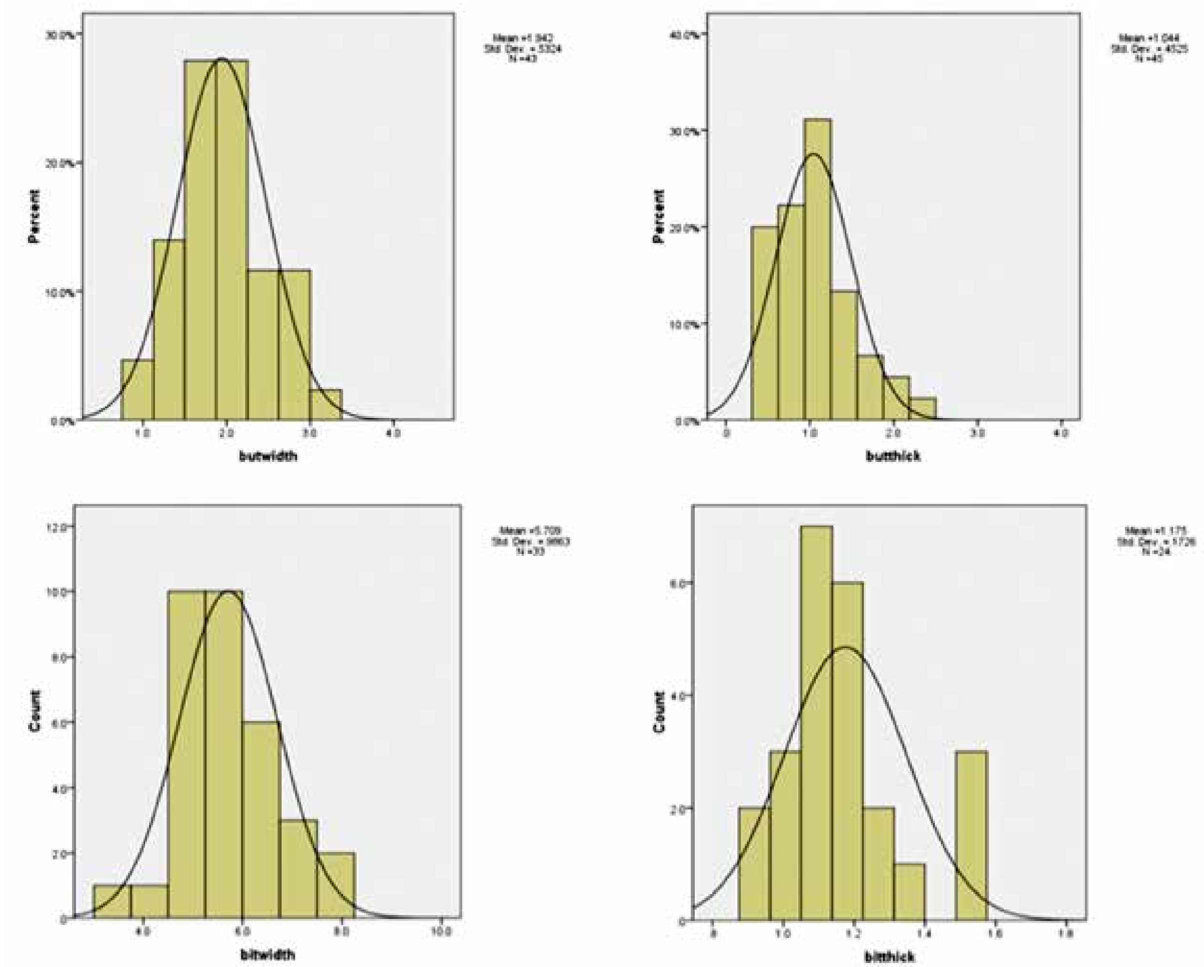

Figure 9: Histograms for LMS archaeological celts based on percent (top) and count (bottom).

Absent from this workshop sample are blanks and/or completed celts; this is true for all "known" quarry workshops from the Gran Cocle Region. That is, it is only core fragments, debitage and hammerstones that are left behind. The reverse is also true, i.e., completed tools are found on habitation sites but cores and debitage indicative of primary manufacturing are absent. A feasible explanation is that celts are being reworked / retrofitted when damaged on habitation sites.

Experimental / Replication Collection

There is an obvious disconnect from the workshop and experimental materials. At the workshop we are left with cores, hammers and debitage; blanks are absent (Figure 10). In the experimental condition the raw material has been used to produce a blank; hence we are left with blanks, hammers and debitage; cores are

Figure 10: Experimental blank and debris.

absent. Nonetheless, when these results are compared to those recovered archaeologically, it is clear that no phase of celt manufacturing is taking place at LMS. At LMS, there are basically spent celts; there are NO cores or blanks. The flakes recovered (most of which contain polish on their dorsal side) are the product of repurposing and/or resharpening.

An interesting note: celts are made of basalt materials that are not available in the lowlands; such quarried material is quite common in the highlands. In highland quarries, blanks are being produced but not the final product. It is unclear as to where the finished celts are being produced. At sites such as LMS we only find the final product (not the raw material, cores, debitage or blanks). That celts are a valuable commodity can be attested to the fact that once they no longer function for their original purpose, they are repurposed – used as scrapers, hammers, etc. It is not unusual to find the toolkits necessary for such retrofitting on a habitation site, e.g., pecking hammers and polishers.

Table 1: Highland celt workshop tools and debris (SE-71).

Collection Method	Whole Flakes	Frag. Flakes	Total Flakes	Core/frag.	Hammer
Surface	163	376	539	6	2
Sondeo	7	33	38	1	0

It should be emphasized that the presence of specialized lithic tools, such as the above celts on habitation sites, along with evidence for resharpening and repurposing do not in and of themselves imply specialized on-site manufacturing. The ratio of celt flakes: celt blank in the experimental collection versus the ratio at habitation sites clearly suggests otherwise. This is true for LMS and for other sites along the Parita River which contain celts, such as El Hatillo (Haller, 2004; Locascio, 2010; Menzies, 2009). I'd like to finally add that despite the presence of specialization at La Mula-Sarigua there is no evidence that socio-political complexity existed therein. This combination begs the question: Is specialization really an indicator of complexity?

Phase 3 (2015-Present)

A Digital Archive Initiative

Archaeological investigations such as those conducted at LMS result in substantial collections of artifacts along with large quantities of paper documents and photographic images. After these collections are catalogued and analyzed, they are eventually packed and stored in places that are out of view and not easily accessible. They are rarely used for further research, student training or public education. Digital technology is now changing this. By recording the above resources in a digital format and putting them in cyberspace, we can bring information to different audiences (researchers, educators, students) wherein their potential can be realized. In other words, this new format is revolutionizing the way we do research, archive our results, and communicate with others.

It has been a longstanding goal of mine to share online the numerous and diverse archaeological resources from LMS. To this end, I am refining a pilot project which focuses on a sample of time- or functionally-sensitive stone tools, e.g., the unifacial points and celts referred to earlier. Below, I will briefly describe the results of my efforts to (1) digitally photograph and/or scan these objects to produce high resolution 3D images, and (2) creating online databases.

This project is not so unusual. There are numerous archival projects that started out very low key at the local / regional level, blossomed into a national record, and, in the case of tDAR (The Digital Archaeology Record [http://www.tDAR.org]) became an international project. The Digital Archaeology Record involves collaborations with the Archaeological Data Service of the UK, the University of Arkansas, Arizona State University, Pennsylvania State University, the SRI Foundation, and Washington State University to produce Digital Antiquity (http://www.digitalantiquity.org/). There is no end in sight when it comes to describing digital archive projects as they relate to archaeology, some are consortiums of university-related anthropologists; others are institutionally-based museums.

Digitizing or Scanning Stage

The process of producing accurate and realistically textured 3-D models has become a trend in archaeology. The present research is creating 3-D images using photogrammetry and 3-D laser scanners (Figure 11). A summary of necessary steps follows.

There are two ways to capture artifact images:

1. Take multiple overlapping photos with a high resolution DSLR camera with a fixed lens (photogrammetry [Jaukaas, 2014]).
2. Use a 3D laser scanner (Means, n.d., Means, Bowles, McCuistion and King, 2013).

Importing images into 3D modelling software:

3. Photogrammetric approach using the software Agisoft Photoscan (http://www.agisoft.com)
   i. The software analyzes the photos and matches up common points as well as records camera and lens metadata.
   ii. Next, a dense point cloud is constructed representing the surface of the image.
   iii. From the dense point cloud data, the software constructs a 3D polygonal mesh representing the artifacts structure.
   iv. Once a mesh has been constructed, a surface texture (or skin) is created from the original photographs allowing for a realistic appearance.
4. 3D laser scanner approach (NextEngine HD) using the software ScanStudio (http://www.nextengine.com):
   i. The scanner utilizes a laser system to collect data points and textures which are layered together to create the 3D model.
   ii. The software manages the laser scanner, refines and compiles the data into a 3D mesh model in almost an identical fashion as does photogrammetry.

My results have thus far found that the most important and time-consuming portion of the process is “editing” the 3-D model for storage. Editing is necessary to create the least amount of error between data points. Once edited, 3D images can be uploaded to database management software.

Figure 11: Left, NextEngine 3-D scanner; right, photogrammetric workstation.

Web-based Repositories / Online Database Stage

We are presently experimenting with 3 (free / open source) database management programs: MDIM3, Omeka, and Sketchfab (Figure 12). Each allows for the input, storage and manipulation of resources (even 3D artifacts using plugins); each also allows for the creation of digital museums / exhibitions from the stored data. A few of our initial items in Sketchfab can be seen in Figure 13 and the following website (https://sketchfab.com/pathansell/).

Such databases will be an important tool for analyses in the future as it allows for extensive research at a distance and independent of the physical objects, records and institution. Once the bugs are worked out of this prototype, it will be important to contact colleagues, particularly those with whom I have collaborated in the past and who work with electronic databases (digital archives). Questions which will need addressing are: (1) how would you and your interns use such digital resources; (2) how would you provide critical feedback to me when technical issues arise; and (3) how might you leverage my work? The bottom line is to provide a valuable research and teaching platform for colleagues – both at my institution and beyond.

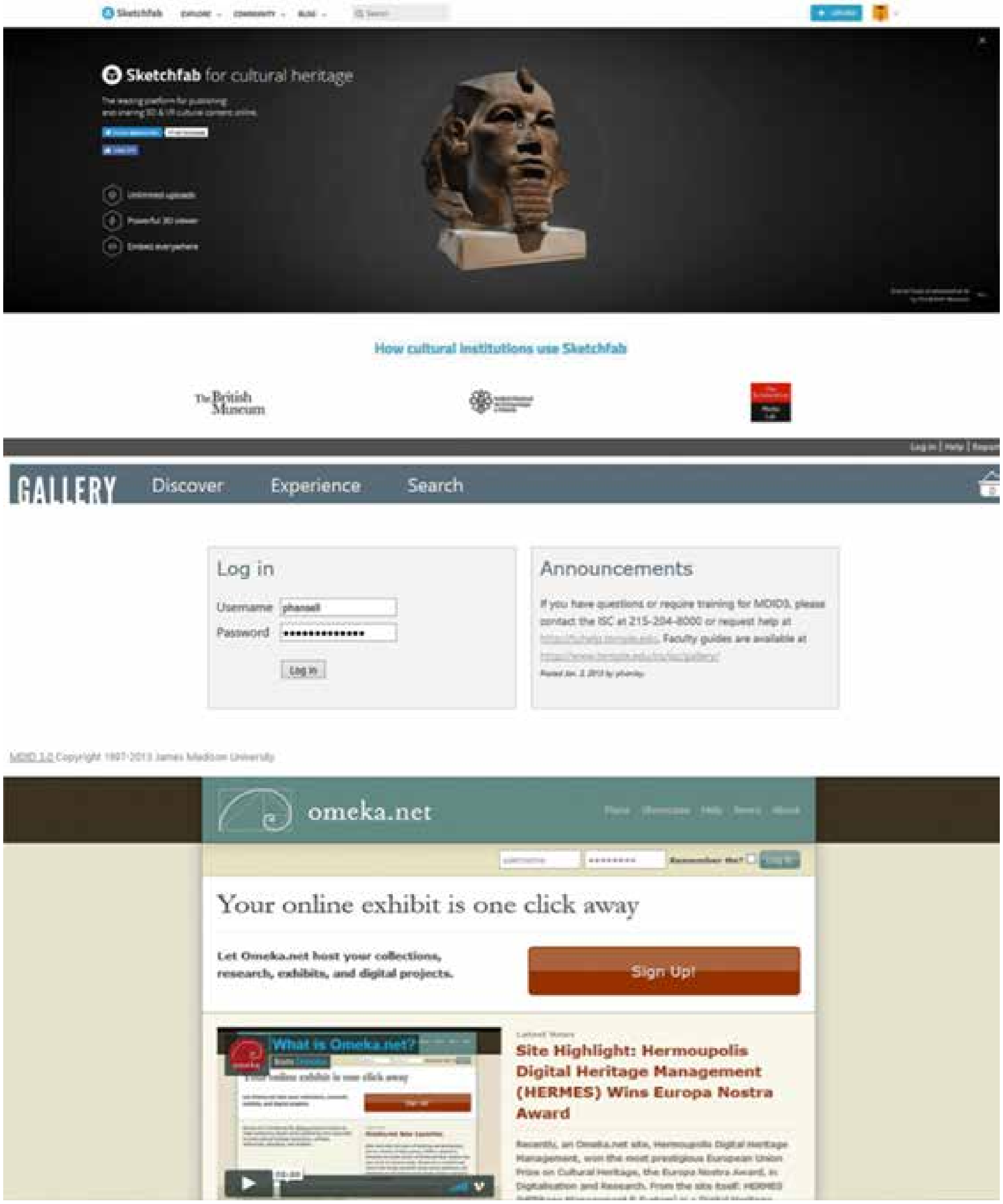

Figure 12: Digital database web sites; (top) http://sketchfab.com/museums; (middle) https://www.mdid.org/; (bottom) http://www.omeka.net/

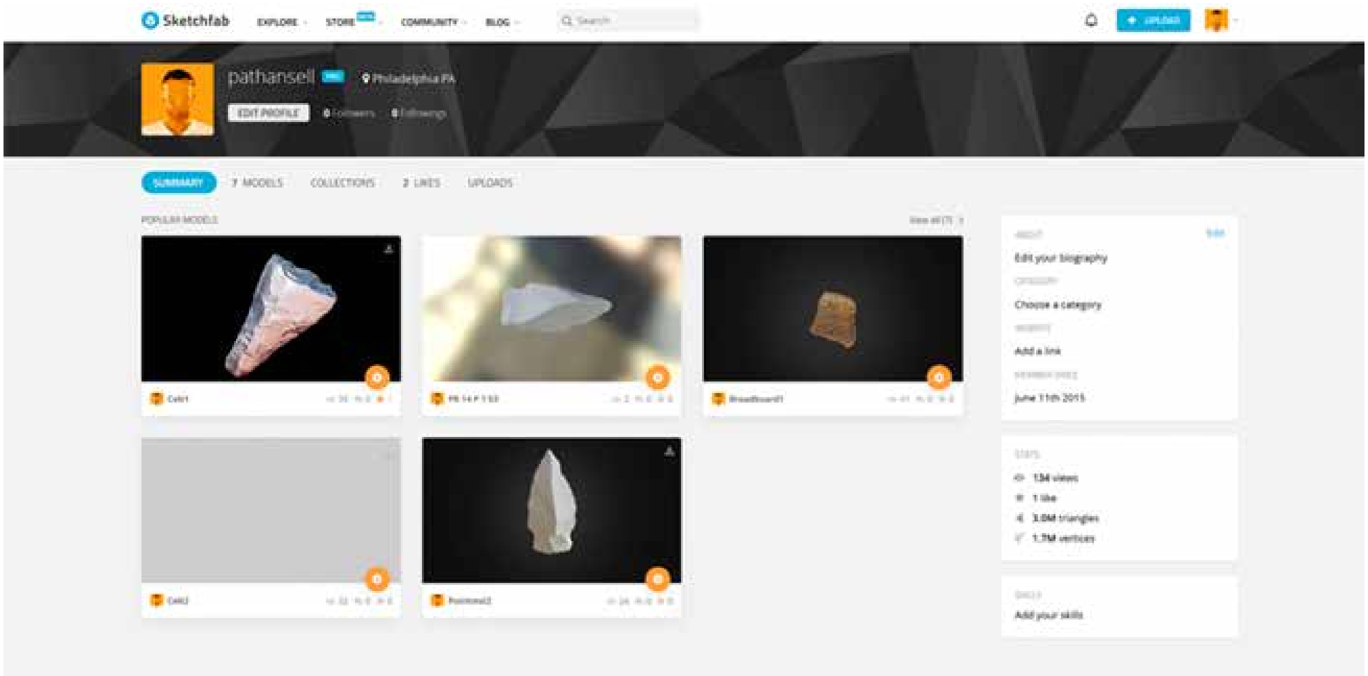

Figure 13: Sketchfab website with several LMS lithic models https://sketchfab.com/pathansell/

Summary

I realize that this volume is a dedication to Richard and that I have not spoken very directly about him. But the beauty about the way Richard works is that if he is not directly involved in one's project he is in the background facilitating it. From this perspective he has contributed to most of the topics I refer to in this paper, including discussions on ways to leave the material record behind for future generations. His enthusiastic sharing of ideas and data is infectious. Richard may (or may not) be cognizant of the fact that he will leave behind a remarkable legacy which includes not only his work but that of all who have worked in Panama. Thank you, Richard!

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