SAS BULLETIN

NEWSLETTER OF THE SOCIETY FOR ARCHAEOLOGICAL SCIENCES

Volume 41 Number 4 **Winter 2018**

FROM THE PRESIDENT

RACHEL POPELKA-FILCOFF

Welcome to the last issue of the *SAS Bulletin* for 2018. This year seems to have gone by quickly, with all of SAS activities, events, and initiatives, and now is a good time to look back at our 40th anniversary celebrations. We also look forward to 2019 and continuing to build on our traditional activities while developing new initiatives to support our members and international archaeological science.

As mentioned in Issue 3, this Issue will be a hybrid of our conventional format as we transition to a new approach for the *SAS Bulletin* in 2019. We thank Tom Fenn for editing the Bulletin over the past couple of years and welcome Carmen Ting as the new Editor. In this issue you will find some of our usual content such as book reviews and articles organized by topic. We are also celebrating our student awards with contributed articles about the exciting research presented by some of the R.E. Taylor student poster award winners at ISA 2018. Extended abstracts from the SciX 2018 conference (The Great Scientific Exchange), only available in the Bulletin, also showcase the research from our new invited symposium this past October. Look out for additional extended abstracts and articles about the up-to-the-minute research presented by our members at national and international conference in future *Bulletins*. While the format and delivery medium will be changing, our articles and features will retain the high quality that you expect. We will also develop the *Bulletin's* content to continue be valuable and timely to members. Please let us know about upcoming conferences and symposia, job announcements, and other items of interest for our membership; these will be promoted on social media and in the Bulletin with a quick turnaround.

Look for new topics, contributors, and formatting in 2019. With these changes we will also be moving to an entirely digital edition that promises rapid delivery of new content as it becomes available. We hope that this mode of delivery will promote more of a discussion between members on the exciting ideas and events in archaeological science worldwide. The *Bulletin* will be fully integrated with our other social media initiatives into a more cohesive suite of communications from SAS. Andrew Zipkin and Destiny Crider are constantly updating our online and social media presence with new programs and content to connect our global community.

Please enjoy the new *SAS Bulletin* and contribute to the conversation through our social media outlets. We look forward to hearing from you.

IN THIS ISSUE

ISA 2018 R.E. TAYLOR STUDENT POSTER AWARD WINNERS

Massive congratulations to Ángela Ejarque Gallardo and Jennifer Campos-Ayala for winning the R.E. Taylor Student Poster Awards at the International Symposium of Archaeometry 2018, which was held between the 20th and 26th May in Merida, Mexico. Congratulations are also in order to Emmie Beauvoit and Mariana Tovalín González Iturbe, whose posters had received honorable mention. In case you have missed their fantastic research, here is the summary of their work:

Colored bones. Methodology for studying the funeral body painting of three neighborhoods of Teotihuacan

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The use of color in Teotihuacan is manifested in a wide range of surfaces and contexts, including mural paintings and anthropomorphic figurines adorned with decorative motifs and polychromatic painted bodies. Other archaeological evidence, highlighting the importance of corporal painting in Teotihuacan society, is found in mortuary contexts, especially at burials that conserve chromatic remains in the surface of the bones. The study of these colored remains is made possible through the use of archaeometric methodology, which provides important information regarding the pigments used for funerary purposes in Teotihuacan, a multiethnic city of the Classic period of Central Mexico.

The present work is the result of my master thesis entitled "*Color y tratamientos funerarios. Estudio arqueométrico, ritual y cultural de materias colorantes procedentes de tres contextos funerarios teotihuacanos: La Ventilla, Teopancazco y el Barrio Oaxaqueño*." This study explored the link between color and mortuary traditions in three neighborhoods of Teotihuacan by examining the presence of pigments in burials and on human bone surfaces, serving as a proxy to identify the recipes used in funerary body painting at the pre-Hispanic city.

The colored bones were discovered in 33 burials of three Teotihuacan neighborhoods. All these neighborhoods were populated in the Classic period (AD 100/200 – 650) by local and people from diverse cultural backgrounds and geographical origins. In this case, the burials date to the period that spanned from AD 150/200 to 550, corresponding with the Teotihuacan chronological phases of Miccaotli (AD 100/150 – 200), Tlamimilolpa (AD 200 – 350) and Xolalpan (AD 350 – 550). The studied materials consisted of a set of 110 pigment samples obtained from the surface of human bones with different colored remains: red, black, white, yellow, and green. These colors were preserved as powder on the surface of different bones, principally on the skulls, humerus, femurs, ribs and pelvis (Fig. 1).

Figure 1. The bone samples included in this study.

In this study, a multi-technique approach – which combined various non-destructive and micro-destructive instrumental techniques such as light microscopy (LM), X-ray fluorescence (XRF), scanning electron microscopy (SEM/EDX), infrared spectroscopy (FTIR), raman spectroscopy, and X-ray diffraction (XRD) – was used to analyze a wide variety of materials that was employed in Teotihuacan to prepare funerary color recipes. These techniques provided complementary data about color preparations, mainly composed of mineral pigments, calcium compounds, clays and natural earths. In some cases, these ingredients not only provided color, but also had conservative and antibacterial properties.

The results show that the black color was mainly composed of black bone pigment, mixed with manganese minerals such as todorokite and hollandite. In case of red color, it was obtained from a mixture of cinnabar, red natural earth and hematite. These compounds were identified by raman spectroscopy, FTIR and XRD. The white samples were made of a mixture of calcite and clays, and in some exceptional cases also with gypsum and diatomaceous earths. Diatomaceous earths are made from the fossilized remains of aquatic organisms called diatoms and it had been in use since Antiquity owing to its antiseptic, antibacterial and fungicide properties (Vázquez de Ágredos and Manzanilla 2016, 2017; Vázquez de Ágredos et al 2018). This compound was identified through the elemental composition and the microscopic image provided by SEM/EDX. It was also possible to identify green earth and jarosite as the composition of green and yellow colors (Fig. 2).

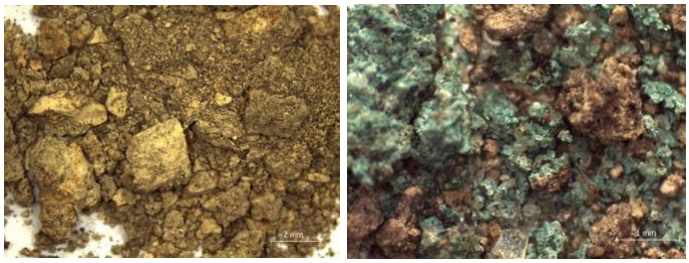

Figure 2. The raw materials used for yellow (left) and green (right) colors.

In more general terms, the results obtained from this multi-technique approach served to confirm the presence of color mixtures, obtained from mineral pigments (cinnabar, jarosite, bone black, manganese black) and natural earths (red and green earth, diatomaceous earth), mixed with calcium compounds and clays. All these results provide information that helps to compare the funerary customs of the three contexts, and highlight the connection between color and mortuary treatments at Teotihuacan. On the other hand, this results also allow us to analyze the practical and symbolic uses of color in Teotihuacan, through which we

have obtained remarkable information about the mortuary customs and rituals of one of the most representative Mesoamerican societies in Central Mexico. This study has further provided a methodological framework to analyze pigments from archaeological bone surfaces.

Acknowledgements I would like to express my gratitude to the directors and supervisors of my thesis, Marisa Vázquez de Ágredos, Carlos Serrano, Jose Luis Ruvalcaba, Linda R. Manzanilla and Verónica Ortega. Thanks should also be given to Rubén Cabrera and *Proyecto Sistema Urbano La Ventilla*, *Proyecto Teotihuacan Élite y Gobierno. Excavaciones en Teopancazco* and *Proyecto Barrio Oaxaqueño*. I would like to extend my gratitude to Laboratorio de Análisis y Diagnóstico de Obra de Arte de la Universidad de Valencia, Servicio de Microscopía Electrónica del Parque Científico de la Universidad de Valencia and Laboratorio Nacional de Ciencias para la Investigación y Conservación del Patrimonio Cultural (LANCIC) of Instituto de Física, UNAM, with support of projects CONACYT LN279740, LN293904, CB239609 and PAPIIT UNAM. Last but not least, I would like to thank the Society of Archaeological Science for this opportunity and for the Poster Award at the ISA Symposium 2018.

References cited

Ejarque Gallardo, A. 2017. *Color y tratamientos mortuorios. Estudio arqueométrico, ritual y cultural de materias colorantes procedentes de tres contextos funerarios teotihuacanos: La Ventilla, Teopancazco y el Barrio Oaxaqueño*, UNAM.

Vázquez de Ágredos, M., & Manzanilla, L. 2016. Corporate Paint and Ancient Pharmaceutical Mixtures from Teotihuacan: the Teopancazco Neighborhood Center. *International Journal of Pharmacovigilance*, 1(1), 1–11.

____.2017. Beauty and Health in the Ancient City of Teotihuacan: Skin and Its Aestetich and Therapeutic Treatments. *Austin Journal of Dermatology* 4 (1), 1-8.

Vázquez de Ágredos, M.L., Natahi, S., Darras, V., Manzanilla, L.R. 2018. Materiality and Meaning of Medicinal Body Colors in Teotihuacan, in: Dupey, E & Vázquez de Ágredos, M.L (eds.) *Painting the Skin. Pigments on Bodies and Codices in Pre-Columbian Mesoamerica*. The University of Arizona Press, Tucson, pp. 24-42.

Purple Dyes from the Carlos Museum Pre-Columbian Textiles Collection: Direct Mass Spectrometry and HPLC Analyses

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Purple dyes derived from molluscs are often considered indicative of high-status objects or individuals. This elevation of certain dyes or dye sources may be related to rarity of the raw materials, requiring long-distance trade in many cases, or the complexity of preparing the dyes. This work focuses on a selection of red, blue, and purple yarns sampled from the Michael C. Carlos Museum collection of ancient South American textiles, primarily those from the Nasca, Wari, and Chancay cultures. This work is part of a larger study on how secondary colors – purple, orange and green – were produced. The purple dyes in particular were expected to be either pure purple from shellfish or red yarns overdyed with indigoid blues. High performance liquid chromatography (HPLC) is considered the standard approach to identifying dyes, yet it requires lengthy sample preparation and analysis times. We report here on using direct analysis in real time (DART) and paper spray (PS) mass spectrometry for analysis of the red, blue and purple dyes, which can be carried out in far less time (seconds to a few minutes) and, in the case of DART-MS, without any sample preparation. One of the limitations of these direct mass spectrometry methods is the inability to differentiate isomers, like xanthopurpurin and alizarin or the various positional isomers of brominated indigoids. Further studies with HPLC, in combination with the MS results, will provide a more complete picture of the source of these dye colorants. The chromatography further lends support to the use of direct mass spectrometry for the rapid classification of South American red dyes as being derived from locally-sourced plants such as *Relbunium* or from cochineal insects as well as for the differentiation of purple dyes as either pure or mixed materials. Since most previous studies of reds in ancient South American textiles have focused on the identification of cochineal, additional evidence of the use of *Relbunium* in Nasca textiles is significant.

The Johnston-Vieillard manufactory (Bordeaux, France, 19th century): preliminary results on white earthenware production

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It is usually thought that in most cases the study of "recent" objects are not really essential. Why should we study objects that were born during the industrial era – a relatively well-documented period? Voluntarily or unintentionally, to keep a trade secret or simply due to a loss of information, a lot of details concerned technical and social history may be missing through time…

My doctoral research entitled "*The Johnston-Vieillard Manufactory (1835-1895): technical and historical study*" focuses on the ceramic productions in a French manufactory during the 19th century. The main goal of this research project, led by Dr Ayed Ben Amara, is to study the production technology of the glazed ceramics and to

document the evolution in technical practices in this manufactory. Among the questions of this research project include: is it possible to distinguish productions of different chronological periods in the Bordeaux region?

The Johnston-Vieillard Manufactory was famous for its white earthenware production. White earthenware is a specific kind of ceramic designating a white, porous body covered with a transparent lead-rich glaze (Brongniart 1844: 109-124). Its production is said to have imitated the highly coveted porcelain and replaced the tin opaque glazed ceramic called faience in France, majolica in Italy or delftware in the Netherlands (Métreau and Rosen, 2014, Jay et al. 2015, Kelloway et al. 2018). The white earthenware invention took place in England in the 18th century, and the French production emerged shortly afterwards in the middle of the 18th century. Despite the Anglo-French Commercial Treaty (by Vergennes in 1786), white earthenware was industrially produced in France at the end of the 18th century and especially in the 19th century. More specifically, in the Bordeaux area, industrial production of white earthenware began in 1835 and definitively closed in 1895. The manufactory has gone through different phases characterized by changes in directors and/or company names. Although general documents such as ceramic treatises, World Exhibition's catalogues, lawsuits, correspondences are available, factory archives documenting the production techniques (choice of raw materials, recipes, firing conditions, division of labor in the manufactory) are severely lacking.

Recently, lots of pieces and remains of white earthenware and porcelain were discovered during an excavation performed in 2015 by the Centre Archéologie Préventive de Bordeaux Métropole in the factory area. This excavation has provided significant quantities of wasted materials used at the different stages of the *chaîne opératoire* of ceramics fabrication (raw materials, plaster molds, kiln furniture, pigments, biscuits, glazed earthenware etc.). The dating of the ceramic materials to specific time periods has been made possible thanks to the stratigraphic excavations and the stamps printed on the back of some pieces. This discovery has provided us with the opportunity to reconstruct the manufacturing processes, production organization, and the diversity of products of the manufactory over a period of 60 years. It should be noted that this project is one of the very few studies that examine early modern ceramic materials found in primary production context, and that only limited studies have been conducted on the white earthenware (Maggetti et al. 2015, Maggetti 2018, Schurr et al. 2018).

In order to reconstruct the production technology of white earthenware, this study focused on the analysis of the sherds found during the excavation (Fig. 1). Firstly, we concentrated on the characterization of white earthenware. A multi-analytical approach was used to investigate ceramic bodies and glazes. Fragments were subjected to analyses using scanning electron microscopy energy dispersive spectrometry (SEM-EDS) and proton-induced X-ray gamma emission (PIXE-PIGE) to determine the major, minor and trace compositions. Preliminary results show that significant differences on chemical composition of glazes and bodies during the different stages of the factory life (Fig. 2). Consequently, it is possible to make hypothesis about the raw material choices and the evolution of recipes used. These first data acquired will be further examined in the light of available written sources (both economic and technical) in order to better understand the historical context and production strategy.

Figure 1: Some representative examples of white earthenware sherds found in archeological excavations (© IRAMAT-CRP2A, photograph by E. Beauvoit).

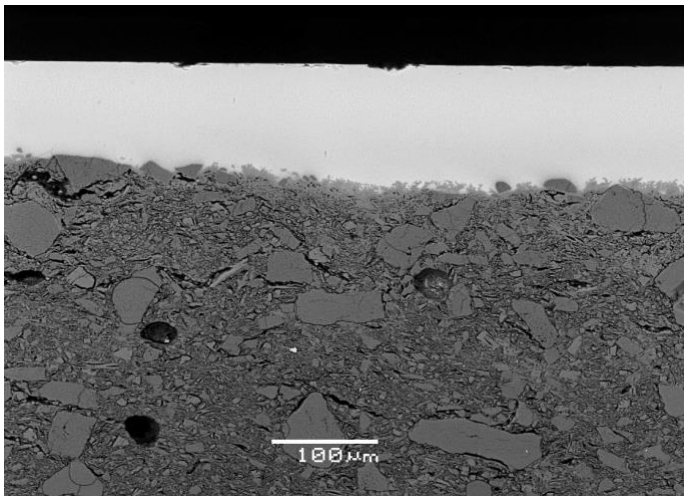

Figure 2: SEM image of a cross section of a white earthenware (© IRAMAT-CRP2A, photograph by E. Beauvoit)

Acknowledgments This work is supported by the Nouvelle-Aquitaine Region, the LaScArBx (Bordeaux Archeological Science Cluster of Excellence), ANR-10-LABX-52, CNRS and Bordeaux Montaigne University.

References cited

Brongniart, A., 1844. *Traité des arts céramiques ou des poteries considérées dans leur histoire, leur pratique et leur théorie*. Béchet Jeune, Paris.

Jay, W., Cashion, J., Blenkinship, B., 2015. Lancaster delftware: A Raman spectroscopy, electron microscopy and Mössbauer spectroscopy compositional study. *Journal of Raman Spectroscopy* 46, 1265–1282.

Kelloway, S., Van Valkenburgh, P., Iñañez, J., Dussubieux, L., Quilter, J., Glascock, M., 2018. Identifying New World majolica from 16th–18th century sites on Peru's north coast. *Journal of Archaeological Science Reports* 17, 311–324.

Maggetti, M., Heege, A., Serneels, V., 2015. Technological aspects of an early 19th c. English and French white earthenware assemblage from Bern (Switzerland). *Periodico di Mineralogia* 84, 139–168.

Maggetti, M., 2018. Archaeometric analyses of European 18th - 20th century white earthenware - A review. *Minerals* 8, 1–38.

Métreau, L., Rosen, J., 2014. Origin and development of French faience: the contribution of archaeology and the physical sciences. *Technical Briefs in Historical Archaeology* 8, 1–21.

Schurr, M., Donohue, P., Simonetti, A., Dawson, E., 2018. Multi-element and lead isotope characterization of early nineteenth century pottery sherds from Native American and Euro-American sites. *Journal of Archaeological Science: Reports* 20, 390–399.

Interdisciplinary study of archaeological wood. Ritual objects in three caves of Morelos-Mexico.

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My masters research, entitled "*Análisis botánico y técnicas de manufactura de artefactos rituales de madera...*", focused on the integral study of the wooden ritual implements recovered in agrarian offerings from Formative Period (800 BC – AD 200) inside the caves of Gallo, Tláloc and Chagüera in Ticumán, Morelos.

In this research, a wide range of techniques, including paleoethnobotanical analysis, experimental archeology, scanning electron microscope (SEM), and 3D scanner, was employed to establish not only the materials used to elaborate the implements, but also the possible sources of the raw materials and the manufacture techniques, as well as an estimation of the amount of time invested in the elaboration process.

The agrarian offerings that were found inside the caves consisted of more than 10,000 botanical elements, with more than 700 of them being wooden artifacts (Fig. 1). The artifacts measure between 3 and 20 cm in length, often with traces of combustion at the tip, making it easy to identify the evidence of the manufacturing process.

Figure 1. Types of wooden artifacts found inside the caves (scale=5cm).

The results of the paleoethnobotanical analysis have recognized 19 taxa: three from the Pine Oak Forest, one from the Cloud Forest, and 15 from the Tropical Deciduous Forest. It is important to note that the type of vegetation in the Ticumán region corresponds to the Tropical Deciduous Forest. However, in spite of their botanical diversity, these taxa were recovered in low proportion, with 90% of the resources used in the manufacture of the artifacts coming from the high areas of the state of Morelos, specifically from the region that corresponds to the Pine Oak Forest.

Once the wood was identified, the research continued with the identification of manufacturing techniques using the methodology devised by Velázquez (2004). The first phase comprised the experimental reproduction of the different traces observed in the archaeological artifacts, using tools made of obsidian, flint and basalt to perform the abrasion process (Fig. 2).

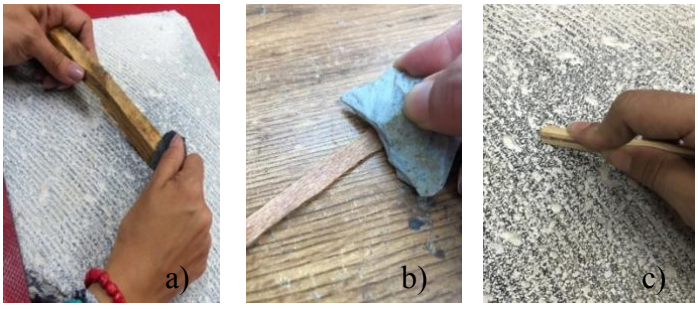


Figure 2. Experimental artifacts and abrasion process working with (a) obsidian, (b) flint, and (c) basalt.

The second phase involved the analysis of the manufacturing traces, first through the naked eye, followed by stereoscopic microscope at 10x, 30x and 60x magnifications, and finally by 3D scanner. The results of this phase have allowed for the recording of the presence of lines with different thickness throughout the entire body of both the archaeological and experimental objects. Based on the results, it was possible to determine that obsidian tools were used as they produced similar traces to those observed in the archeological object. This was confirmed by the analysis of 3D models, where fine lines were observed along the body of the artifact and a smooth surface at the tip (Fig. 3). This finding indicates that probably two different instruments were used in the elaboration of the artifacts.

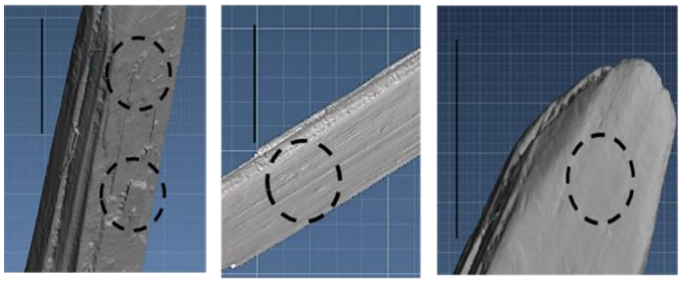
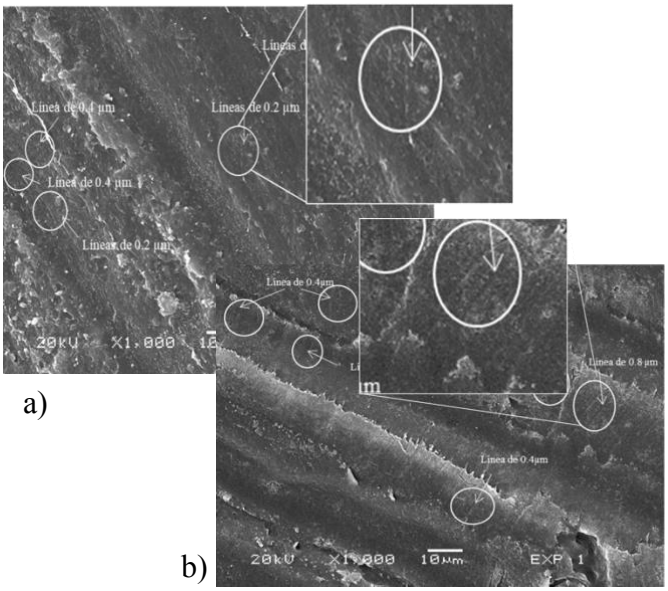


Figure 3. Manufacturing traces using 3D scanner (scale=5cm).

Finally, the SEM was used to identify the metallography technique used to produce replicas in polymers (acetate) of the different traces observed in the artifacts. The polymers were softened with acetone, pressed onto the zones that were to be analyzed and gold-coated for their observation in high vacuum at different magnifications (from x100 to x1000). The abrasion traces observed with the SEM at 1000x in the body of the artifacts revealed the presence of fine lines in the range of 0.2-0.8µm in both archaeological material and the replicated object worked with obsidian (Fig. 4).

On the other hand, the traces of abrasion observed with SEM at 100x at the tip of the artifact showed the presence of the band lines in the range of 130-160µm both in archaeological material and in the replicated object worked with basalt (Fig. 5). Since the tip of the archaeological objects was burned, the tip of the replicated object was also burnt to obtain similar effect.

The results of this investigation have led us to suggest that an intensive use of pinewood constituted an essential part of the offerings. It is interesting to note that the closest coniferous woods are located at a distance of 40 km. This leads to the conclusion that in order to perform the rituals inside the caves, there was a definite concern to obtain allochthonous resources. Finally, the data collected after the technological analysis indicated the use of obsidian and basalt instruments to manufacture the wooden objects. All evidence points to the existence of a standardized elaboration process of the implements offered in the caves during the Formative Period.



a)

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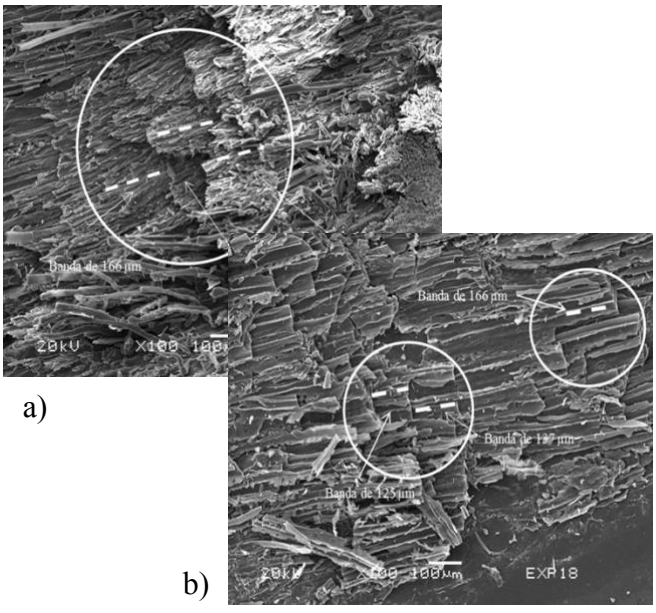
Figure 4. SEM images showing the abrasion traces at 1000x of (a) the archaeological sample, and (b) the experimental object worked with obsidian.



a)

b)

Figure 5. SEM images showing the abrasion traces at 100x magnification of (a) the archaeological sample, and (b) the experimental object worked with basalt.

References cited

Tovalín, M. 2017. *Análisis Botánico y Técnicas de Manufactura de Artefactos Rituales de Madera. Cueva Del Gallo y Abrigo Tláloc, Ticumán-Morelos.* Tesis de Maestría. UNAM, México.

Velázquez, A. 2004. *Técnicas de manufactura de los objetos de*

concha del Templo Mayor de Tenochtitlan. La producción especializada de los objetos de concha del Templo Mayor de Tenochtitlan. Tesis de Doctorado en Antropología, UNAM, México.

EXTENDED ABSTRACTS FROM THE SCIX 2018 CONFERENCE

Did you know that presentations by SAS members have been a regular feature of the The Great Scientific Exchange (SciX) for years? SciX is the annual conference of the Federation of Analytical Chemistry and Spectroscopy Societies (FACSS), and is a great opportunity for SAS members to learn about cutting-edge methods and applications, network with potential collaborators, and get feedback from professional chemists. This year for the first time, our society officially organized an invited symposium at SciX: "Chemistry in Art and Archaeology Sponsored by The Society for Archaeological Sciences". SciX 2018 was held from October 21st-26th in Atlanta, Georgia and the SAS-sponsored symposium was planned by members Prof. Mary Kate Donais and Dr. Andrew Zipkin. Extended abstracts from four of the symposium speakers are presented below; next year we hope to expand this event into a double symposium featuring ten invited speakers.

Elemental Analysis of Etruscan Loom Weights Using X-Ray Fluorescence Spectrometry

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Loom weights excavated from Cavità 254 in Orvieto, Italy were analyzed using portable energy dispersive x-ray fluorescence spectrometry (EDXRF). A proposed theory regarding loom weight usage and ownership is that a loom weight would be made locally and then sometimes marked. Markings may have made the loom weights identifiable based on the owner or the local workshop that made them. It is also thought that loom weights may have been passed down from mother to daughter and may have travelled with brides to their new homes after marriage. If loom weights were made in different workshops, some of which may have been local to Orvieto but others specific to different Etruscan communities in the region, then groupings of similar chemical compositions should be observed within the EDXRF data. A total of 47 truncated pyramid shaped weights in a range of 200-600 grams were studied; some loom weights were intact and other were broken and contained only the top or only the bottom. Each loom weight was analyzed at five separate spots.

This study sought to identify the elements present in these Etruscan objects and to explore possible groupings based on differences in chemical composition, visual color, and/or inscription type/marking. Chemical differences were found to associate with visual color, with loom weights appearing more white in color exhibiting elevated levels of calcium, those appearing more black exhibiting elevated manganese, and those appearing more red in exhibiting elevated iron. A fourth color type, labeled black-spot had a mixed elemental composition between the red and black loom weights. Elements identified in the weights included calcium, titanium, manganese, iron, strontium, and rubidium.mInitial data evaluation via multivariate statistics utilized spectral data that were live-time corrected and normalized to the Compton peak.

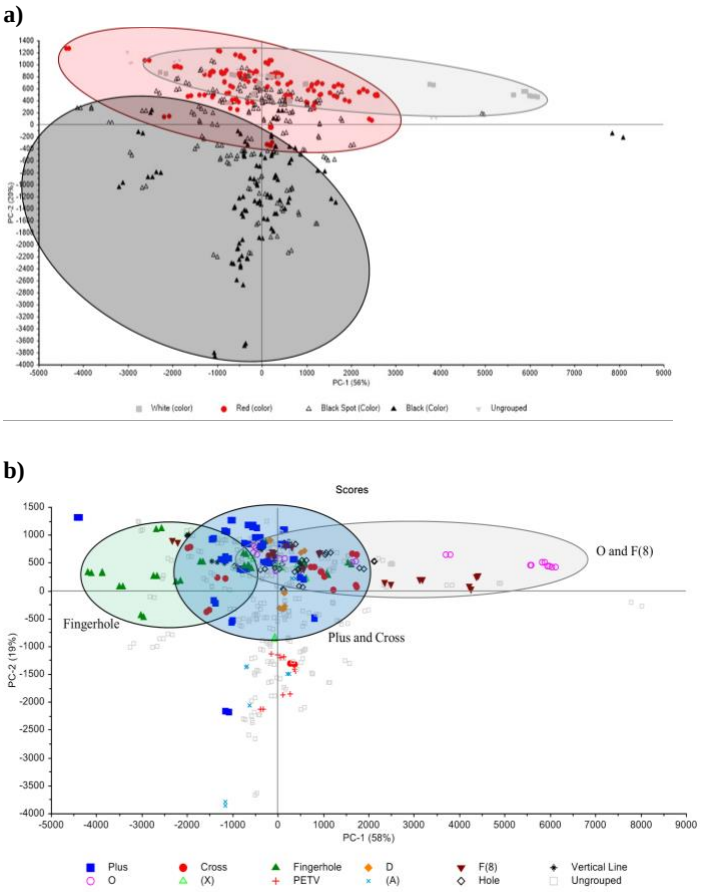

Figure 1. Scores plots showing (a) color groupings, and (b) inscription groupings.

As shown in the principal component analysis (PCA) scores plot in Figure 1a, the two color categories of red and black form two slightly overlapping groups; the white group significantly overlaps with red. The scores plot with labelling by inscription/marking type is shown in Figure 1b. Loom weights with finger hole marks group toward the

left of the plot, those with circle and figure 8 inscriptions group toward the right, and those with plus and cross inscriptions form a group in the middle.

Additional data processing prior to PCA was attempted, including using averaged peak areas in place of the spectra data. This approach improved the PCA explained variances but did not alter the observed groupings.

Conclusions drawn from the study thus far include: 1) Etruscan loom weights are a relatively easy archaeological sample to analyze considering their small size and relatively flat surfaces; 2) chemical differences exist among the samples analyzed thus far; 3) some chemical differences seem to be related to visual color and inscription/marking type. Future work will include comparing chemical composition data for Orvieto loom weights to those from other Etruscan sites in the region as well as attempting additional data analysis approaches.

Identifying Damaging Sulfur Compounds in Bone – A Novel Application of Wavelength Dispersive Spectroscopy (WDS)

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[2] Pennsylvania State University
[3] National Institute of Standards and Technology

Researchers working with artifacts in museum collections require simple, fast, and cost-effective methods to detect damaging chemical reactions affecting materials. Pyrite (FeS_2) formation and oxidation, colloquially termed "pyrite disease," is of particular concern to skeletal and fossil collections. Due to the small unit cell size of the crystals, detection of pyrite in the pores of bone material has been problematic for traditional diffraction methods. By traditional methods, three different techniques on three different instruments were necessary to positively identify small pyrite crystals in fossil pores in our study. Energy dispersive spectroscopy by electron probe microanalysis (EDS by EPMA) identifies only elemental concentrations, but cannot identify specific compounds. X-ray diffraction (XRD) is able to identify crystal structures, but only if the structure is sufficiently large – in this case, XRD was not able to localize pyrite. In order to confirm the structure, it was necessary to employ a third technique, electron backscatter diffraction (EBSD). This route to identifying damaging pyrite is time consuming, costly, and can lead to false negative results. It is usually not until there are macroscopic signals of pyrite disease that the damage is identified, and often by that point the damage to the specimen is extensive and irreversible. Here, we present a novel application of wavelength dispersive spectroscopy (WDS) to the identification of both pyrite and its oxidized compound (iron sulfate) in bone micropores. We show that it is possible to differentiate atoms of sulfur in different oxidation states with a very small sample of material using a single instrument. These results could aid the museum and research community in early detection of pyrite formation and oxidation, allowing for preventative conservation measures to be implemented prior to major deterioration.

Reconstructing Anthropogenic Landscape through ICP-MS: Urban Transformation at Tlalancaleca, Central Mexico, during the Formative Period (800 BC-AD 250)

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Tlalancaleca was one of the first-generation cities before the rise of Teotihuacan in Central Mexico and likely provided cultural and historical settings for the creation of Central Mexican urban traditions during later periods. Yet its urbanization process as well as socio-spatial organization remain poorly understood. The Tlalancaleca Archaeological Project has reconstructed the trajectory of urban formation and transformation based on mapping, ground survey, and full-coverage surface collection (Murakami et al. 2017). Our research indicates that some residential groups were settled at Tlalancaleca towards 800 BC and the settlement was urbanized following significant population growth during the later Middle Formative period (ca. 650 – 500 BC); the city experienced large-scale urban transformations during the Late Formative (ca. 500 – 100 BC) and a subsequent and final urban expansion during the Terminal Formative (ca. 100 BC – AD 250). While Tlalancaleca's long occupational history provides a unique opportunity to address long-term social transformations during the Formative period, the site is characterized by a complex natural and artificial landscape, consisting of a large plateau, gullies, its surrounding hills, and modern agricultural terraces, which poses a challenge for us in interpreting the surface collected materials. Due to the effect of numerous natural and human disturbances, it is important to establish strategies to examine the validity of surface-collected materials. We complemented surface collection with auger probes and soil geochemistry using ICP-MS (Inductively Coupled Plasma Mass Spectrometry) and examined the validity and the degree of efficiency of this multi-method approach to reconstructing occupational history and activity areas (Murakami et al. *in press*).

The overall results demonstrate the utility of the combined use of auger probes and soil geochemistry for reconstructing anthropogenic landscape. This study confirmed that the city expanded to the west (Area 1 in Figure 1) during the Late Formative period and to the north (Area 2 in Figure 1) during the Terminal Formative period. We identified occupational levels based on stratigraphy and the distribution of anthropogenic elements (e.g., phosphorus), and charcoal samples collected through auger probing were dated to 400-200 cal BC (Late Formative) and 60 cal BC-30 cal AD (Terminal Formative), respectively. However, our research in the southern sector of the city (Area 3 in Fig. 1) revealed that this area was substantially altered through the construction of modern agricultural terraces and that pre-Hispanic occupational levels are not preserved, especially at lower terraces (the presence of Middle Formative occupations was confirmed at the highest terrace, though). This indicates that surface materials are from erosion and/or destruction of ancient features and that surface materials are not reliable for interpreting ancient activity areas and/or the intensity of activities. The multi-method approach presented in this study will be used to select areas for intensive and extensive excavations.

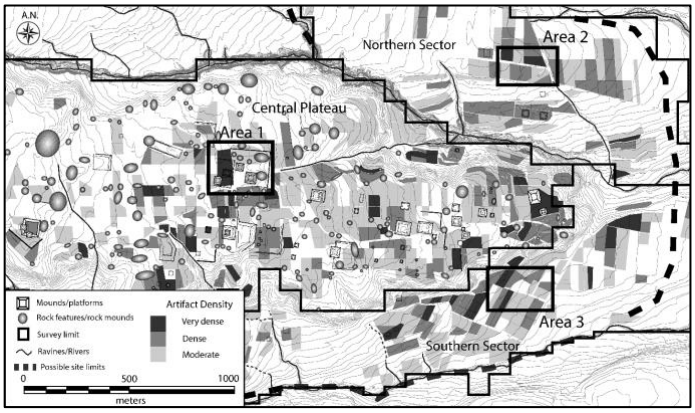

Figure 1. Site map of Tlalancaleca showing artifact density and three areas mentioned in the text.

References Cited

Murakami, Tatsuya, Shigeru Kabata, Julieta M. López J., and José Juan Chávez V., 2017. The Development of an Early City in Central Mexico: The Tlalancaleca Archaeological Project. *Antiquity* 91, 455-473.

Murakami, Tatsuya, Shigeru Kabata, Julieta M. López J., and Paige Phillips, *in press.* A Multi-Method Approach to Reconstructing Occupational History and Activity Areas: A Case Study from the Formative Site of Tlalancaleca, Central Mexico. *Journal of Field Archaeology*.

New perspectives on portable Raman spectroscopy in archaeometry

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Raman spectroscopy has grown to a well-appreciated approach in archaeometry research. Indeed, it has some very advantageous properties, that come in very useful for the non-destructive analysis of artworks and archaeological objects [1-2]. As a spectroscopic technique, the approach allows for the analysis of inorganic as well as organic molecules, and antique as well as more recent artworks can be analysed. It is possible to record Raman spectra from particles down to 1 µm, which corresponds to the typical dimensions of pigment grains. Moreover, next to pigments it is also possible to identify degradation products [3]. By using objective lenses to focus the laser beam, it is possible to obtain a good spatial resolution, to examine the archaeological or art objects in great detail. Interference caused by fluorescence can be avoided by selecting an appropriate laser wavelength. Raman spectroscopy is a molecular spectroscopic technique, which allows to identify molecules. It is often to complement other approaches, such as X-ray fluorescence, that reveals the elemental composition of the object [4].

In the last decade mobile Raman instrumentation was increasingly more frequently applied. Different sizes of spectrometers are available, ranging from mobile instruments down to palm-sized spectrometers [5-6]. For use in archaeometry, typically mobile and portable instruments are of interest, as smaller instruments often lack sufficient spectral resolution as required for these applications [6]. The use of fibre optics probeheads is often an advantageous property, as these can easily be positioned in front of the artefact. Often these probeheads can be equipped with different objective lenses, ranging from long working distance objectives to contact probes – all with different magnifications. In some cases, touching the precious artefact is not allowed. As Raman spectroscopy is non-destructive (provided the laser intensity is kept sufficiently low), mobile instrumentation can be implemented to perform on-site investigations as well as for studies in the (museum) laboratory.

In archaeometrical research one always has to balance the (risk on) damage to the artefact and the amount of information that can be obtained. Therefore, performing non-destructive investigation, using portable instrumentation, is a good way to handle this. This approach was applied on the one hand in a museum context [7], and on the other hand during fieldwork [8-9]. In the first case, our research group performed the direct analysis of a cork scale model, made by Antonio Chichi, after the pantheon in Rome (fig. 1a). It was possible to identify the

pigments that were used to colour this masterpiece. In the second case, next to the fibre optics probehead, the availability of batteries to operate the instrument was exploited during a field campaign in Patagonia (fig. 1b). Several painted rock panels from different hunter-gatherer groups were investigated in order to identify the materials and study degradation phenomena. These approaches illustrate the wide range of applications and working modalities of portable Raman spectroscopy instrumentation.

References cited

[1] D. Bersani, C. Conti, P. Matousek, F. Pozzi, P. Vandenabeele, *Anal. Methods* 2016; *8*, 8395.

[2] Ph. Colomban, *J. Raman Spectrosc.* 2012; *43*, 1529.

[3] M. Maguregui, U. Knuutinen, I. Martínez-Arkarazo, A. Giakoumaki, K. Castro, J.M. Madariaga, *J. Raman Spectrosc.* 2012; *43*, 1747.

[4] A. Rousaki, L. Moens, P. Vandenabeele, *Physical Sciences Reviews* 2018; *3(9)*, in print.

[5] P. Vandenabeele, K. Castro, M. Hargreaves, L. Moens, J.M. Madariaga, H.G.M. Edwards, *Anal. Chim. Acta* 2007; *588*, 108.

[6] P. Vandenabeele, H.G.M. Edwards, J. Jehlička, *Chem. Soc. Rev.* 2014; *43*, 2628.

[7] A. Rousaki, P. Pincé, S. Lycke, A. Harth, M. Martens, L. Moens, P. Monsieur, P. Vandenabeele, *Eur. Phys. J. Plus* 2018; submitted.

[8] A. Rousaki, C. Vázquez, V. Aldazábal, C. Bellelli, M. Carballido Calatayud, A. Hajduk, E. Vargas, O. Palacios, P. Vandenabeele, L. Moens, *J. Raman Spectrosc.* 2017; *48*, 1459.

[9] A. Rousaki, E. Vargas, C. Vázquez, V. Aldazábal, C. Bellelli, M. Carballido Calatayud, A. Hajduk, O. Palacios, L. Moens, P. Vandenabeele, *Trends Anal. Chem.* 2018; *105*, 338.

MARITIME ARCHAEOLOGY

Nicolás C. Ciarlo, Associate Editor

This column covers three notes on ongoing investigations in maritime archaeology. The first deals with the death seasonality determination of pinnipeds at a cave of the Argentinean Patagonia (P. Ambrústolo et al.). The second and third entries are focused on the problems and potential of detecting submerged evidence of prehistoric hunter-gatherer sites (O. Grøn et al.). Also, an account on recent papers, books, and previous conferences is presented.

Current Research

Cueva del Negro site, Argentine Patagonia: death seasonality determination in pinnipeds teeth

The initial results on age and season of death of South American sea lions (*Otaria flavescens*) captured by hunter-gatherer groups at *Cueva del Negro* site (northern coast of Santa Cruz Province, Patagonia, Argentina) are presented in this note.

The teeth of pinnipeds, as well as other marine or terrestrial mammals, are useful for determining the age of an individual under study. Depending on the quality of the tooth section, the last group of layers close to the pulp cavity may indicate the precise moment of the animal's death (Crespo et al. 1994; Grandi et al. 2010). From an archaeological perspective, it constitutes an important inferential tool in terms of the discussions about the predator-prey relationship and the capture strategies followed by human populations.

The death seasonality studies of pinnipeds from *Cueva del Negro* were made on eighteen sample teeth from the stratigraphic sequence. The study was carried out by counting groups of complete (annual) bands of growth layers in each tooth (Figure 1).

The teeth of adult individuals were cut longitudinally or transversally with a handsaw, polished with sand paper (400-1000 grain) and observed with a stereoscopic microscope with transmitted light. Macroscopically, the dentine deposition pattern in the South American sea lion involves a wide opaque layer and a thin translucent layer deposited during the breeding season. The opaque and the translucent layers correspond chronologically to one year (Crespo et al. 1994). Seasonality was determined as the proportion of the opaque layer deposited next to the last translucent layer and the pulp cavity. This means that if the last layer was a translucent one, the animal died during the breeding season. If a quarter of an opaque layer was formed, the animal died at the end of summer or early fall (March-April). Half an opaque layer would therefore indicate its death took place halfway through winter (around July), and so on.

The first trends of seasonality studies show that in *Cueva del Negro* occupation contexts the pinniped capture would have taken place at specific times of the year, during the summer and early autumn, between January and April. Regarding the age determination, it is worth mentioning that most of the samples belong to neonatal individuals and, to a lesser extent, to juvenile female prey. Only one piece belongs to an adult male whose death estimation corresponds to January. Between the neonate and juvenile pinnipeds, the death data of the samples was identified in

all the months that comprise the aforementioned period. The possible seasonal exploitation of pinnipeds is also consistent with the stable isotope studies carried out on human bone remains in order to evaluate the paleodiets of the populations that occupied the area. Results show a clear trend towards the identification of mixed diets (marine and terrestrial) (Zilio et al. 2018). This trend could be explained by the existence of a seasonal use of the coast, within the framework of a complementary exploitation between the interior and littoral areas.

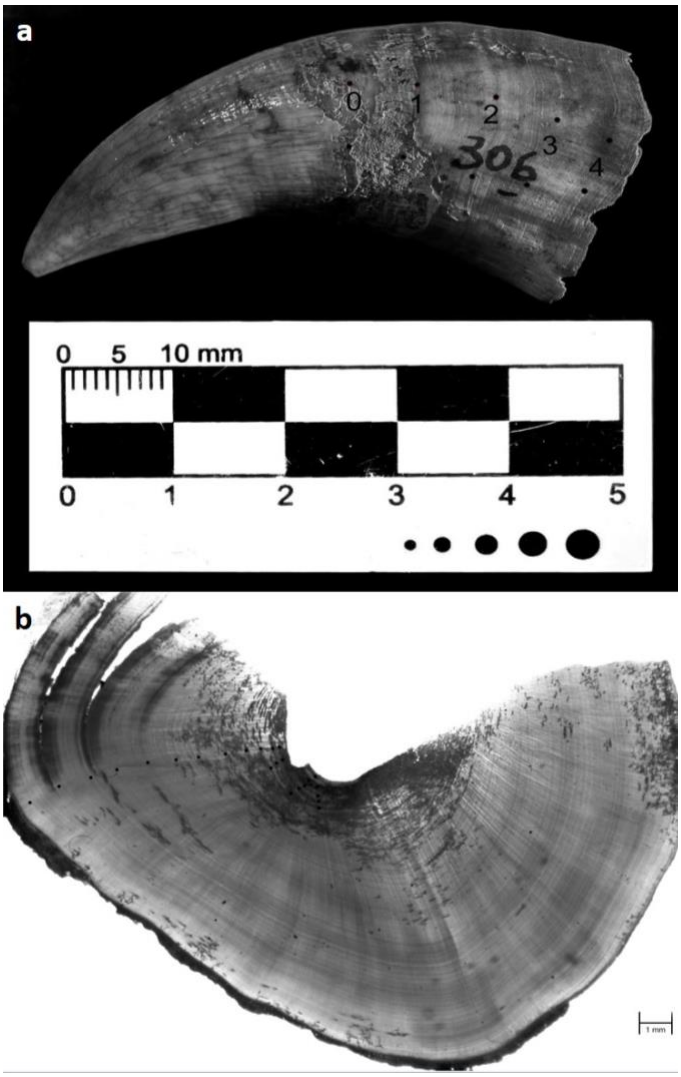

Figure 1. (a) Upper canine teeth of a 4-year-old male sea lion. Increment layers can be counted with the naked eye. No. 0 is the neonatal line, nos. 1 to 4 are layers deposited during the breeding season in January. Additional lines indicate death around the end of summer or early autumn; (b) Section of an adult male sea lion. Additional lines indicate death around the end of summer.

References cited

Crespo, E. A., Schiavini, A., Perez Macri, G., Reyes L. and Dans, S. (1994). Estudios sobre determinación de edad de mamíferos marinos del atlántico sudoccidental. In Oporto, J. (Ed.), *Anales de la Cuarta Reunión de Trabajo de Especialistas en Mamíferos Marinos Acuáticos de América del sur. Centro de Investigaciones y manejo de mamíferos marinos* (31-55). Valdivia, Chile.

Grandi, M. F, Dans, S. L., García, N. A. and Crespo E. A. (2010). Growth and age at sexual maturity of South American sea lions. *Mammalian biology* 75: 427-436.

Zilio, L., Tessone, A. and Hammond, H. (2018). Stable isotope ecology and human palaeodiet in the northern coast of Santa Cruz (Argentine Patagonia). *International Journal of Osteoarchaeology*, 1-13.

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Acoustic mapping of Submerged Stone Age sites (2)*

The previous report of successful experimental use of acoustics for mapping of submerged Stone Age sites has been supported by a series of experiments with the acoustic setup based on a Teledyne Chirp III sweeping the interval 2-20 kHz, used in the group's former work. This was employed to register the response from samples of human knapped flint placed on the sea floor in a bag as well as embedded in sediment in a bucket. Both types of samples created an acoustic response. A sample of naturally cracked flint did not. Recordings in areas known to have large amounts of naturally cracked flints embedded in the sea floor did not either. Practical experiments with knapped lithics in combination with finite element modelling is being continued to carry through a signal improvement that can facilitate detection of human knapped lithics of all materials at maximal depths into the sea floor sediments.

According to the modelling results obtained so far, there is hope that single pieces of knapped lithics can be detected several meters deep in the sediment and small concentrations even deeper (Grøn et al. 2018; Hermand & Tayong 2013). Such a development will represent a significant improvement of our ability to map submerged Stone Age sites.

*A previous note on this subject appeared in the *SAS Bulletin* 40.1 (2017)

References cited

Grøn, O., L. O. Boldreel, J.-P. Hermand, H. Rasmussen, A. Dell'Anno, D. Cvikel, E. Galili, B. Madsen, and E. Nørmark, 2018: Detecting human-knapped flint with marine high-resolution reflection seismics: A preliminary study of new possibilities for subsea mapping of submerged Stone Age sites. *Underwater Technology* 35 (2):35-49.

Hermand, J.-P. and R. Tayong, 2013. Geoacoustic characterization of Stone Age cultural layers: Preliminary FE modelling. Proceedings of OCEANS 2013, MTS/IEEE, Bergen, Norway. DOI: 10.1109/OCEANS-Bergen.2013.6608184.

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Topographical Modeling Stone Age sites

Problems with the practical application of purely topographical modeling for mapping of potential Stone Age habitation areas has led to an analysis of the obvious and hidden assumptions behind such approaches. The employment of the widely used Danish 'fishing-site-model' appears only to result in registration of around 0.6% of the number of sites that should be expected in similar landscape situations on land (Figure 1) (Grøn 2018; Gross et al. 2018).

Figure 1. The Karrebækminde Fjord system with a sea level similar to that of the Late Mesolithic showing recorded Late Mesolithic sites. The size of the red dots signifies the number of flake axes found on the sites and thereby serves as an indication of the site's size. The sites should according to the 'fishing-site-model' be located mainly around the mouths of inlets and watercourses. That is far from the case.

A number of problems in most applied modeling approaches have been identified:

1. They generally ignore the vegetation and its dynamics as well as the faunal resources related to it. Both are important for where humans chose to settle.
2. When vegetation and faunal resources are taken into account, they are generally regarded as "evenly distributed" and "rather stable." This is in conflict with the landscape ecology that developed since the 1990s which deals with quite dynamic population "patches."
3. The general assumptions about how Stone Age cultures place their habitation sites in the landscape do not account for the archaeological as well as ethnoarchaeological fact, that cultures living in similar landscapes may well have different settlement strategies.

It is so far obvious that successful modeling of Stone Age habitation areas is much more complex and resource demanding than it appears from the earlier very general attempts (Hansson et al. 2018), and it is a central question how effective such an approach can become. As an alternative, physical detection of Stone Age sites based on specific acoustic characteristics of knapped flint and not present in naturally cracked pieces is discussed. It is apparently possible to detect knapped lithics from submerged Stone Age sites covered by meters of sediment (Grøn et al. 2018).

References cited

Gross, D., A. Zander, A. Boethius, S. Dreibrodt, O. Grøn, A. Hansson, C. Jessen, S. Koivisto, L. Larsson, H. Lübke, and B. Nilsson, 2018. People, lakes and seashores: studies from the Baltic Sea basin and adjacent areas in the early and Mid-Holocene. *Quaternary Science Reviews* 185:27-40.

Grøn, O. 2018. Some problems with modelling the positions of prehistoric hunter-gatherer settlements on the basis of landscape topography. *Journal of Archaeological Science: Reports* 20:192-199.

Grøn, O., L. O. Boldreel, J.-P. Hermand, H. Rasmussen, A. Dell'Anno, D. Cvikel, E. Galili, B. Madsen, and E. Nørmark, 2018: Detecting human-knapped flint with marine high-resolution reflection seismics: A preliminary study of new possibilities for subsea mapping of submerged Stone Age sites. *Underwater Technology* 35 (2):35-49.

Hansson, A., B. Nilsson, A. Sjöström, S. Björck, S. Holmgren, H. Linderson, O. Magnell, M. Rundgren, and D. Hammarlund, 2018. A submerged Mesolithic lagoonal landscape in the Baltic Sea, south-eastern Sweden - Early Holocene environmental reconstruction and shore-level displacement based on a multiproxy approach. *Quaternary International* 463 (Part A):110-123.

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Recent Publications

Journal of Archaeological Science. From year 2018 (up to June), Vol. 89: "Archaeological use of Synthetic Aperture Sonar on deepwater wreck sites in Skagerrak" (Ø. Ødegård et al.); Vol. 91: "Tracing grog and pots to reveal Neolithic Corded Ware Culture contacts in the Baltic Sea region (SEM-EDS, PIXE)" (E. Holmqvist et al.); and Vol. 93: "Inferring fishing intensity from contemporary and archaeological size-frequency data" (M. J. Plank et al.); "Presenting multivariate statistical protocols in R using Roman wine amphorae productions in Catalonia, Spain" (A. Angourakis et al.); and "Fish and resilience among Early Holocene foragers of southern Scandinavia: A fusion of stable isotopes and zooarchaeology through Bayesian mixing modeling" (A. Boethius & T. Ahlström).

Journal of Archaeological Science: Reports. From year 2018 (up to June), Vol. 17: "Scales of analysis: Evidence of fish and fish processing at Star Carr" (H. K. Robson et al.); "The compositional analysis of hunter-gatherer pottery from the Kuril Islands" (E. Gjesfjeld); "Obsidian circulation in the early Holocene Aegean: A case study from Mesolithic Damnoni (SW Crete)" (T. Carter et al.); "Species composition of First Nation whaling hunts in the Clayoquot Sound region of Vancouver Island as estimated through genetic analyses" (S. L. Béland et al.); "Assessing the potential to calendar date Māori waka (canoes) using dendrochronology" (G. Boswijka & D. Johns); "New archaeological insights from petrographic analysis of ceramics from the Bocas del Toro Archipelago, Panama" (K. M. Marsaglia et al.); "An archaeometric study of some pre-Roman glass beads from Son Mas (Mallorca, Spain)" (M. Van Strydonck et al.); "Determining the boundaries, structure and volume of buried shell matrix deposits using ground-penetrating radar: A case study from northern Australia" (S. L. Kenady et al.); and "Towards a refined understanding of the use of coastal zones in the Mesolithic: New investigations on human–environment interactions in Telemark, southeastern Norway" (M. Wieckowska-Lüth et al.);

Vol. 18: "$\delta^{13}C$ and $\delta^{15}N$ variations in terrestrial and marine foodwebs of Beagle Channel in the Holocene. Implications for human paleodietary reconstructions" (S. Kochi et al.); "Before the spatial analysis of Beg-er-Vil: A journey through the multiple archaeological dimensions of a Mesolithic dwelling in Atlantic France" (G. Marchand et al.); "Detecting single events in large shell mounds: A GIS approach to Cabeço da Amoreira, Muge, Central Portugal" (C. Gonçalves et al.); "Living in the southwest Portuguese coast during the Late Mesolithic: The case study of Vale Marim I" (J. Soares & C. Tavares da Silva); "The social use of space in a shell midden: Testing ethnoarchaeological data from Tierra del Fuego (Argentina) with intra-site spatial analyses" (A. García-Piquer & J. Estévez-Escalera); "Diet at ancient Helike, Achaea, Greece based on stable isotope analysis: From the Hellenistic to the Roman and Byzantine periods" (C. McConnan Borstad et al.); "Ground penetrating radar in the medieval oyster shell middens of Saint-Michel-en-l'Herm (Vendée, France)" (E. Cariou et al.); "Multi-isotopic analysis of first Polynesian diet (Talasiu, Tongatapu, Kingdom of Tonga)" (E. Herrscher et al.); "Fishing at Arapus-Mangaasi, Efate, Vanuatu (2800–2200 BP): New methodological approaches and results" (L. Bouffandeau et al.); "The genetic history of whaling in the Cantabrian Sea during the 13th–18th centuries: Were North Atlantic right whales (*Eubalaena glacialis*) the main target species?" (A. Rey-Iglesia et al.); "Possible diffuse idiopathic skeletal hyperostosis (DISH) in a 3000-year-old Pacific Island skeletal assemblage" (A. Foster et al.); and "The Watts Point dacite source and its geological and archaeological occurrence along the shores of the Salish Sea, British Columbia Canada" (R. Reimer); and Vol. 19: "Early medieval seascapes in Western Ireland and the geochemistry of ecclesiastical cross stones" (N. Goodale et al.); "Shallow geophysical exploration at the ancient maritime Maya site of Vista Alegre, Yucatan Mexico" (R. Jaijel et al.); "Early and mid-Holocene coastal settlement and demography in southeastern Norway: Comparing distribution of radiocarbon dates and shoreline-dated sites, 8500–2000 cal. BCE" (S. Solheim & P. Persson); "Neighbourly ties: Characterizing local and Sicilian pottery in post-medieval Malta" (R. Palmer et al.); and "Revisiting the date of the Java Sea Shipwreck from Indonesia" (L. C. Niziolek et al.).

Geoarchaeology. From 2018 (up to June), Vol. 33, No. 1: "Tracing the Alkinoos Harbor of ancient Kerkyra, Greece, and reconstructing its paleotsunami history" (C. Finkler et al.); Vol. 33, No. 2: "Hunting, Gathering, and Fishing on the Coast of the Atacama Desert: Chinchorro Population Mobility Patterns Inferred from Strontium Isotopes" (V. G. Standen et al.); and Vol. 33, No. 3: "Long-term retreat rates of Israel's Mediterranean sea cliffs inferred from reconstruction of eroded archaeological sites" (O. Barkai et al.); and "Archaeological prospection of the nearshore and intertidal area using ultra-high resolution marine acoustic techniques: Results from a test study on the Belgian coast at Ostend-Raversijde" (T. Missiaen et al.).

Quaternary International. From year 2018 (up to june), Vol. 463, Part A: "A submerged Mesolithic lagoonal landscape in the Baltic Sea, south-eastern Sweden – Early

Holocene environmental reconstruction and shore-level displacement based on a multiproxy approach" (A. Hansson et al.); "Palaeoenvironmental and archaeological records for the reconstruction of the ancient landscape of the Roman harbour of Narbonne (Aude, France)" (C. Faïsse et al.); and "Earthquakes and coastal archaeology: Assessing shoreline shifts on the southernmost Pacific coast (Chonos Archipelago 43°50'–46°50' S, Chile, South America)" (O. Reyes et al.); Vol. 464, Part A: "Beach deposits containing Middle Paleolithic archaeological remains from northern Israel" (E. Galili et al.); Vol. 470, Part B: ""To 'seafood' or not to 'seafood'?" An isotopic perspective on dietary preferences at the Mesolithic-Neolithic transition in the Western Mediterranean" (D. C. Salazar-García et al.); Vol. 471: "Characterising marine mollusc exploitation in the eastern African Iron Age: Archaeomalacological evidence from Unguja Ukuu and Fukuchani, Zanzibar" (P. Faulkner et al.); and Vol. 473, Part A: "Geoarchaeological evidence of marshland destruction in the area of Rungholt, present-day Wadden Sea around Hallig Südfall (North Frisia, Germany), by the Grote Mandrenke in 1362 AD" (H. Hadler et al.); "The sedimentary and geomorphological imprint of the AD 365 tsunami on the coasts of southwestern Crete (Greece) – Examples from Sougia and Palaiochora" (V. Werner et al.); "Geoarchaeological investigations of a prominent quay wall in ancient Corcyra – Implications for harbour development, palaeoenvironmental changes and tectonic geomorphology of Corfu Island (Ionian Islands, Greece)" (C. Finkler et al.); and "Water saturated sand and a shallow bay: Combining coastal geophysics and underwater archaeology in the south bay of Tel Dor" (M. Lazar et al.); see also the other articles of this special issue, titled *Integrated geophysical and (geo)archaeological explorations in wetlands* (C. Zielhofer et al., eds.).

It is worth to mention other articles on archaeometric research published during the first half of 2018, that could be useful for maritime archaeologists: ***Anthropocene***, Vol. 21: "Anthropogenic and climatic impacts on a coastal environment in the Baltic Sea over the last 1000 years" (W. Ning et al.); ***Antiquity***, Vol. 92, No. 361: "What lies beneath ... Late Glacial human occupation of the submerged North Sea landscape" (L. Amkreutz et al.); "El Médano rock art style: Izcuña paintings and the marine hunter-gatherers of the Atacama Desert" (B. Ballester); and "Radiocarbon dating and Bayesian modelling of one of Remote Oceania's oldest cemeteries at Chelechol ra Orrak, Palau" (S. M. Fitzpatrick & N. P. Jew); and Vol. 92, No. 363: "'The gleaming mane of the serpent': the Birka dragonhead from Black Earth Harbour" (S. Kalmring & L. Holmquist); ***Archaeological and Anthropological Sciences***, Vol. 10, No. 1: "Compound-specific amino acid isotopic proxies for distinguishing between terrestrial and aquatic resource consumption" (E. C. Webb et al.); "Luminescence geochronology and paleoenvironmental implications of coastal deposits of southeast Cyprus" (E. Tsakalos et al.); and "Scattered shipwreck site prospection: the combined use of numerical modeling and documentary research (*Fougueux*, 1805)" (T. Fernández-Montblanc et al.); and Vol. 10, No. 4: "Plant remains and amphorae from the Roman harbour under Flacius Street in Pula (Istria, Croatia)" (S. Essert et al.); ***ArcheoSciences | Revue d'Archéométrie***, Vol. 42, No. 1: "Découverte exceptionnelle de restes de Crevettes (Crustacés Décapodes) dans les niveaux du port romain de *Ratiatum* (Rezé, Loire-Atlantique)" (A. Borvon & Y. Gruet); ***Historical Archaeology***, Vol. 52, No. 2: "Culturally Modified Red Pine, Birch-Bark Canoes, and the Strategic Geography of the Fur Trade on Lake Saganaga, Minnesota, U.S.A." (L. B. Johnson et al.); ***Journal of Anthropological Archaeology***, Vol. 49: "Isotopes and human burials at Viking Age Birka and the Mälaren region, east central Sweden" (T. D. Price et al.); ***Journal of Cultural Heritage***, Vol. 29: "Subsea spectral identification of shipwreck objects using laser-induced breakdown spectroscopy and linear discriminant analysis" (M. López-Claros et al.); and "3D survey and modelling of shipwrecks in different underwater environments" (C. Beltramea & E. Costa); and Vol. 30: "The measurement of maximum water content (MWC) on waterlogged archaeological wood: A comparison between three different methodologies" (N. Macchioni et al.); ***Mediterranean Archaeology & Archaeometry***, Vol. 18, No. 2: "Archaeometallurgical analysis of maritime steel nails from Crusader Jaffa, ca. 13th century AD" (B. Kaufman et al.); and "Archaeometric analysis for provenance and content of Roman amphorae from the site of Sa Mesquida (Mallorca, Spain)" (M. A. Cau Ontiveros et al.); and ***Quaternary Science Reviews***, Vol. 185: "People, lakes and seashores: Studies from the Baltic Sea basin and adjacent areas in the early and Mid-Holocene" (D. Groß et al.); Vol. 187: "Middle Holocene marine flooding and human response in the south Yangtze coastal plain, East China" (Z. Wang et al.); and Vol. 188: "Middle-Holocene sea-level fluctuations interrupted the developing Hemudu culture in the lower Yangtze River, China" (K. He et al.).

The following articles published in other non-archaeological journals are worth mentioning: ***Continental Shelf Research***, Vol. 158: "Estuarine development and early Holocene transgression across an aeolianite substrate, Caesarea, central Israel" (J. A. Goff et al.); ***Corrosion Science***, Vol. 132: "Stabilization treatment of cultural heritage artefacts: *In situ* monitoring of marine iron objects dechlorinated in alkali solution" (F. Kergourlay et al.); ***Deep Sea Research Part II: Topical Studies in Oceanography***, Vol. 150: "Deep-water

archaeological discoveries on Eratosthenes Seamount" (B. Ballard et al.); and "Telepresence-enabled archaeological survey and identification of SS *Coast Trader*, Straits of Juan de Fuca, British Columbia, Canada" (J. P. Delgado et al.); ***Earth-Science Reviews***, Vol. 177: "Geoarchaeology of the Roman port-city of Ostia: Fluvio-coastal mobility, urban development and resilience" (F. Salomon et al.); ***Estuarine, Coastal and Shelf Science***, Vol. 200: "Effects of substrata and environmental conditions on ecological succession on historic shipwrecks" (M. M. González-Duarte et al.); ***Geomorphology***, Vol. 303: "Reconstructing Holocene shore displacement and Stone Age palaeogeography from a foredune sequence on Ruhnu Island, Gulf of Riga, Baltic Sea" (M. Muru et al.); ***International Journal of Biological Macromolecules***, Vol. 109: "Multi-analysis of chemical transformations of lignin macromolecules from waterlogged archaeological wood" (Y. Xia et al.); ***Journal of Asian Earth Sciences***, Vol. 152: "Holocene evolution of the Liaohe Delta, a tide-dominated delta formed by multiple rivers in Northeast China" (L. He et al.); ***Marine Geology***, Vol. 395: "Shipwrecks and man-made coastal structures as indicators of historical shoreline position. An interdisciplinary study in the Sancti Petri sand spit (Bay of Cádiz, SW Spain)" (T. Fernández-Montblanc et al.); and Vol. 396: "A new chalcolithic-era tsunami event identified in the offshore sedimentary record of Jisr al-Zarka (Israel)" (N. Tyuleneva et al.); ***Ocean & Coastal Management***, Vol. 156: "Predicting coastal erosion in St. Kitts: Collaborating for nature and culture" (C. E. Stancioff et al.); ***Palaeogeography, Palaeoclimatology, Palaeoecology***, Vol. 497: "Coastal reconstruction of Vista Alegre, an ancient maritime Maya settlement" (R. Jaijel et al.); and Vol. 498: "The onset of islandscapes in the Balearic Islands: A study-case of Addaia (northern Minorca, Spain)" (G. Servera-Vives et al.); ***Quaternary Science Reviews***, Vol. 180: "An early colonisation pathway into northwest Australia 70-60,000 years ago" (K. Norman et al.); and Vol. 182: "Marine resource reliance in the human populations of the Atacama Desert, northern Chile – A view from prehistory" (C. L. King et al.); ***Regional Studies in Marine Science***, Vol. 21, several contributions to the special issue *Historical Ecology of Semi-enclosed Basins: Past, Present and Future of Seas at Risk* (C. Mazzoldi et al., eds.); ***Science of The Total Environment***, Vol. 613-614: "Study of the influence of physical, chemical and biological conditions that influence the deterioration and protection of Underwater Cultural Heritage" (M. Bethencourt et al.); ***Scientific Reports***, Vol. 8: "The impact of the *Deepwater Horizon* blowout on historic shipwreck-associated sediment microbiomes in the northern Gulf of Mexico" (L. J. Hamdan et al.); ***Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy***, Vol. 190: "Raman analysis of cobalt blue pigment in blue and white porcelain: A reassessment" (X. Jiang et al.); and ***The American Journal of Human Genetics***, Vol. 102, No. 1: "The Comoros Show the Earliest Austronesian Gene Flow into the Swahili Corridor" (N. Brucato et al.).

Archaeopress. The following book published in the early 2018 is of special interest: "The Gwithian Landscape: Molluscs and Archaeology on Cornish Sand Dunes" (T. M. Walker, with contributions from R. Y. Banerjea & C. R. Batchelor), ISBN 978-1784918033. This monograph summarizes the work conducted by Walker in Gwithian, on the north coast of Cornwall. The research is focused on the palaeoenvironmental characteristics of the settlement sites in the area, from the Neolithic onwards. To analyze how changes in landscape have influenced, and been affected by, human occupations, the authors examined mollusk species from the coastal dunes and the micromorphology of sites. Pollen and diatom analyses and dates obtained by means of radiocarbon and optically stimulated luminesce, among other field and laboratory studies, allowed assessing these changes in detail. Finally, fine-resolution geochemistry was used to investigate mining activities from the Bronze Age to the present day.

Previous Meetings and Conferences

51th Annual Conference on Historical and Underwater Archaeology. *Landscapes, Entrepôts, and Global Currents*. This meeting was held from 3rd to 7th January 2018, at the New Orleans Marriott Hotel in Louisiana. Papers from the session 'Remote Sensing and Mapping in Underwater Archaeology' can be highlighted: "System of Environmental Analysis (SEA): An Underwater Environmental Sensor and its Applications" (R. Casas Jr. et al.); "Photogrammetric Survey of a Sixteenth-Century Spanish Shipwreck Near Punta Cana, Dominican Republic" (K. M. Hawley et al.); "Pushing the Boundaries: Technology-Driven Exploration of Thunder Bay National Marine Sanctuary" (J. C. Bright & S. Gandulla); "Understanding Maritime Heritage Through the Iterative Use of Geophysics and Diving" (L. Tizzard et al.); and "Layer Upon Layer Upon Layer – Interpreting the Historic Shipwreck Sites of Kenn Reefs, Coral Sea, through GIS" (P. Hundley & I. A. Malliaros).

ARCHAEOLOGICAL CERAMICS

Charles C. Kolb, Associate Editor

This issue contains two topics: 1) Previous Professional Meetings; and 2) Book Reviews on Ceramics.

Previous Professional Meetings

The 11th International Congress on the Archaeology of the Ancient Near East *(ICAANE)* was held at Ludwig-Maximilians-Universität, Munich, Germany, 3-7 April 2018. There were 32 oral presentations, 11 posters, and 24 workshops on ceramics; the papers and workshops were 30 minutes each.
See program:
http://www.icaane2018.vorderas-archaeologie.uni-muenchen.de/programme/main-sessions/3aprilprogram.pdf
See abstracts:
http://www.icaane2018.vorderas-archaeologie.uni-muenchen.de/programme/main-sessions/abstract-book.pdf.

Ceramics: From Crafts to Art, Technology, Decor, Style; International academic research conference*, 22-25 May 2008, Saint Petersburg*. Institute of History of Material Culture RAS. Saint Petersburg, Russia: Stieglitz Academy. There were sessions devoted to Ancient Ceramics, Medieval Ceramics, Ceramic of New Time, Ceramics in Architecture, Ethnographic Ceramics, and Contemporary Ceramics and Glass Art. The majority of the contributions concerned Eastern European and Russian topics and the presenters were from institutions in Europe and Asia. Among the papers were five of special interest to archaeological ceramics: Aussage, P. C. "Brief history of kiln technology: Firing with wood from the Neolithic to modern practices"; Sharmin, D. "Application of polished thin-section method in ceramic research: Technique vs. technology"; Szeliga M., Rauba-Bukowska A., and Huber M. "Incrustation of engraved ornament on the LPC vessels in the light of Scanning Electron Microscopy (SEM-EDS): Preliminary results"; Bugoi R., Ignat T., Lazăr C., and Constantin F. "Deciphering the chaîne opératoire of Eneolithic pottery by experimental archeology and imaging methods"; and. Uhl, R. "Vessel production, capacity and painting: a study on ceramic standardization from the settlement Petreni." https://www.academia.edu/36670664/From_Crafts_to_Art._Ceramics_technology_decor_style._International_academic_research_conference_22_25_May_2018_Saint_Petersburg._Abstracts._Saint_Petersburg_Stieglitz_Academy_2018

The 42nd International Symposium on Archaeometry *(ISA 2018)* was held in Merida, Yucatan, Mexico, 20-26 May 2018. Proceedings of ISA 2018 will be published by Science and Technology of Archaeological Research (STAR), an open access journal by Taylor & Francis. There were 13 oral presentations on ceramics and 50 posters on ceramics; Rob Tykot was co-author of six posters. See http://isa2018.mx/ISA2018ProgrammeF1.pdf

Book Reviews on Ceramics

Prehistoric Pottery from Dakhleh Oasis, Egypt, edited by Ashton R. Warfle. Dakhleh Oasis Project Monograph 18. Oxford and Philadelphia: Oxbow Books, 2018. 144 pp., illustrations. ISBN-10: 1785708244, ISBN-13: 978-1785708244 (print) £45.00 / $62.48, paperback, and ISBN-13: 978-1785708251 (epublication).

The Dakhleh Oasis Project, a multifaceted archaeological and environmental program, has been underway since 1978. The monograph under review presents a major study on the ceramics recovered from early and mid-Holocene sites in Egypt's Dakhleh Oasis, which come from 96 registered sites and five other findspots and comprise more than 10,000 sherds (an exact number is not stated). The region's name, Dakhleh, translates to "inner" oasis, and this is one of the seven oases of Egypt's Western Desert. It is situated in the New Valley Governorate, 350 km from the Nile and between the oases of Farafra and Kharga. Dakhleh Oasis measures about 80 km from east to west and 25 km from north to south. The reader is reminded that pottery is one of the few surviving from the late prehistory of northeast Africa, pottery serves as an essential material category by which to explore long-term human development. None of the ceramic objects come from burials, but derive from settlement sites that display evidence of living activities (hut circles, hearths, chipped stone scatters, etc.), or sites for which there is no other evidence of human activity. Through detailed description, classification, and quantification, a detailed cultural sequence has been determined, demonstrating discrete stylistic variations between sites and over time, highlighting growing diversity and innovation in local pottery-making from the late seventh to mid-third millennia cal. BC. These differences help to refine the characterization of local cultural units within the Holocene sequence for Dakhleh Oasis, and allow comparisons with parallel pottery traditions elsewhere in the desert.

The volume has a brief "Preface and acknowledgments" (p. vii), list of "Plates" (pp. ix-x) seven chapters, an "Appendix: Site Collections" (pp. 79-87, 2 endnotes) documenting materials from the 96 registered sites and five findspots; a "Bibliography" (pp. 88-94) with 202 entries, and "Plates" (pp. 95-130) 1-8 are in color and document surface treatments, decoration, and fabrics – fresh break sherd cross-sections, and Plates 9-36 which are line drawings of sherds and vessel profiles. Chapter 1 "Introduction" (pp. 1-6, 2 figures, 7 endnotes) considers methodologies and the structure of the study, research history on the ceramic collection, and "points of clarification." Part I includes Chapters 2-5, while Part II embraces chapters 6 and 7.

Chapter 2 (pp. 7-17, 1 figure, 3 tables, 7 endnotes) reviews terminologies, descriptions, methods of analysis, fabric descriptions, surface treatments, and vessel shapes. Among the topics are descriptions of the groundmass (clay texture, fracture, zoning and colors of cross-sections), inclusions (shale clay aggregates limestone, gypsum, vegetal materials, and microfossils), technological properties (hardness, wall thickness, construction techniques, and firing conditions). Surface treatments are reported as plain, coated, compacted, or textural decorated, with the latter providing explanations of techniques of decoration and details on elements and motifs: rippling, incised, impressed, imitation basketry, fingernail impressed, and potmarked. Seven vessel shapes are discerned in seven subclasses and vessel contours (simple, composite, inflected, and complex) as well as vessel proportions. Miscellaneous objects include truncated cones, perforated discs, tokens, spoon-shaped objects, and sherd scrapers.

Chapter 3 "Classification" (pp. 18-26) details the classifications of fabrics n = 33 (pp. 18-24) and wares (n = 9 classification (pp. 25-26). Nine Fabric Families are described and data on groundmass, inclusions, and technical properties included in each Family member: FF-1: sand-and-shale (five fabrics: 1A- 1E); FF-2: shale rich (four fabrics: 2A-2D); FF-3: sand (six fabrics: 3A-3F); FF-4 vegetal (seven fabrics: 4A-4G); FF-5 fine sand and limestone (two fabrics: 5A and 5B); FF-6 gypsum (two fabrics: 6A and 6B); FF-7 clay aggregates (three fabrics: 7A-7C); FF-8 marl (one fabric: 8A); and FF-9 silts (three fabrics: 9A-9C). Table 5 provides a graphic of fabrics and surface treatment matrices. There are 80 Ware Classifications (pp. 25-26) categorized into nine groups: 1 Plain (Hp) wares (n = 28); 2 Compacted (Hm) wares (n = 13); 3 Coated (Hc) wares (n = 1); 4 Textured (Hx) wares (n = 8); 5 Decorated (Hd) wares(n = 8); 2.6 Compacted-and-coated (Hmc) wares (n = 3); 7 Compacted-and-textured (Hmx) wares (n = 2); 8 Compacted-and-decorated (Hmd) wares (n = 5); and 9 Textured-and-decorated (Hxd) wares (n = 1).

Chapter 4 "Quantitative analysis" (pp. 26-61, 24 figures, 3 tables, 12 endnotes). The author discusses methods of analysis and use of multidimensional scaling and similarity percentage. Four series of non-metric multidimensional scaling (MDSCAL), similar to other multivariate analyses, were run. Data on pottery from 35 Masara sites suggested little evidence of pottery production; the ceramics derive from later occupations. The Bashendi pottery tradition was characterized on the basis of 33 sites; there were strong patterns within surface treatments. Thirty vessels from sites 401, 407, 409, 420, 422 and 423 are detailed and the Sheikh Muftah pottery tradition is characterized on the basis of materials from 764 vessels and miscellaneous ceramic objects from 52 sites. Early Sheikh Muftah ceramics are reported from two sites and Late Sheikh Muftah pottery from 46 sites. Handmade pottery from sites that are not registered on the Holocene prehistory index and handmade pottery from 4-5 findspots are, likewise, reported.

Chapter 5 "Long-term change in the ceramic record" (pp. 52-57, 6 figures, 4 endnotes) are summarized including fabrics; strong patterns were noted in FF-1 1A-1C and FF-2 2A-2C. Surface treatments tended to be rare in the collection, diachronically, small vessels were replaced by larger ones. In comments on ware and shape cross-tabulation, there are 415 instances where shapes could be matched with wares.

In Part II, Chapter 6 "Provenance" (pp. 61-73, 1figure, 1 table, 18 color plates of thin section microphotographs, 4 endnotes), Warfle introduces the problem of discerning locally-made versus imported pottery. The bulk of this chapter is the result of thin-section analysis performed by Mark Eccleston (pp. 66-73); 49 specimens are reported: 9 from Kharga Oasis and 40 from Dakhleh Oasis. Table 10: Comparative thin sections and macroscopic fabric groups illustrates correlations between ten Roman numeral-numbered thin section groupings and Warfle's 33 fabrics: I Coarse Ferruginous, II Fine Ferruginous, III Vegetal Tempered Fine Ferruginous, IV Coarse Shale, V Coarse Shale and Quartz, VI Coarse Shale and Quartz and Limestone, VII Medium Shale, VIII Organic, IX Nile Silt, and X Microfossil. The "Bibliography" lists four of Eccleston's works: *Provenance Study of Ceramics from the Dakhleh Oasis, Egypt*. Unpublished BA (Hons) thesis. Melbourne: Monash University (1997); *Petrographic Study of Locally Produced Ceramics from the Dakhleh Oasis, Egypt*. Unpublished MSc thesis. Sheffield: University of Sheffield (1998), "Early and mid-Holocene Ceramics from the Dakhleh Oasis: Macroscopic, Petrographic and Technological Descriptions" in R. F. Friedman (ed.), *Egypt and Nubia: Gifts of the Desert*, London: British Museum Press, pp. 62-73 (2002), and *Technological and Social Aspects of High-Temperature Industries in the Dakhleh Oasis, Egypt, during the Ptolemaic and Roman Periods*. Unpublished Ph.D. thesis. Melbourne: Monash University (2006). Eccleston cites his own publication (2002) in the analysis. It is difficult for the reader to discern if there is much input from Warfle in this section as the contents seem to be completely from Eccleston's studies.

Chapter 7 "Conclusions" (pp. 74-78). Warfle discusses pottery variation and classification and issues of "reaching a compromise." The assessment indicates the FF-1: 1A-1E, FF-2: 2A-2D, FF-3: 3a and 3b, FF-4: 4A-4C, and FF-5: 5A

and 5B are all locally-produced wares, while FF-6: 6A and 6B are imports. GG-7: 7A-7C are grog tempered ceramics, FF-8: 8A is a Nile Valley import, and FF-9: 9A and 9C are also from the Nile Valley. The conclusions also include a discussion of how this analysis results in a better understanding of the early and mid-Holocene cultural units, and ends with proposed future directions for study. The "Appendix" provides provenance data on the collections and the 96 registered site and five findspots; the "Plates" (pp. 95-130) provide excellent color illustrations of the surface treatments, decoration and fabrics: 1A-1E, 2A-2D, 3A-3F, 4A-4G, 5A-5B, 6A-6B, 7A-7C, 8A, and 9A-9C.

This is a very traditional monograph based on Warfle's revised and updated doctoral thesis (2008). It provides a basic analysis of Dakhleh Oasis ceramics dated to the late seventh to mid-third millennia cal. BC. The detailed description and classification are appropriate and informative, but the quantification of the ca. 10,000 sherds (whole vessels included) might be further elaborated, especially how many specimens or what percentages of the corpus were tabulated within each of the 33 fabric categories and nine wares. Surface treatment analyses and shape descriptions would also benefit from further quantification. No attempt has apparently been made to correlate Dakhleh Oasis ceramics with the pottery characterized in *A Manual of Egyptian Pottery*, 4 vols.: *Vol. 1: Fayum A-Lower Egyptian Culture*, Vol. 2: *Naqada III-Middle Kingdom*, AER Field Manual Series 1-4, Boston: Ancient Egyptian Research Associates, Inc. (2009-2010) by Polish archaeologist and ceramic expert Anna Wodzinska; see SAS *Bulletin* 33(3):12-13 (2010). Several contributions in *Under the Potter's Tree: Studies on Ancient Egypt Presented to Janine Bourriau on the Occasion of her 70th Birthday* edited by David Aston, Bettina Bader, Carla Gallorini, Paul Nicholson, and Sarah Buckingham, Orientalia Lovaniensia Analecta 204, Leuven, Paris, and Walpole, MA: Uitgeverij Peeters en Departement Oosterse Studies (2011) might further illuminate aspects of the monograph; see *SAS Bulletin* 35(3):7-9 (2012). The author does mention one chapter published in *Functional Aspects of Egyptian Ceramics in their Archaeological Context: Proceedings of a Conference held at the McDonald Institute for Archaeological Research, Cambridge, July 24th-July 25th, 2009* edited by Bettina Bader and Mary F. Ownby Orentalia Lovaniensia Analecta 217, Leuven: Peeters Publishers (2012); see *SAS Bulletin* 36(4):10-13 (2013). Ownby's ceramic research provides a model to be emulated. Nonetheless, with the exception of the excellent but limited number of thin section studies (n = 49) a good deal of ceramic analysis could yet be conducted on this starting with pXRF.

Nishapur Revisited: Stratigraphy and Ceramics of the Qohandez, edited by Rocco Rante and Annabelle Collinet, with contributions by Rajabali Labbaf Khanoiki, A. Bouquillon, Y. Coquinot, C. Doublet, Y. Gallet, A. Genevey, E. and A. Zink; Oxford and Oakville: Oxbow Books, 2013. xv + 210 pp., 107 figures, 33 tables, bibliography (there is no index). ISBN: 9781842174944, £40.00 (hardcover).

The archaeological site of Nishapur in eastern Iran was an important Silk Road city, its position providing links to Central Asia and China, Afghanistan and India, the Persian Gulf and the west. Portions of the site had been excavated on two prior occasions, initially from 1935 to 1940 when a team, The American Archaeological Mission in Nishapur, from the Metropolitan Museum of Art led by Charles Wilkinson initiated explorations and again in 1947 interrupted by World War II. Despite these prior excavations there were a number of unresolved questions concerning the site: When was the city founded? Was Nishapur a Sasanian city? And, if so, was it founded by the Sasanian king Shapur I or II? The original excavators had dated the structures and objects between the late 8th and 12th centuries but did not provide appropriate stratigraphic data which impeded research interpretations and the ability to develop a more precise chronological framework. Subsequently (1995 to 2002), an Iranian team conducted excavations in the area of Shadyakh uncovering a large residence; however, no report was ever published. Hence, the chronology of occupation and the ceramic sequence are problematic particularly for late antiquity and the medieval period, and a comprehensive topographic plan of the site was lacking.

In 2004 the Iranian Centre of Archaeological Research (ICAR), directed by Masud Azarnoush, invited a French archaeological team led by Monique Kervsan to assist them in re-opening excavations in Nishapur. The goal of this new project was to revisit the history and material culture of this important city at the nexus of trading routes connecting Baghdad with the cities of Merv, a major oasis-city in Central Asia, on the historical Silk Road, located near today's Mary in Turkmenistan, Balkh and Herat in northeastern Afghanistan, and further east to China and southeast to the Asian Subcontinent. The Irano-French archaeological mission at Nishapur (2004 to 2007) (CNRS-MAEE-Musée du Louvre) focused on the Qohandez, or citadel, the oldest part of Nishapur. Excavations were conducted in different areas of the mound, in order to address these questions. After an introduction to the site and the former American and Iranian excavations, this book presents the stratigraphy and the pottery of the site. The ceramologists included Annabelle Collinet, Z. Delarami, C. Juvin, J. Kamalizad,

S. Khozaymeh, D. Miroudot, A. Mousazadeh, A. Péli, and H. Sharifan. The difficulties involved in establishing a precise history of the site, as well as the complexities of studying the pottery led to a program of analysis undertaken by the Research Centre of French Museums (C2RMF). Chemical and petrographic analysis, thermoluminescence (TL) dating and archaeomagnetism analysis as support to the TL results were done. The chemical and petrographic analyses were undertaken by Anne Bouquillon, Yvan Coquinot, and Christel Doublet. A pottery database has been created regrouping the stratigraphical and laboratory analyses data, in order to manage and present an organised corpus of 1,000 samples. The combination of the data from the stratigraphical and laboratory analyses gives an accurate and completely new chronology of the site. Moreover, the study also brought to light a new typological sequence of the ceramic, as well as new data about ceramic production at Nishapur. The monograph uses the term "shards" rather than sherds for pottery fragments.

An "Introduction" (pp. xiii-xv) provides salient background and states three goals: 1) resolve the long accepted relationship between the toponymal of Nishapur and its history; 2) develop a more precise chronology of the occupation and the ceramic sequence; and 3) discern the real extent of the archaeological area. Chapter I "Historical and Geographical Background" (pp. 1-12, 7 figures, 1 table). The geographical and historical settings are detailed and a synthesis of the previous American and Iranian excavations is provided. The authors note Wilkinson's "incomplete" ceramic studies and point out that the 1935-1940 excavation reports characterize briefly the ceramic kilns and the interpretation that most ceramic wares were local products (except for the T'ang and Islamic pottery). His research emphasized the glazed earthenware's, hence, the analysis of unglazed wares and glazed fritwares was perfunctory (C. K. Wilkinson, Nishapur: Pottery of the Early Islamic Period, New York: Metropolitan Museum of Art, 1973).

Chapter II "The Excavation and the Absolute Chronology" (pp. 13-55, 33 figures [24 in color], 10 tables). The site today occupies ca. 3.5 ha and is an "extremely damaged and jumbled mass" (p. 13). The Irano-French Excavation focused on the northeastern portion of the (citadel). The previously noted dating problems were to be resolved using multiple strategies including Thermoluminescence Analysis (TL). Sample preparation, measurement apparatus, luminescence tests, palaeodose, annual dose, and numerical simulation are detailed and studies resulted in discerning three groups from 18 specimens (eight tables provide raw data and interpretations): TL analysis; U-Th-K20 content; annual dose rate, a summary of standard uncertainty components; the seriation matrix; list of samples; locations of external dose rate measurement and variables using in the Bayesian treatment. The following period were discerned: Period I: ca. 450-150 BC; Period II: late 4th to late 8th century AD; Period IIIa: 2nd half of the 8th century to early 11th century AD; and Period IIIb: 11th century to 1165 AD (the Mongol invasion). Insights from Archaeomagnetic Analysis are reported as TL support for the dating. The sample collection and magnetic properties, intensity experiments, and archaeointensity results are documented (Table 10). The specimens included 19 fragments (17 pottery shards from the TL study and two from brick) and five other shards. Three groups are discussed: 1) 485 BC – AD 4154; 2) 415-650; and 3) the Islamic period. The stratigraphical sequence was discerned through the results from four test-pits: Test-pit B (Periods I, II, and IIIa); Test-pit 10 (Periods II, IIIa, and IIIb); Test-pit 26 (Periods I, II, IIIa, and IIIb); and Test-pit 27 (Periods II, IIIa, and IIIb). An interpretation of the occupation chronology and urban development (pp. 53-55) concludes the chapter).

Chapter "III - Pottery Study and Analyses" (pp. 56-135, 36 figures, 22 tables). The authors document the recording methodology and the use of data record cards that included nine major variables. The ceramic analysis program is likewise detailed. A total of 7,312 shards (5,590 excavated at Qohandez and 1,722 from the surface survey of the citadel, Shahrestan, and the mosque area) were selected and four fabric groups were delineated. Petrographic (optical microscopy) analysis was undertaken on 47 glazed and unglazed shards and seven fritwares while PIXE was used on 52 glazed and unglazed shards four kiln elements and seven fritwares, and chemical analyses. XRD and SEM were used on the fritware glazes. The authors note (p. 128) that there are very few previously published scientific analyses of Iranian ceramics – the vast majority (nine) undertaken in the 1990s and 2000s by R. B. Mason (published in Archaeometry, Iran, and JAS). Color microphotographs of the petrographic thin sections (Figures 51, 55-60, 62-63) and microphotographs of the SEM analysis (Figures 73-76) illustrate the studies on the clayey fabrics and fritwares (pp. 68-101). The analysis includes an assessment local manufacture versus importation. The ceramic groups and their production are related to local geological materials (volcanic, metamorphic, and detritic). The clayey fabrics are petrographically homogeneous (Fabrics Aa, Ab, and B) found at Qohandez and Shahrestan in Periods I and IIIb, but less so during IIIa; 12 earthenware fabrics relate to Periods II, IIIa, and IIIb; glazed earthenware to Period IIIa; and two fritware groups to the 12th century AD. The data demonstrates conclusively that the clay was local to

Nishapur, confirming that the shard samples were from pieces manufactured in the city.

Chapter IV "Chronology of the Qohandez pottery" (pp. 136-203, 28 figures). The chapter focuses on a discussion of test-pit data and the chronological sequence of the Qohandez pottery and relationships between fabrics, vessel shapes, and decoration. Period I (ca. 450-150 BC): Architecture is lacking so that archaeomagnetic dating data, fabric types, and pottery forms (the vast majority storage vessels) are reviewed. Period II (end of the 4th century AD to 785): Architecture first appears and the vessel forms include large storage and transport jars, jugs, cooking pots, and a preponderance of closed forms. Glazed wares initially appear. Period IIIa 2nd half of 8th century to early 11th century): TL data is employed and related to vessel forms including jars, jugs, and cooking pots; stamped decoration initially appears. The assemblage includes glazed wares (mostly monochrome bowls); opaque white wares; splash and sgraffiato wares; slip painted wares; buff wares; and other polychromes. Period IIIb (11th century to 1165 AD): Vessel forms proliferate and consist of jars, jugs, cooking pots, basins, bowls, lids, and dishes. The assemblage includes clayey glazed wares (mostly polychromes); monochrome wares; splash and sgraffiato wares; slip painted wares; buff wares; other polychromes; and fritwares (monochrome turquoise). There is also a useful comparative study with the main Khorasanian sites: Period II: Tureng Tepe, Gurgan Plain, Merv, Balkh (Sasanian levels), and Afrasiab. Period IIIa: Tureng Tepe, Gurgan Plain, Merv, Balkh (Period IV), Herat, and Tashkent Oasis. Period IIIb: Tureng Tepe (11th-14th centuries), Gurgan Plain, Merv, Balkh (pre-Mongol era), Herat, Afrasiab, Tashkent Oasis, Kultepa, Isfahan, and Rayy. In a "Conclusion" the authors summarize the chronological refinements, the periods and fabrics and associated vessel forms, and details the changes that occur in the status of Nishapur and its role in Khorasan. The "Bibliography" (pp. 207-212) provides a list of abbreviations employed and lists six Sources (one Latin and five Persian) and 157 Studies.

This splendid monograph helps to fill a significant gap in the analysis of Iranian ceramics and especially pottery manufacture in Nishapur in the pre-Mongol era. The narrative is clearly and logically presented and includes a great deal of significant data. The color illustrations of the shard specimens are superb and the microphotographs are clear and detailed. Alas, the color designation of the shards and thin sections do not employ the Munsell color notation system so the reader is left to infer colors such as beige orange, beige/buff, red pinkish, etc. from shard photos and photomicrographs. I wish that more had been said about the optical petrographic analysis and the equipment and procedures employed. Nonetheless, the volume is a valuable contribution to our understanding of pottery production in Iran.

Ceramics in Archaeology: From Prehistoric to Medieval times in Europe and the Mediterranean: Ancient Craftsmanship and Modern Laboratory Techniques, 2 vols. Ninina Cuomo di Caprio. Volume 2 of Manuali L'Erma Volume 203 of Studia archaeologica. Rome: L'Erma di Bretschneider, 2017. 664 pp., 260 b/w illustrations, 24 graphics, 23 tables, 68 text-boxes, and several indices. ISBN-13 9788891310125, ISBN-10 8891310123. Prices vary € 90.00-135.00 / $113.00, paperback.

The two-volume "manual" on pottery-making in antiquity under review here focuses on western and southern Europe and the Mediterranean seacoast. Ceramics and manufacturing techniques from other areas of the Old and New Worlds are not considered. European scholars will likely recognize that this publication is a revision, expansion, and English translation of previous Cuomo di Caprio books published only in Italian by 'L'Erma' di Bretschneider which has content that is now somewhat dated: *Ceramica in Archeologia, Antiche tecniche di lavorazione e moderni metodi d'indagine*, La fenice, Collana di scienze della'antichià, 365 pp. (1985) and *Ceramica in Archeologia, Antiche tecniche di lavorazione e moderni metodi d'indagine*, 2nd ed., Studia Archeologica 144, 752 pp. (2007). Both of these were designed to provide Italian university students with an introductory textbook on ceramic technology and laboratory procedures used in the archaeometric and physicochemical analyses of archaeological pottery. A majority of the content for these volumes was drawn from the author's own lectures at the University Venice in the early 1980s.

Part 1 concerned pottery technology (clay acquisition through kilns and firing) while Part 2 described "chemico-physical methods of laboratory analysis." Both parts contained brief lists of published materials intended to provide students with a basic bibliography for those who might undertake further studies; bibliographic citations within the text narrative and footnotes are nil. In addition to 42 figures, there were 18 inserts ("text-boxes") of one to five pages each that addressed technical issues, for example, the Periodic Table and Mohs scale. A unique feature are selected quotations from ancient Medieval, and Renaissance literary sources on ceramics, and Cuomo di Caprio's own comments. The expanded second edition (which is still in print at $113.00) contains a "Bibliografia abbreviate" and "Indice analitico."

The 2017 two-volume translated edition follows the format of the 2007 publication. "Part One: Ancient Craftsmanship" is on pottery technology and "Part Two: Modern Laboratory Techniques" provides a summary of the most widely used scientific techniques which can aid the archaeologist in understanding and interpretation of ancient ceramics. Volume I has a "Foreword" by late Professor David P. Peacock (University of Southampton, UK) who stated: "This manual on pottery-making in antiquity is a compendium of almost everything bearing on the interpretation of ancient ceramics in antiquity. Because of this, it is likely to remain a standard work for many years to come. Both the student and the more experienced researcher will benefit from this book and will find it easy to follow because of the lively presentation. The whole subject of ceramics is here, from clay acquisition to kilns and firing, backed with an extensive bibliography. It is a work of reference which should have a place on every archaeologist's bookshelf from their first day at University until retirement." The text contains useful inserts (68 numbered "text-boxes") with relevant topical information presented in appropriate locations throughout the narrative. Examples of the content are: Wentworth grain-size classification, clastic sedimentary rocks, Mohs scale, a brief history of mineralogy, "colour and color charts" (emphasizing the Munsell system), cooking ware, scale and mode of production, traditional wheel-throwing and firing, and heat transfer. As in his previous two books, the author includes literary writings and relevant poems related to pottery, such as "Keramos: the Hero of Ceramics."

Volume I begins with a "General Bibliography: Abbreviations for Journal Titles and Sourcebooks" (pp. 1-15) which contains 207 primary references (the most recent references date to 2010 and 2012). The citations for each of the 13 chapters in Volume I are grouped in the second volume (pp. 378-520) as clustered endnotes; this is nearly half of the pages in the second volume. Part One in the initial volume focuses on "Ancient Craftsmanship" (13 chapters). "1. Introducing Part One" (pp. 28-34, 1 text-box, 30 citations) provides a general essay on the transformation of clay to archaeological ceramics. "2. Clay" (pp. 36-45, 1 text-box, 21 citations), considers geological perspectives and differentiates primary and secondary clays. "3. Clay Minerals" (pp. 46-56, 3 text-boxes, 46 citations) identified crystallo-chemical properties, explains the clay-water system, identified the three primary groups of clay and minor groups. "4. Nonclay Minerals and Incidental Constituents" (pp. 58-81, 3text- boxes, 33 citations) documents temper, quartz, flux, high and low temperature feldspar, calcite, iron oxides and hydroxides, grog, and organic and inorganic additives. "5. Technological Properties of Clay and Pottery" (pp. 89-96, 2 text-boxes, 68 citations) reviews plasticity, shrinkage, and thermal and chemical properties. "6. Working the Clay" (98-108, 5 boxes, 58 citations) focuses rather briefly on clay sourcing, processing and refining, while "7. Forming "(pp. 116-172, 9 text- boxes, 197 citations) elaborates hand-building and subtypes, wheel-throwing and variants, molding, and experimental archaeology. "8. Drying" (174-188, 2 text-boxes, 21 citations) has a brief discussion on of the stages of drying and issues of warping and cracking. "9. Applying Coatings to Vessels before Firing" (pp. 190-202, 1 text-box, 46 citations) and concerns raw materials, coating and painting, and forms of application (dipping, brushing, wiping, sponging, splashing, and pouring). "10. Slip and Gloss" (pp. 204-257, 12 text-boxes, 311 citations) differentiates slip, matte finish, wash, black gloss, and sigillata red slip. "11. Glazing and New Technologies in Medieval Times" (pp. 258-295, 8 text-boxes, 161 citations) is a well-documented essay on raw materials, lead glazes, multiple firing techniques, and maiolica. "12. Decorating Vessels before Firing in antiquity" (pp. 296-323, 5 text- boxes, 112 citations) reviews decoration by excision or compression (incising, cutting, and stamping), and by addition (barbotine, sand, applique, and mold-made relief); painting (geometric and figure painting and polychrome) – the section on painting could be elaborated. "13. Firing" (pp. 324-382, 9 text-boxes, 237 citations) details fuels, direct flame firing, firing structures, open firing, clamps for bricks, pit firing, updraft kilns types (and examples), stacking procedures, and kiln operations. The illustrations of kiln types are especially useful. The last part of the first volume includes "The Poem of Homer on the Kiln".

Part Two (Volume II) begins with "References: A Pocket Library for Instant Use" (pp. 378-520) with *annotated references* (more like footnotes) for the 13 chapters in Volume I and Part One as well as for each of the text-boxes. This volume has seven chapters (14-20) that provide summaries of the most widely used scientific techniques which could aid the archaeologist in understanding and interpreting ancient ceramics. Part Two: "Modern Laboratory Techniques" includes the "Periodic Table of elements (Table 19, p. 524) and "Chemical elements: elements listed in alphabetical order" (Table 20, p. 525). "14. Introducing Part Two: Archaeological ceramics in the laboratory" (pp. 527-538, 28 references /readings, 3 graphics [20-22]) focuses on three basic questions of *how* the ceramic was made (mineralogical composition and working practices: forming, costing, and firing); *when* it was made (TL) and *where* it was made (mineralogical and physicochemical characterization). Topics considered are clay selection and refining, sampling limits and ways for obtaining specimens, issues relating to artifact damage, sample reusability, and time

required. Readings emphasize mineralogical, chemical, and analytical analyses; 13 physicochemical methods and three characterization methods are introduced which are elaborated in the subsequent chapters. "15. OM, Optical Mineralogy for Mineralogical Characterization" (pp. 540-551, 5 readings, text-box #63) reviews the use of a magnifying glass, stereomicroscopy, and polarized light microscopy (PLM). Point counting and digital imaging are covered very briefly and comparison charts are illustrated. The text-box documents heavy mineral analysis. "16. Thermal Techniques" (pp. 533-557, 3 readings, text box #64) concerns the analyses of clays and ancient ceramics using DTA and TGA while the text-box elaborates TMA analysis measuring thermal expansion. "17. Physicochemical Techniques" (pp 559-590, text-box #65) covers a variety of methods. Text-box #65 covers the "Traditional Chemical Analyses": Volumetric analysis by titration, colorimetric analysis, and gravimetric analysis (wet and dry methods). Thirteen physicochemical methods are described (each in a page or two accompanied by line drawing schematics and images illustrating the processes). Every entry has a summary that includes nine variables: archaeological issues, damage of the object, sample, focus of the analysis, properties determined, level of output, approximate cost, and time required for the sample preparation and the output of results.

"18. Characterization Techniques" (pp. 591-597, 8 references, text-box). Text-box # 68, "Relevant New Analyses" describes briefly NMR, TOF-ND, XAS, XANES, and OSL – some are not quite "new" -- while the remainder of the chapter emphasizes X-Ray Radiography (p. 592), Porosimetry (p. 593), and TL Dating (pp. 594-597). "19. Data Handling and Statistical Processing' (pp. 599-601, 10 references) describes Cluster Analysis, Principal Components Analysis, and Discriminant Analysis. There is a final section on the history of the atom 1897-1926 (p. 601). "20. The Decade 2001-2010: a ten-year trend in the application of analytical techniques to archaeological ceramics" (pp. 602-607) reviews trends in analytical techniques and their frequencies of use during the decade, demonstrating changing incidences of the use of specific techniques. Data for this exercise came from articles in two major journals published 2001-2010: *Archaeometry* 55 articles and *Journal of Archaeological Science* 40 articles. The 95 articles are listed (pp. 609-617) and the accompanying graphics illustrate the ebb and flow for methods as older ones are replaced by newer techniques. Lastly, there is s "Glossary of Scientific Instrumentation" (pp. 618-622) and an annotated appendix of "Literary Sources from Classical to Renaissance Times" pp. 624-637) as well as acknowledgments and sources of the illustrations, and an "Index" (pp. 653-664).

The author initially designed the as introductory Italian language textbooks or handbooks for Italian university students and the content derives primarily from a series of lectures given by Cuomo di Caprio at the University of Vienna 1981-1983. The English-language editions reviewed here have been rendered carefully into English and checked by a number of native English speakers (the author names and thanks them). The contents of Volume I is only slightly updated and slightly expanded and basically the same as the 2007 volume in organization and format. The most updated citations date to 2010 and 2012 so that the numerous references to Prudence Rice's *Pottery Analysis: A Sourcebook* are from her 1985 edition rather than the newer 2015 publication; see my review in *SAS* Bulletin 38(3):3-7 (Fall 2015). Likewise, there are no references to current reports or thinking as seen in primary sources such as *Archaeometry* and the *Journal of Archaeological Sciences*, and nothing from *The Encyclopedia of Global Archaeology*, 52 articles on ceramics (2014 and a newer online edition being assembled in 2017) *SAS Bulletin* 37(2):4-6 (Summer 2014) or the *Encyclopedia of Geoarchaeology* (2017).

The organization of Cuomo di Caprio's handbooks is unusual, beginning with a basic bibliography (I: pp. 1-15) and the very useful and informative "References: A Pocket Library for Instant Use" (II: pp. 378-520) with 1,314 annotated citations (1,021 for the text and 320 for the "Boxes) in the second volume. However, this arrangement makes a rapid consultation of references rather difficult. The scattered "text-boxes" are a useful adjunct to the narratives but vary in length from one or two sentences to five pages, and may hinder the reader's concentration on the basic chapter text narratives. Volume II (Part 2) has been extensively modified based on a comparison with the 2007 edition and incorporates materials through 2011. Content from the articles cited in Volume II from *Archaeometry* and *Journal of Archaeological Science* (pp. 609-617) on trends and frequencies in laboratory techniques are not incorporated into the content of Volume I. The 13 physicochemical methods and three characterization methods (X-Ray Radiography, Porosimetry, and TL Dating) are appropriately explained but NMR, TOF-ND, XAS, XANES, and OSL could have been elaborated. Readers could supplement this by consulting recently posted articles in the second edition of *The Encyclopedia of Global Archaeology* and forthcoming. *The SAS Encyclopedia of Archaeological Sciences*. Cuomo di Caprio emphasizes ceramic s made in Europe and the Mediterranean region to the detriment of other parts of the Old World and all of the New World. While a valuable resource, *Ceramics in Archaeology: From Prehistoric to Medieval times in Europe and the Mediterranean: Ancient Craftsmanship and Modern*

Laboratory Techniques, 2 vols., portions from Volume I may be enhanced with material in *An Introduction to Archaeological Chemistry* by T. Douglas Price and James H. Burton (New York: Springer, 2011) and Prudence Rice's *Pottery Analysis: A Sourcebook*, 2nd ed., 2015; see *SAS Bulletin* 34(1):2-4 (Winter 2011) and 38(3):3-7 (Fall 2015).

Materiality, Techniques and Society in Pottery Production: The Technological Study of Archaeological Ceramics through Paste Analysis, by Daniel Albero Santacreu, Warsaw and Berlin: De Gruyter, Open Ltd., part of Walter de Gruyter GmbH, Berlin/Munich/Boston, 2014. 336 pp., 37 figures, references, index. Available in three formats: ISBN 978-3-11-041020-4, eBook (pdf), Open Access; ISBN 978-3-11-042729-5, eBook (EPUB), Open Access; ISBN 978-3-11-041019-8, hardcover € [D] 119.95 / US$ 168.00 / GBP 108.99. Open access versions are available online at three locations: http://www.degruyter.com/view/product/449658, https://www.academia.edu/9623351/Materiality_Techniques_and_Society_in_Pottery_Production, https://www.researchgate.net/publication/269038064_Materiality_Techniques_and_Society_in_the_Pottery_Production_The_Technological_Study_of_Archaeological_Ceramics_Through_Paste_Analysis.

Your reviewer was a bit surprised that this volume, published in December 2014, has apparently not yet been reviewed in the archaeological literature. This may be because the work could be considered a textbook rather than a monographic ceramic study.

The book is divided into three sections with a total of 14 chapters plus "Frontmatter" (pp. i-v), a "Preface" (pp. vi-vii), and "Contents" (pp. ix-xi), as well as 632 "References" (pp. 282-313), a "List of Figures" (pp. 314-316) n=37 with their captions, and a double-column "Index" (pp. 317-324) of topics – and a handful of proper nouns. In the "Preface," Albero states that the primary purpose of his book is to provide "a broad overview of the chief methods that can be followed in the study of ceramic technology and paste analysis." His ultimate goal is to" encourage the reader's reflection, especially of those scholars who first face the analysis of the ceramic record." The objective is to provide them with a basic basis from which they can start to develop their own research as well as their particular concerns and interests this book aims generally to introduce the different types of paste analyses that can be developed in archaeology as well as some of the methods usually applied to the study of ceramics. The type of information that these methods provide and the different enquiries that pottery analysis deals with today are also addressed. [sic.] The notes that archaeometric methods and techniques applied to the study of ceramic fabrics have greatly advanced in recent decades and allow us to approach materiality much more accurately than ever before. There has been also an intense theoretical reflection on ceramic technology, especially from social theory. "This reflection has transformed the epistemological foundations of our discipline and researchers cannot ignore it" (p. vii).

In the first section the author focuses on some practical issues "that have to be taken into account" when initiating the study of archaeological ceramics. These issues range from designing an effective sampling strategy that fits a series of previous questions to the various methodologies that allow the obtainment of large datasets**.** The primary analytical techniques, procedures, and methods applied in the study of ceramic materials, including a brief section centered on some new methods as well as others whose application is not widespread.There is also reflection regarding the nature of the data obtained and how these relate to the life cycle of pottery vessels.

Part I: Materiality, Archaeometry & Analythical [sic.] Methods (four chapters). "1: Introduction: Ceramic Archaeometry and Paste Analysis" (pp. 2-4). The opening sentence reads: "Paste analysis is essential in the study of archaeological ceramics" (p. 2) – one cannot argue about this. Albero goes on to state that "archaeometric studies of pastes and fabrics are fundamental to the classification and characterization of pottery, providing relevant data, among other aspects, about its production, function and social meaning." Studies focused on archaeological ceramics have been substantially enriched by the implementation of chemical, physical and mineralogical analyses. This improvement has enabled us to transcend the analytical scales and the information that used to be obtained by less sophisticated macroscopic methods or the typological classification of the vessels. This book focuses on the study of pottery production and most of the issues that it entails basically through the archaeometric analysis of ceramic pastes and fabrics. The archaeometric characterization of fabrics mainly focuses on defining the petrological, mineralogical, chemical and textural composition of the vessels. "2: Sampling Strategies" (pp. 5-10) includes a discussion of limitations in the strategy and sampling for archaeometry.

The subsequent chapter "3: Analytical Methods" (pp. 11-44, 5 figures) begins with macroscopic approaches in ceramic studies, followed by sections on textural, petrographic, mineralogical, chemical, and micropaleontological analyses. Topics in *textural analysis* include grain size distribution, granulometric analysis,

notably Laser Diffraction Particle Size Analysis (LS-PSA) that is applied following different procedures (e.g., the Coulter method). LS-PSA permits researchers to characterize and quantify the finest fraction of the sediments (fractions less than 4 μm in diameter point counting study can be systematically performed using digital image analysis coupled with an image processing sensor, and specialized software. Albero notes that data obtained from textural analysis may be qualitative, quantitative, or semiquantitative; there are no standardized procedures regarding which measurement units and parameters apply in textural approaches. *Mineralogical analysis* can utilize XRPD to define mineralogical phases: primary (before firing), neo-formed (crystalline), and secondary (amorphous). *Petrographic analysis* is used to determine petrofabrics by means of a petrographic microscope using polarized transmitted light which incorporates a polarizer filter, a removable polarizer filter called the analyzer and a rotating stage. Particle distribution and sorting and archaeological applications are reviewed. A section on *chemical analysis* focuses on standard procedures including Instrumental Neutron Activation Analysis (INAA), X-Ray Fluorescence (XRF) and, Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Other techniques such as X-ray Emission Induced by Protons (PIXE) or Scanning Electron Microscopy combined with Energy Dispersive X-ray Spectroscopy (SEM-EDX/EDS) are noted in passing. The provenience postulate and determination of reference groups are also covered.

Point chemical analysis (SEM-EDS, SEM-EDX, and BSE) are evaluated as are the analysis of microstructures and *micropaleontological studies*, and are Raman, Infrared and Mössbauer spectroscopy. Statistical analysis focuses on Principal Component Analysis (PCA) and Hierarchical Cluster Analysis which are, by far the multivariate methods most commonly used in paste studies. Albero cites mostly the work of European authors: Buxeda, Calvo, Freestone, Gibson, Heron, Kilikoglou, Maggetti, Mommsen, Orton, Quinn, Pollard, Tite, Tsantini, and Whitbread; and a few non-Europeans: Dean Arnold, Bishop, and Neff. A more comprehensive discussion on "Provenance Studies in Archaeology" [Ceramics, Lithics/Stone, Metals, Glass, and Textiles] written by Charles C. Kolb appears in *Encyclopedia of Global Archaeology*, 2nd ed. (Claire Smith, ed.-in-chief); New York: Springer, 2018. Online version. 17 January 2018. 11 pp. DOI: https://doi.org/10.1007/978-3-319-51726-1_327-2 [This is a revised and updated version of the same article published in the first edition, 2014: pp. 6172-6181.] "4: Analytical Data and the Life Cycle of Ceramics" (pp. 45-48) follows the writings of Schiffer and Tite, among others, and covers contextual topics such as systemic, archaeological, and heritage management contexts.

Part II: Materials, Techniques & Chaînes Opératoires (ten chapters) (pp. 49-51). The second section focuses on ways in which ceramic features can be related to the use of certain materials, techniques and *chaîne opératoires*. Key concepts – such as technology, technique or technological choice – are introduced, placing greater emphasis on the concept of *chaîne opératoire* and its relevance for the analysis of archaeological ceramics. Hence, a detailed analysis of the multiple phases that define the pottery production process is included. The roles of experimental archaeology and ethnoarchaeology in the study of the physical (i.e., material) and social dimension of the techniques used in pottery production are discussed at the end of this section.

"5: Techniques, *Chaîne Opératoire and Technology*" (pp. 52-59). The author focuses on concept of technological choices (Lemonnier 1986) as a prelude to essays on *chaîne opératoire* which he traces to studies of pottery technology from the 1970s, with significant contributions, among others, from the school of Techniques et Culture of the French CNRS (Balfet 1965) and Department of Pottery Technology of the University of Leiden (Van As 1984) and work by Gosselain, Livingstone Smith, and Roux. He does not mention that the concept was initially used in the study of lithic technology decades earlier. Albert does state that the *chaîne opératoire* is the "preferred method" for approaching many aspects such as the organization of pottery production, technological change, knowledge transmission and the properties of end products. In addition, Albero writes about concepts of technology and phases of the pottery *chaîne opératoire*: 1. Clay selection and extraction; 2. Paste preparation; 3. Modelling; 4. Drying; 5. Surface treatment; and 6. Firing. Lastly, he notes that there are many handbooks (e.g., Cuomo di Caprio 1985; Gibson and Woods 1990; Morales 2005; Orton *et al*., 1993; Rice 1987 [the second edition, 2015, was published after Albero's book was issued]; Rye 1981; Shepard 1971; Sinopoli 1991; and Velde and Druc 1999) that provide a comprehensive approach to the phases of the *chaîne opératoire* in pottery production. *Archaeological Ceramic Materials: Origin and Utilization* by Bruce Velde and Isabelle C. Druc; Berlin, Heidelberg, and New York: Springer, Natural Science in Archaeology Series, 1999) was reviewed in *SAS Bulletin* 23(1):17-21 (Spring 2000).

In Chapters 6-11, Albero cites New and Old World geographical examples and authors' reports. The content of these essays is similar to most standard handbooks except the more detailed volume by Prudence Rice: *Pottery Analysis: A Sourcebook*, 2nd ed. (Chicago:

University of Chicago Press, 2015), reviewed in *SAS Bulletin* 38(3):3-7 (Fall 2015). "6: Clay Selection and Procurement" (pp. 60-64, 3 figures); "7: Clay Extraction" (pp. 65-66): "8: Paste Preparation" (pp. 67-76, 5 figures) including clay purification, temper addition, and clay mixing; "9: Forming Methods" (pp. 77-79, 1 figure); "10: Drying Process" (pp. 80-81); and "11 Surface Treatments (pp. 82-86, 3 figures) including only painting and application of slips. In Chapter "12: Firing Process" (pp. 87-108, 8 figures) the author provides a very fine discussion of the technical and physicochemical complexity involved in the firing process. Experimental re-firings and the use of XRPD diffractometers equipped with a high-temperature chamber or thermal analysis (e.g., Differential Thermal Analysis-DTA, Thermogravimetric Analysis-TGA, Differential Scanning Calorimetry DSC, Dilatometry-DIL) are noted. These methods seek to record changes in specific types of clays or pastes. Changes in the clay matrix during the firing process may be studied by SEM-ESED while thermometric changes in calcareous pastes can be assessed using DTA-TGA. Other topics of analysis include calcite temper and coarse particle size, organic matter in pastes, and non-calcareous pastes such as quartz. The discussion of firing atmospheres reports on 13 variants of oxidation-reduction; likewise, the results from closed versus open firings of pottery vessels are differentiated.

In "13: Raw Materials, Techniques and Sequences: Fabrics" (pp. 109-111, 1 figure), Albero discusses the difference between paste and fabric by examining the actions performed by the potter along the *chaîne opératoire*, and in "14: The Role of Ethnoarchaeology and Experimental Archaeology in the Study of Ceramics" (pp. 112-122) he reviews topics such as ethnoarchaeology as related to ethnoarchaeometry and ceramic technology as a point of departure for theoretical issues in ethnography and processual archaeology, experimentation in archaeology. He rightly comments that criticisms made to experimental approaches "lie in the fact that most research exclusively undertakes functional, materialistic or technical explanations of the results obtained. They rarely refer to other aspects of the artefacts that are also important to properly understand other dimensions of their use, such as the symbolic or social spheres" (p. 121).

Part III: The Social Context: Ceramic Technology, Archaeometry & Theoretical Trends (eight chapters). This third section provides a summary of the main theoretical trends usually applied in the current interpretation of the techniques and materials identified through paste analysis. Albero focuses on the way the diverse ecological, functional and anthropological perspectives interpret ceramic technology in ancient societies. For each of these, he examines their foundations and basic concepts and provides a constructive assessment of what he views as their possibilities and limitations in the study of pottery technology. Hence, the role of the environment, the economic background, or the function of artefacts regarding pottery production, and other important phenomena such as learning processes, knowledge transmission systems, and issues connected to the social organization of the potters are examined.

"15: Analytical Levels and Scopes in Ceramic Archaeometry" (pp. 124-126). This phase of the investigation process is essentially descriptive and the researchers analyze and describe shapes, types, fabrics, pastes, chemical and mineralogical features, petrofabrics, textures, etc. Studies of the similarities, differences, and variants in the ceramic assemblage allow for classification and categorization and that data are interpreted through theoretical frameworks. A precise and accurate characterization of the pastes and fabrics helps to identify the materials and techniques used in its production, and to interpret these technical actions within a society. "16: Ceramic Technology and Theoretical Perspectives" (pp. 127-128). Subsequent chapters focus on the three main theories currently applied in the interpretation of ceramic technology through data obtained from the archaeometric analysis of pottery fabrics: ceramic ecology, functionalism and the social theory of technology.

"17: Ceramic Ecology" (pp. 129-145). Most of the processual studies related to systems theory and focused on archaeological ceramics can be broadly included in a theoretical trend known as Ceramic Ecology (Matson 1965). Albero discusses the provenance of raw materials, settlement and subsistence bases, and the scope and goals of ceramic ecology followed by a critique of the theory in which he states that "the environment is deterministic" (p. 143) – this is incorrect. Among those who have employed and expanded the method and theory are Dean Arnold, Philip Arnold, Charles C. Kolb and Prudence M. Rice. Fifteen of Dean Arnold's publications are cited. A rebuttal to Albero's contentions may be found in "Ceramic Ecology" by Charles C. Kolb in *Encyclopedia of Global Archaeology*, 2nd ed. (Claire Smith, ed.-in-chief); New York: Springer, 2018. Online version 21 January 2018. DOI: https://doi.org/10.1007/978-3-319-51726-1_3228-1.

"18: Functionalist Approach" (pp. 146-193, 5 figures). Two key aspects characterize vessel life: the function they perform, which refers to the previous purposes of the potter, and their daily use. Albero discusses science-based approaches to thermal shock resistance (thermal expansion, non-plastic components in pastes and fabrics, porosity, firing temperature, thermal conductivity,

abrasion resistance, impact resistance, cooling effectiveness, and vessel weights ("lightness") related to transport. He also reviews clay procurement, the addition of temper, modelling, drying, and firing from a functionalist perspective using *chaîne opératoire*. In addition, he has included an essay about functionalism and ceramic building materials looking at the manufacturing process and form and function prior to a critique of science-based material approaches and limitations of the functionalist approach to ceramic studies. "19: Social Theory of Technology: (pp. 194-244, 3 figures). Albero discusses *habitus* and agency as related to the life cycle of ceramics, pottery meaning and concepts of information, social distance, social interaction and the transfer of knowledge or learning (masters and apprentices), gender identity, intra-technology relationships, pottery properties (durability and social visualization) and contexts of use, the social role of raw materials, social and symbolic issues, taskscapes, and paste recipes and technological traditions.

"20: The Organisation of Pottery Production" (pp. 245-261, 1 figure.) Part of Albero's essay is based on the work of Dean Arnold and Ron Bishop. Five strategies of clay procurement are reviewed as are production patterns, specializations in pottery production, levels of variability in production, standardization, and potter's skills as a part of the social organization of ceramic production.

"21: Change and Stability in Pottery Production" (pp. 262-278, 1 figure). Albero notes that pottery is physically very sensitive to change due to its plastic and additive nature, but the dynamics of these changes and their intensity are not well-known Ceramic ethnoarchaeology and ethnography have demonstrated that both the potters and their products can be very conservative and reluctant to change, even in social environments where there is severe acculturation. He focuses on ceramic change in processual archaeology, characterizing modifications due to external contacts, changes in subsistence strategies, distances between producers and end users, changes in population number or density (vessel sizes), and environmental factors. In addition, he examines agency and change in ceramic technology *habitus* and information transition, and changes in pottery variability (both in utilitarian and ritual ceramic production). Lastly, in "Final Reflections" (pp. 279-281), the author states that: "Once the ceramic assemblages are characterized, it is possible to generate explanations regarding the way pottery production is socially organised and how ceramic technology interacts with the other technologies and social dynamics recorded through the analysis of other kinds of artefacts. This involves an inductive and deductive process that allows investigating how particular phenomena observed in the pottery are connected through time and space with diverse social dynamics and other kinds of structural phenomena" (p. 280). The application of multiple theoretical frameworks and viewpoints, among which we should include ethnoarchaeology and experimental archaeology, is crucial in order to carry out a more detailed interpretation of material culture and its complex relations to social structure.

In *Materiality, Techniques and Society in Pottery Production: The Technological Study of Archaeological Ceramics through Paste Analysis* Albero provides a valuable but limited discussion of ceramic production focusing on one key of ceramic fabrication -- paste analysis – to the exclusion of other components. These include as methods of fabrication in forming ceramic vessels, surface treatments and the decoration of pottery, and the complex issues of firing ceramic materials. Little is said about forming techniques such as coiling, slab-building, the use of molds, and variants of wheel-turned pottery. Likewise, except for slipping, not much is said about is said about polishing and burnishing and especially painting and the application of glazes or pre- and post-fire surface modifications such incision, punctuation, rouletting, applique, etc. Methods of open firing and the array of kiln types are not considered. In terms of physicochemical and other analytical methods, Albero provides cursory coverage of some of the more commonly used methods but does not provide a comprehensive assessment: see Prudence Rice's *Pottery Analysis: A Sourcebook*, 2nd ed. (Chicago: University of Chicago Press, 2015; *SAS Bulletin* 38(3):3-7, Fall 2015) and Alice M. W. Hunt's edited *Oxford Handbook of Archaeological Ceramic Analysis* (Oxford Handbooks. Oxford: Oxford University Press, 2017). *SAS* Bulletin 40(3):5-9, Fall 2017), and Kolb's "Provenance Studies in Archaeology" in In *Encyclopedia of Global Archaeology*, 2nd ed. (Claire Smith, ed.-in-chief; New York: Springer, 2018. Online version, DOI: https://doi.org/10.1007/978-3-319-51726-1_327-2) provide more details. Albero's coverage is better than Walter Noll and Robert B. Heimann's geographically limited *Ancient Old World Pottery: Materials Technology, and Decoration* (Stuttgart, Germany: Schweizerbart / Borntrager Science Publishers, 2016, *SAS Bulletin* 41(1):[in press], and Ninina Cuomo di Caprio's *Ceramics in Archaeology: From Prehistoric to Medieval times in Europe and the Mediterranean: Ancient Craftsmanship and Modern Laboratory Techniques*, 2 vols. (Rome: L'Erma di Bretschneider, 2017, *SAS Bulletin* 41(2): [in press].

The first two parts of Albero's volume (pp. 1-122) employ examples primarily from his own research in the Western Mediterranean and Northeast Ghana, whereas those from the third section (pp. 124-281) dealing with technology,

archaeometry, and theoretical trends provide more diverse global examples. A few minor typographical errors escaped proofreaders: Analythical (p. 1) = Analytical, Aronold (p. 283) = Arnold, Dean, and Sheppard, A. (p. 2, 307) = Shepard, Anna (those who knew her realize that she would be rather annoyed by this blunder).

Mobility and Pottery Production: Archaeological and Anthropological Perspectives, edited by Caroline Heitz and Regine Stapfer, Leiden: Slidestone Press, 2017. 320 pp., figures, footnotes, references. ISBN 978-90-8890-460-8 (paperback) €39.95 / $60.00 + free PDF, ISBN 978-90-8890-461-5 (hardcover) €120.00 /$180.00 + free PDF, ISBN 978-90-8890-46 (PDF e-book) €9.95.
Read online for free:
https://www.academia.edu/33374330/2017_Mobility_and_Pottery_Production_Archaeological_and_Anthropological_Perspectives.

This important and thought-provoking volume resulted from an interdisciplinary workshop, "Mobilities and pottery productions: archaeological and anthropological perspectives," held at the Institute of Archaeological Sciences (University of Bern) in 2015, and funded by the Swiss National Science Foundation (SNSF). The volume contains a "Foreword" by Albert Hafner, three sections with a total of 12 chapters, and an "Afterword" by Philipp Stockhammer. Each chapter has its own set of references and information on the authors' affiliations as well as mail and email addresses. There is no list of illustrations or figures and no index. This is essentially a Continental "Eurocentric" volume with citations to the work of some UK authors; notably, there are few citations to any American-authored literature (and none to Dean Arnold, Ron Bishop, Alice Hunt, Hector Neff, Mary Ownby, and Prudence Rice, among others) and one to Mike Glasscock. Petrographic analysis is mentioned in two papers, one contribution employs a now common archaeometric tool: pXRF), and another (Albero) employs a variety of archaeometric methods.

The goal of the workshop was not to promote a single epistemic approach or any elaborated empirical findings but to stimulate thoughts and foster further discussions. In this regard, it is a very successful publication. The first part of the book (three chapters) contains introductory texts, which explore the relationship between anthropology and archaeology and their different takes on 'culture', 'mobility' and 'things' throughout their research histories' paradigmatic shifts. There is much material on the history of anthropological and archaeological theory related to material culture, the production of ceramics, and 'mobility' related to the distribution of finished products rather than the procurement of raw materials (clay and temper). These three chapters focus on the history of theories of culture and mobility up to the present (Heitz and Stapfer) prehistoric archaeology and material culture (Hafner), and material culture and mobility (Van Oyen). The contributions would be useful for classes on archaeological method and theory.

The second part (five chapters) includes archaeological contributions that address mobility and social ties by focusing on variability in pottery production within, as well as between, settlements and regions. The authors take a more object-centered perspective, and focus on attempts to think beyond established concepts of archaeological cultures and chronological issues. The third part (four chapters and an "Afterword") is comprised of anthropological and archaeological texts that take actor-centered perspectives involving making, distributing, and using pottery. These authors examine how humans and things are intertwined though practices and various rhythms of movement and mobility. Therefore, cultural forms are reproduced but also transformed by humans and things, such as pots, potters, pottery sellers/distributors, and pottery users that are intermittently mobile. The "Foreword" is by Albert Hafner (pp. 7-8), University of Bern, Institute of Archaeological Sciences, a mentor to several of the contributors. He comments that mobility and migration are amongst the most important sociopolitical topics of our time and that the workshop presentations combined the topics of prehistoric archaeology with perspectives of cultural and social anthropological research which were "once sister disciplines that have since unfortunately grown apart."

Part 1. "Changing perspectives, changing insights" (3 chapters), 'Mobility and pottery production', what for? Introductory remarks" by Caroline Heitz and Regine Stapfer (pp. 11-38, 104 references). This narrative establishes the framework for the presentations. The editors discuss the current shortcomings of pottery studies and spatial mobility – moving from place to place – which has experienced a noticeable upturn as a field of research in recent years. They provide background to 2015 workshop and four objectives of the published volume https://www.academia.edu/12438368/2015_International_Workshop_Mobilities_and_Pottery_Production_Archaeological_and_Anthropological_Perspectives. In addition, they review the history of concepts of culture (Tylor, Frobenius, Childe, and Boas), the cultural-historical approach (Malinowski, Radcliffe-Brown, Leroi-Gourhan, Bourdieu, Giddens, and Robb), and recent thoughts on mobility from "migration" to "movement" and "mobilities' (Leary, Salazar, Oka and Kusimba, Kopytoff, Schier and E. Kaiser) as well as the material turn from

"material culture" to "materiality" and the "agency of things" (Hicks, Hahn, Knappett, Latour, and Stockhammer). Lastly, they summarize the content of the book.

"Prehistoric archaeology, anthropology and material culture studies: aspects of their origins and common roots" by Albert Hafner (pp. 39-51, 1 figure, 46 references, 3 Internet links). Hafner reviews in depth the aspects of the origins and common roots of prehistoric archaeology, anthropology and material culture studies, then focuses on concepts from prehistoric archaeology (Keller, Ankermann, Graebner, Schmidt, Childe, Malinowski, Radcliffe-Brown, and Mead) and materiality and prehistoric cultures (Schwab and Kissinna -- predating Childe). He also considers anthropology and early prehistoric archaeology (Virchow and de Morillet) and material culture studies (Rorty, Levi-Strauss, Geertz, Hodder, Willey and Rowlands, and Knappett). The third essay "Material culture and mobility: A brief history of archaeological thought" by Astrid Van Oyen (pp. 53-65, 2 figures, 45 reference) examines in greater detail how 'material culture and mobility' has been addressed in the history of archaeological thought' by alluding to examples from her research in the field of Roman archaeology (mostly *terra sigillata*) concluding that, thanks to the "material turn," the mobility of humans and things can be addressed in a new way. She argues that paying attention to the shifting perspectives on material culture is critical in understanding the role that mobility can play in archaeological narratives. Finally, the article proposes that recent refinements of the material turn may open important new avenues for studying the movement in time and space of objects, knowledge, and people. Summaries of diffusionism and the culture-historical model (Haverfield and Sørensen), the post-processual model or "mobility muddied" (Binford, Trigger, Hodder, Eckardt, Appadurai, Kopytoff, Brughmans *et al*., Miyazaki, and Knappett), and mobility after the material turn (Ihde, Ingold, D. Miller, and Knappett) are presented.

Part 2. "Object-centered perspectives: From 'cultures' and chronology to relations and mobility" (five chapters). "The Munzingen culture in the southern Upper Rhine Plain (3950–3600 BC)" by Loïc Jammet-Reynal (pp. 69-88, 9 figures, 40 references) provides an example of how Neolithic pottery served as a chronological tool in central European archaeology by demonstrating how two typo-chronologically separated groups of the so-called Munzingen pottery were actually two different practices of making and using pottery. The author provides a geographical and chronological framework, the present state of research, background on the Upper Rhine Valley (4300-3600 BC) and Munzingen A in Upper Alsace (southern area) and its relations to adjacent regions, and Munzingen B-style formation from Michelsberg in Lower Alsace (northern area). MZ A-style arises out of a cultural background only lightly connected with the Michelsberg. In the far south, relations with the Cortaillod pottery of the Swiss Plateau have been repeatedly highlighted but new overviews of the Upper Rhine sequence have been undertaken and published in local journals but have frequently remained unnoticed. Likewise, there are possible relations to other pottery styles in neighboring regions, especially the Swiss Plateau. Taking a spatially and temporally broad overview, the culture-historical approach allows the author trace influences between neighboring stylistic groups and the resulting long-term transformations that lead to new regional pottery styles – all ultimately referable to the mobility and encounters of people.

The next chapter, "From typo-chronology to inter- and intra-site variety: the 'Michelsberg' pottery of South Germany (4300–3600 BC)" by Ute Seidel (pp. 89-114, 10 figures, 51 references), assesses the method behind the typo-chronological system that has dominated studies on the Neolithic Michelsberg pottery for decades. By shifting the perspective from typo-chronology to inter- and intra-site variety she shows how the 'Michelsberg' pottery of South Germany (4300-3600 BC) cannot be perceived as an indication of a homogeneous cultural or even social entity any longer. Seidel reveals a complex picture of multidirectional ties based on pottery features, which might indicate intertwined economic, social and cultural practices reaching beyond settlements and regions. The typology of Michelsberg ceramics (classical version by J. Lüning 1967); basic shapes, types and variations, chronological systems, and refinements of that typology (essayistic mode) are reviewed. The shifting percentages of the respective pot types in the repertoire through time, as well as the changing proportions of ceramic profiles, could be traced back to a probable change of economic behaviors and a change of function of special ceramic shapes like the "Tulpenbecher (tulip beakers)." Attempts at interpretation demonstrate a need for future studies.

"Social dynamics and mobility: Discussing 'households' in Linear Pottery Culture research (6 ML BC)" by Isabel Hohle (pp. 115-140, 6figures, 71 references) details another presupposition of stability, homogeneity, and congruence that underlay many notions of past societies, the basic equation: one house = one household = one family = one kinship. Six basic assumptions and foci in most LBK research have been rarely questioned prior to this research. She examined the pottery of the LBK settlement of Schkeuditz-Altscherbitz in northwest Saxony (DE), which was *completely excavated* along with

corresponding graves, dated by dendrochronology, and provided a corpus of nearly complete pots. In addition, the author studied ceramic and chronological data from ca. 10,000 LBK houses in order to demonstrate that the settlement structure, social organization and therefore pottery practices were entangled beyond the formerly alleged spatial and social boundaries of the "one house represents one family" paradigm. "Households" as well as settlement structure and social organization, likely were complex, dynamic and, unsteady. The attempt to deconstruct models that are informed by underlying notions of stability, homogeneity and correspondence – as between houses, households and families – is taken here as a first step to open the path for investigating more dynamic phenomena: e.g. intra-site activities, or supra-regional networks that might have existed in those societies and which were linked to different forms of spatial mobility.

"Special pottery in 'Cortaillod' settlements of Neolithic western Switzerland (3900–3500 BC)" by Regine Stapfer (pp. 141-167, 11 figures, 48 references). "Special" or "foreign" pottery, which stylistically stands out from the predominant local / regional pottery style, was discovered in many lakeside settlements of western Switzerland. Six settlements of Concise are situated on the northern shore of Lake Neuchâtel and were excavated between 1995 and 2000; these are stratigraphically separated and absolutely-dated by dendrochronology. The author examines the phenomena of migrations and triggered mixtures in pottery styles, especially the phenomenon of NMB pottery in so-called "Cortaillod" settlements challenging notions of homogenous cultural entities from an empirical perspective. By studying different aspects of these vessels, such as shape and raw material used, e.g. temper, it is possible to detect a variety of different phenomena related to entanglements and mobility between different societies. The aim of this article is to provide insights into the everyday life and entanglements of the settlements' societies in western Switzerland. Difficulties in the interpretation of pottery as indications of such cultural phenomena are addressed. Central for these reflections are the Neolithic settlements of Concise, which show a unique situation in comparison to others in western Switzerland. The distribution and proportions of NMB pottery style and an examination of the raw material using pXRF suggest that two pottery traditions were combined, producing a new one. She concludes that entanglements with different regions versus 'waves of newcomers' provide evidence that the idea of homogenous "pottery cultures" suggested by previous research is increasingly unlikely.

"Cultural and chronological attribution of pottery on the move: from rigid time-space schemata towards flexible microarchaeological 'messworks'" by Eda Gross (pp.169-186, 5 figures, 41 references, 1 Internet source). Gross examines the history of Neolithic research and reveals the conceptual relationship between Neolithic cultures and time-space schemata. Four empirical examples are reviewed to unmask shortcomings of this former research practice and illustrate how persistently traditional time-space schemata influence the specific Neolithic topics. She is convinced that rigid space-time models are typological relics from a time when the storing, mapping, and publishing of big data were still a technical problem or too expensive. As these models had to be easy to produce and understand, they tended to be simplistic and meaningless. Some archaeologists still argue that schemata and the names for cultures and periods facilitate the communication with lay people and improve the understanding between archaeologists. However, remembering discussions between archaeologists about chrono-spatial questions and schemata, I doubt that these concepts have value, and as an alternative suggests the adoption of Fahlander's microarchaeological perspective as a new approach to structuring the time and space of Neolithic remains in Switzerland and adjacent regions. Rather than trying to fit pottery into clearly defined entities – like the allegedly homogeneous cultures – archaeologists should accept their ambiguity, e.g. "messwork," emerging from multiple factors that led to the preserved remains of the past.

Part 3. "Actor-centered perspectives: Movements of making – mobilities of pots, potters, skills and ideas" (five chapters). "Movement in making: 'Women working with clay' in northern Côte d'Ivoire" by Iris Köhler (pp. 189-211, 15 figures, 6 references). Köhler explores an ethnographic example of the entanglements of materials, potters, and pots in the process of making and selling pottery in the village of Sangopari. A major part of the village's female population is able to make pottery which they produce with simple tools in their free time, in addition to their domestic and farming tasks. She also focuses on the decisions in and reasons for pottery making. She initially describes the research area and notes that in this patrilocal society pottery-making is considered as women's work and that there are both mobile and stationery work areas in the village, locations of clay sources are described (these follow Arnold's 1985 distance to source paradigm but this isn't mentioned), and firing places described. Fabrication processes, shaping (potters move around stationery pots), surface treatment, firing, organization of production, and uses of vessels within the village are reviewed. Notably, "the spectrum of pots produced in Sangopari does not necessarily correspond to the inventory existing in the village. The pots found in the houses and compounds are of different origins – in time and space" (p. 204). Additionally, there are three loci

within 30 km of the village for selling pots. This research was conducted 1996-2000 and the author tries to show what people have 'written' in the pots and what may have been materialized. Hence, she demonstrates that potters and pots are mobile while making and selling pottery, but not all of these practices are visible in the materiality of the pots themselves. From a temporal perspective, she documents how pottery-making is transforming.

"Form follows fingers: Roman pottery, the producer's perspective and the mobility of ideas" by Nadja Melko (pp. 213-228, 10 figures, 18 references). Roman wheel-thrown common wear pottery made in the second century AD at the *vicus* Kempraten in present-day Canton of Saint-Gall, Switzerland, provides the evidence for past people's value systems in crafts production. Melko conducted ethnoarchaeological observations in a present-day pottery workshop in order to devise a methodology to describe the 'mutuality between potters and pots' in the creation process. Value systems influenced the potters' technique during the course of apprenticeship and the acquired memory is then reflected in the finished vessels' materiality. This embodied knowledge is why a *chaîne opératoire* is just the beginning of describing pottery-making. The archaeologist and the potter have two distinct perceptions of fabrication; hence, potters know much more than they are able to tell investigators because the "verbal description, however detailed, can hardly capture the phenomenological perturbations of real activity and the reciprocality [sic.] between the crafted and the crafter" (Malafouris 2008). Melko states that this is an initial methodological step toward understanding the transformative impact of potters' and pots' mobility. Note that Louana Lackey, a professional pottery and ethnoarchaeologist, pointed this out in *Pottery of Acatlán: A Changing Mexican Tradition* (1983).

"Practice, social cohesion and identity in pottery production in the Balearic Islands (1500–500 BC)" by Daniel Albero Santacreu (pp. 229-256, 6 figures, 69 references). The author's research on pots and potters from the Balearic Islands during the Bronze Age and the Early Iron Age employ's Bourdieu's (1977) theory of practice (*habitus*) with archaeological and archaeometric analyses of pottery sherds. Albero argues that during this period different 'communities of practice' existed on the Balearic Islands and suggests that these shared practices – once internalized by the individuals and giving place to a certain technological *habitus* "promoted the social cohesion of the islander groups" (p. 250). Hence, he contends that it is highly likely that pottery production practices were also linked with shared identities of potters. Albero conducted archaeometric analyses of 89 handmade pottery samples of different shapes and sizes recovered from diverse archaeological sites of the Balearic Islands (Spain) that were occupied during the 'Naviform' period (Middle-Late Bronze Age, c.1550-850 BCE) and / or the 'Talayotic' period (Early Iron Age, c. 850-500 BCE). Methodologies included the analysis of pottery thin sections by petrographic microscopy in combination with other techniques, usually X-ray powder diffraction (XRPD) or X-ray fluorescence (XRF) – previous scholars conducted calcimetric studies. Albero also used scanning electron microscopy (SEM) to study the microstructure of some pottery samples and the firing strategy. He documents paste recipes, firing strategies, potters' skills and the degree of variability associated with the pottery produced during the two periods. Observations of voids, inclusions and temper orientation by means of optical microscopy demonstrated a "clear index of the pressure applied by the potters when modelling and joining the coils." These practices and technological choices can be associated with specific learning strategies, degrees of expertise, perception of the vessels, and the emergence of social cohesion strategies and a common identity among the potters, both within the members of each community and between the different communities of the Balearic archipelago. The maintenance of identity ties and a specific technological tradition through several centuries has to be explained by a shared *habitus* among the individuals and the existence of social strategies aimed at community cohesion. Cohesion strategies are also seen in other dimensions of material culture on the basis of fractal-like models.

"Making things, being mobile: pottery as intertwined histories of humans and materials" by Caroline Heitz (pp. 257-291, 10 figures, 78 references, 10 Internet links). In questioning current models of central European Neolithic societies that are informed by concepts of sedentarism and cultural homogeneity, Heitz combines Bourdieu's (1977) theory of practice and Ingold's (2007, 2011) concepts on the 'making' of things. By acknowledging the mutuality of human-thing relations, she proposes the approach that pottery vessels are intertwined with the histories of humans and materials. Heitz argues that a pot's features reveal three itineraries: 1) the pot's geological materials, 2) the potter through chosen techniques and designs reveals cultural and social parameters, and 3) the pot itself by the place where the pot was used and found. Pottery from the Neolithic settlement of Hornstaad-Hörnle IA at Lake Constance (DE) (3918-3902 BC) is used to support her arguments about mobility. Materials, pots, and potters can be on the move; hence, she proposed a useful paradigm to differentiate between locally made and used "local vessels," traveled "translocal vessels" and "in-between vessels" that show creative material, stylistic and technical appropriations, resulting out of encounters with others.

Some vessels are made and used at the same place ("local vessels") others are transported over various distances ("translocal vessels"). When humans and things are on the move, encounters with otherness can trigger creative processes, which might also become materialized in pottery ("in-between vessels"): the appropriation of new materials, different techniques, styles, etc. To follow the itineraries of things thus offers an entry point to a deeper understanding of past peoples' mobilities and the negotiation and transformation of temporarily stable cultural forms.

"Pots on the move become different: Emplacement and mobility of pottery, specific properties of pots and their contexts of use" by Hans Peter Hahn (pp. 293-314, 13 figures, 41 references. 1 Internet resource). By employing examples from contemporary pottery-making in Northern Togo, Hahn demonstrates that in single settlement households can differ considerably regarding the sets of pottery they use. There are about a dozen ethnic groups in an area of about 400 x 100 km with different sizes of the settlement areas and demographics ranging from a few thousand to more than half a million. Hence, there is a complex spatial distribution giving the impression of a spatial "patchwork." Inspired by Mary Helms' key argument in *Ulysses' Sail: An Ethnographic Odyssey of Power, Knowledge, and Geographical Distance* (1988), Hahn examines short-distance mobility of things, and about the dynamics of different meanings and usages in neighboring communities. The materiality of cultural relations and material links across cultural (and ethnic) boundaries, therefore, the pottery of different styles made in different places by different ethnic groups can and does co-exist. He contends that the transcultural material mobility of pots should be considered as a key to cultural exchange. The meanings and practices in which these travelling pots become relevant can change from one place to the other. In addition, he emphasizes that "although things carry traces of their mobility within them, people evaluate these objects differently -- for example by bluffing or negating the mobile object itineraries" (p. 296). General assumptions about congruent distribution areas are thereby questioned. It is shown how meanings and modes of use of the very same form of a pot can change from one place to the other, very often without the users' knowledge about such differences.

Lastly, an "Afterword: The pot and the archaeologist – changing each other in an (un)happy marriage?" by Philipp Stockhammer (pp. 315-320, 18 references). The author praises, critiques, and offers salient comments on each of the dozen chapters preceding his own. In their introduction, Heitz and Stapfer argue for an innovative approach to the study of pottery that learns from, and at the same time goes beyond, past approaches and which should be inspired by current theories in material culture studies and the practice turn. Stockhammer discusses several aspects of the foregoing chapters, notably that there is still a lack of collaboration between archaeology and anthropology (at least in Central Europe, where both disciplines are clearly separated at universities (Hafner); the extensive borrowing from human-related concepts like "agency" or "biography" (Van Oyen); and the practice of potting as an integrated bodily and mental process (Melko, Heitz, Albero, and Hahn). "Materiality is defined by me [Stockhammer] as the physical presence of an object within the material world, which is perceived by a human individual at a particular moment. Therefore, materiality is inseparably connected to perception and, especially, our perception of things" (p. 316). Stockhammer defines three different changeabilities of objects: "first, based on the continuously changing perception of the objects; second, the change of objects through time without human interference; third, the transformations of objects due to human practices. All three changeabilities are entangled with each other because the relevant factors for their transformation – i.e. perception, time and practice – depend on each other. All three changeabilities can force humans to act. They constitute an object's effectancy [sic.]. Objects have an effect on us and we do not have to associate their potential with any kind of intentionality, which again is integral for agency" (p. 318). Pots are much more dynamic than archaeologists often think: the changeabilities reveal the potential of their effectancy, of which understanding is so necessary when thinking about human-thing entanglements.

The English-language volume gives the reader some current and thoughtful perspectives regarding Continental European ceramic studies and a variety of theoretical issues. A number of case studies borrow from recent research and substantiate, augment, or challenge the writings of other scholars. It is well-worth the attention of scholars residing outside of Europe.

Journal of Roman Pottery Studies, Volume 17, edited by Steven Willis, Oxford and Philadelphia: Oxbow Books for The Study Group for Roman Pottery, 2018. 121 pp. ISBN: 9781785709340, £38.00 (paperback).

This is the seventh volume to be reviewed in the *SAS Bulletin* since 2004; all published by Oxbow Books, Oxford, UK, for The Study Group for Roman Pottery. References: Volume 10: Amphorae in Britain and the Western Empire (Plouviez and Symonds, eds.), 2003, *SASB* 27(4):25-27 (Winter 2004); Volume 11 (Irvin, ed.), 2004, *SASB* 28(4):14 (Winter 2005); Volume 13: A

Mortarium Bibliography for Roman Britain Hartley and Tomber, with Webster (eds.), 2007, *SASB* 30(3):21 (Fall 2007); Volume 14 (Irving and Willis (eds.), 2009, *SASB* 33(3):13 (Fall 2010); Volume 15 (Willis, ed.), 2012, *SASB* 36(2):16-18 (Summer 2013); and Volume 16 (Willis, ed.), *SASB* 39(3): 3-4):12-14 (Fall-Winter 2016). In brief, Volume 17 includes papers relating to new research on Roman period ceramics found in England and Western Europe. Two papers present evidence of Late Iron Age and early Roman pottery forms and fabrics from west and east Kent: from West Malling, including transitional wares, and by Sholden villa, with groups of second century date including samian. Ceramic fire-dogs discovered in the area of the Dutch Lowlands and Flanders brings to attention a type of find that may prove to be more common than previously noted. The same may be the case with portable Roman ceramic ovens and baking plates recorded in recent years in Britain; these two papers contribute to a growing corpus and debate on Roman cooking, 'fast-food' and functions. Amphorae from the eastern Mediterranean in northern Europe and pottery used in Roman ritual and religion noting distinct types and trends often involving symbolism are discussed. Details of the pottery production site at Snape, Suffolk, and the types produced, are described.

Volume 17 begins with an "Editorial" (pp. ix-xi) and Obituaries: "David Peacock" by Roberta Tomber (pp. xiii-xv) (14 January 1939-15 March 2015). Peacock was internationally known for his work on pottery and stone analysis. He was particularly interested in later prehistoric and the classical worlds, and the ways that a study of modern societies can help us understand them better. Always keen to build bridges between archaeology and science, he demonstrated how thin-section analysis of pottery could upset assumptions based on stylistic considerations and how distribution studies could illuminate unexpected patterns of trade. Professor Peacock later turned his attention to Egypt. He helped excavate two of the greatest quarries of the Roman Empire at Mons Claudianus (198719-93) and Mons Porphyrites (1994-1998). Peacock proved that Quseir al-Qadim was the long-lost Myos Hormos, Rome's principal Red Sea port for trading with the Arabian Peninsula and India. There are two shorter obituaries "Cathy Tester" by Jo Caruth (p. xvi) an archaeologist for nearly 50 years who worked on Roman pottery in Suffolk, and "Phil Jones."

This volume has eight major contributions. "The import and distribution of eastern amphorae within the Rhine provinces" by Tyler V. Franconi (pp. 1-10, 1 figure, 3 tables, 70 references). The author focuses on eastern Mediterranean amphorae found in 65 sites in Germania and Belgica dated to the early Imperial Roman period, peaking in the 1st century AD. Regional and local wine production, costs of transport, data quality, form repertoire, consumption patterns, and more specific chronologies are detailed. MNI and RBH are reported for ca. 25,000 specimens; three main amphorae types dominate but there is great diversity in types recovered from military camps. "Roman pottery in ritual contexts: types, fabrics and manipulations" by Constanze Höpken and Manuel Fiedler (pp. 11-21. 7 figures, 96 references). Pottery from cultic and ritual sites is documented in German and Danubian provinces. Vessel types, decorated vessels (featuring snake heads), incense burners, siphons and perforated rim vessels (related to wine mixing), and everyday ceramics are reported. "An early Romano-British double flue pottery kiln at Church Road, Snape, Suffolk" by Antony Mustchin and Andrew Peachey, with John Summers (pp. 22-31, 7 figures, 4 tables, 24 references). A Romano-British kiln (#2633) dated mid-to-late 1st century AD and associated wasters was active 56-74 AD (C14) prior to abandonment. The authors describe the fabrics and the unspecialized vessel types (eight predominate: butt beakers and jars), commenting that the kiln is associated with a nearby villa rustica. "Roman pottery groups from the excavation of pits, a cremation and other features at Sholden, Kent" by Rob Perrin (pp. 32-45, 7 figures, 7 tables, 31 references). Perrin reports on a site near Deal, Kent that yielded 55 vessels and an adult cremation burial (Pit #1005). The fabrics mostly relate to storage jars (grog tempered ware, reduced ware, and oxidized ware predominated) but Central Gaulish Samian ware was also recovered; the site is associated with a Roman villa. The previous Mustchin et al. and Perrin contributions are the result of CRM salvage work.

"Bread and circuses, cutlets and sausages? Romano-British pre-formed ovens and ceramic baking plates" by Jane Evans with Alison Heke and Andrew Peachey (pp. 46-64, 6 figures, 85 references). Evans and colleagues review excavations of prefabricated ceramic ovens and food preparation and cooking in situ vessels from Worcester, Chester, and Soham. The authors describe oven functions, associated terminology, manufacturing techniques, oven sizes, and dates (90-135 AD). The study builds on a previous study by Darling (2012) and considers the social implications of the ovens and plates. A final contribution from England is "A Late Iron Age and early Roman pottery assemblage from Leybourne Grange, West Malling, Kent" by Edward Biddulph (pp. 74-91, 6 figures, 5 tables, 30 references). The chapter focuses on the transition period 50 BC-AD 70 and the analysis of 3,591 sherds, most from locally-produced vessels but there are some imported amphorae and Gallo-Belgic wares. The majority of the local ceramics are grog tempered but, recognized here for the first time, pottery tempered with sandstone. The

analytical methods are detailed and 32 wares (including eight Roman forms) reported. Vessel uses (predominately bowls and jars for cooking and storage) and a catalog of the pottery is provided. The use of local sandstone as a tempering material was short-lived and the detailed petrographic analysis conducted by Sean Patrick Quinn (UC London) is included by Biddulph (pp. 83-88) with six color photomicrographs.

There are two contributions from the Continent. "Curved ceramic firedogs from Flanders and the western Netherlands" Jeroen van Zoolingen (pp. 65-73, 7 figures, 19 references). Firedogs serving as cooking aids to support wood or for food roasted directly over a fire were recovered from the site of The Hague-Uithofslaan. The author reviews Roman-era distributions and contexts of firedogs in Europe from later prehistory into Gallo-Roman times. Based on 20 specimens, he suggests a possible German origin for these artifacts. "Fifth and sixth century African Red Slip and Late Roman C wares from Ossonona (Faro, Algarve, Portugal: the assemblage from Horta da Misericórdia" by Edgar Fernandes (pp. 92-109, 8 figures, 5 tables, 10 endnotes, 40 references). The contribution focuses on the trading of ceramics dating to the Roman and Late Antique periods excavated at a site located in southeastern Portugal (Lusitania) and pottery recovered from 18 sites in Iberia. Six forms were identified from the 4th century and 208 from the 5th-6th centuries. New perspectives on import patterns for AD 425-510 suggest that greater quantities of ceramics were imported that previously thought; the study builds on previous studies by Catarina Viegas (2011).

The volume concludes with "Pottery Retrospectives" on Beth Richardson (pp. 110-112, 2 figures, 6 references) and Peter Webster (pp. 113-114, 1 figure); these are JRPS interviews about the careers of two Roman pottery investigators. Two book reviews are included: The Arverni and Roman Wine: Roman amphorae from Late Iron Age sites in the Auvergne (Central France): Chronology, fabrics and stamps by Matthew Loughton, 2014. Reviewed by Robin P. Symonds (pp. 115-118) and Insight from Innovation: New light on archaeological ceramics, E. Sibbesson, B. Jervis, and S. Coxon (eds.), 2016. Reviewed by Edward Biddulph (pp. 118-119. Lastly, there are "Résumés," in French, of the eight major articles (pp. 120-121). This new volume continues to add to our knowledge of Roman ceramics in western Europe.

REAL FAKE: The Story of a Zapotec Urn, edited by Justin Jennings and Adam T. Sellen. Museum Forgery Series. Toronto, Ontario, Canada: Royal Ontario Museum, 2018. ix + 266 pp., illustrations, tables. ISBN 978-0-88854-523-7. Not available as a print or e-book; online gratis at:
https://www.academia.edu/36550534/2018_Justin_Jennings_and_Adam_Sellen._Real_Fake_The_Story_of_a_Zapotec_Urn._Royal_Ontario_Museum_Toronto
Archaeological fakes have been created for almost a millennium but there have been few book-length treatments dealing with ceramic artifact forgeries, especially for Mesoamerica. One of the earliest scientific journal articles was by William H. Holmes, "The Trade in Spurious Mexican Columbian Art" *Science* 7:170-172 (1886), and a significant treatment by Leopoldo Batres *Antigüdades mejicanas falsificadas: Falsificacion y falsicadores*. Mexico, D F: Imprenta de Fidencio S. Scora (1909), 143 pp.,
http://www.anonymousswisscollector.com/wp-content/uploads/Batres-Leopoldo-Antiguidades-Mejicas-Falsificadas-copy.compressed.pdf.

These early scholars of New World archaeology agreed that artifact falsification was already a booming "industry" even a century ago. A pioneering scientific work is by Stuart J. Fleming, *Authenticity in Art: The Scientific Detection of Forgeries*, London: Institute of Physics, and New York: Crane, Russack (1975). Conferences have been held on the topic, notably Elizabeth H. Boone's (ed.), *Falsifications and Misreconstructions of Pre-Columbian Art*, Washington, DC: Dumbarton Oaks (1982). A significant conservation science article has been prepared by Catherine Sease, "Faking Pre-Columbian Artifacts," AIC Objects Specialty Group Postprints 14: 146-160 (2007) http://resources.conservation-us.org/wp-content/uploads/sites/8/2015/02/osg014-09.pdf. During the past decade three books are notable contributions to the subject: Nancy L. Kelker and Karen Olsen Bruhns, *Faking Ancient Mesoamerica*, Walnut Creek, CA: Left Coast Press (2009); Paul T. Craddock, *Scientific Investigation of Copies, Fakes and Forgeries*, Burlington: Butterworth-Heinemann (2009); and Rhonda L. Brulotte, *Between Art and Artifact: Archaeological Replicas and Cultural Productions in Oaxaca, Mexico*, Austin: University of Texas Press (2012). The scope of the forgeries is incredible: Eileen Kinsella, "A Staggering 96% of the Artifacts in San Francisco's Mexican Museu m May Be Fake," *Art Net News* (July 7, 2017). https://news.artnet.com/art-world/mexican-museums-artifacts-mostly-fake-1016198. A scientific report concluded that only a fraction -- 83 of 2,000, or just over four percent -- of pre-Columbian artifacts could be certified as "museum-quality" by an independent team of museum curators who came from Mexico City to conduct an assessment. The remaining 1,917 items most of which lack provenance are considered "decorative," and will likely be given to schools or smaller museums. Don't begin

to think about the issue of donated objects and tax deductions.

The book under review here is a unique, sobering and informative contribution to the topic, and differs from all others in that the subject is one ceramic artifact (cataloged as HR 1953) subjected to a battery of modern scientific analyses that, perhaps, no other single piece has ever received: a Zapotec-style ceramic urn from Oaxaca, Mexico, in the collections of the Royal Ontario Museum (ROM), Toronto, Ontario, Canada. The volume is edited by Justin Jennings (Curator of Latin American archaeology, Royal Ontario Museum) and Adam T. Sellen (CEPHCIS-UNAM [Centro Peninsular en Humanidades y en Ciencias Sociales - Universidad Nacional Autónoma de México], with contributions from a most impressive group of archaeologists, archaeometricians, and museum conservators. There are 14 chapters each with its own bibliographies, color and monochrome images and line drawings, a "Preface" (pp. v-vii) and "Acknowledgments" (p. ix).

The "Preface" provides essential background and goals: "Some objects in the ROM's collections are not what they appear to be. In this book, we set out to unravel the complexities of one particular object: an imposing ceramic effigy, acquired almost a century ago from Mexico. Is it ancient? Is it a fake? Or is it something altogether different? The intriguing results of our investigation -- a study that began, many years ago, with a rejection -- comprise the chapters of this book' (p. v). In 1999 a team of Mexican researchers was invited by the Royal Ontario Museum (ROM) to examine its collection of Zapotec effigy vessels. The authenticity of many of the vessels had been in doubt for some time, especially after a previous study had demonstrated that there were numerous fakes among them. The researchers began to select which of the more than 120 vessels they would test. They focused on an urn with catalogue number HM 1953 which was received at ROM more than a century ago in a damaged but heavy restored condition, yet did not conform to what was then known about the fakes. The nose was unusual, and the headdress glyph was "nonsensical"; the iconography of some of the features was correct, but other motifs did not respect ancient Zapotec canon. Adam Sellen visited ROM in 2015 and in a discussion with ROM curator Susan Stock, decided to examine the object in greater detail and initial X-ray imaging proved that the object was held together by metal wire – not a Prehispanic trait. Sellen also thought that there may have been an identical companion to it in the Ethnologisches Museum Berlin, and perhaps another in a museum in Mexico. Hence, a plan for analysis of this "ugly duckling" artifact was drawn up and experts signed on to the project. [Note: some of the authors (notably Aaron Shugar) have posted their contributions online on https://www.academia.edu. If known, your reviewer will provide these references.] The volume is divided into two sections" Part I," Chapters 1- providing background material on the history of Zapotec urns, Oaxacan archaeology, and ROM's acquisition of HM 1953. "Part II," Chapters 5-13 presents the analyses, comparanda, and conclusions. This is one of the few times that a book on ceramics devotes more pagination to the scientific studies of an object than its humanities/social science perspectives. Most of the chapters have "Boxes" in which the authors discuss or define scientific topics.

"Part I." Justin Jennings "Chapter 1: Really Fake?" (pp. 12-28. 8 figures, 60 references). ROM was founded in 1915 and its director, Charles Trick Currelly, sought to build an encyclopaedic museum of world art and natural history. Traveling to Mexico in 1919, Currelly met Constantine Rickards, a British diplomat who had sold and donated pieces to major museums in Europe and the United States. Rickards offered Currelly a collection of some 1,500 pieces of Zapotec art from Oaxaca, the highlight which was a group of 120 Zapotec ceramic effigy urns representing gods and ancestors, and expressed religious ideas that structured life in one of Mexico's earliest states. TL testing of the Rickards urn collection in 1977 determined that two-thirds of the corpus was of recent manufacture and these were segregated from the rest of the collection. The subject of this book, urn HM 1953, was never TL-tested. Sections of the chapter also consider what is "real and" what is "fake," "Essentialism and the Making of Encyclopaedic Museums," Cabinets of Curiosity, "Post-structuralism and the Socially Constructed Object," and "modern" museums. Javier Urcid "Chapter 2: Ritual and Society in Ancient Central Oaxaca (350-850 CE)" (pp. 30-71, 36 figures, 59 references). Urcid, an archaeologist at Brandeis University, has prepared a highly readable, magnificently illustrated essay on the Classic period Zapotec urbanization, settlement patterns, writing and genealogical recordings, sociopolitical characteristics, house and compound configurations, world view and symbolism, and – especially – effigy vessels with named personages (pp. 55-64). Your reviewer has written about the preceding era: Charles C. Kolb, "Continued Developments in the Oaxaca Valley and the Early Form of Monte Albán (8000 BCE-300 CE), World History Encyclopedia Volume 5, Alfred J. Andrea (gen. ed.) Santa Barbara, Denver, and London: ABC-CLIO, pp. 66-69, 2011).

Adam T. Sellen "Chapter 3: Zapotec Urns: Witnesses to an Ancient Culture" (pp. 73-90, 13 figures, 46 references). Zapotec effigy vessels (urns imply incineration but the vessels show no evidence of this use) consist of a vessel

and an applied effigy, and are documented in the archaeological record 300 BCE-CE 800 CE. A diversity of ceramic pastes was used, but the majority of the wares were formed with fine brown clay that turns light to dark grey upon firing) and painted. Zapotec urns were used in two principal contexts: the great majority as objects destined for internment with the dead in elaborate tombs as part of a complex funerary cult, and a small number were offerings dedicated to temples and the erection of stele. He discusses the evolution of the vessels and their chronology (300 BCE-CE 600), with phases proposed by Acosta (1967) and Lind (1991-1992). The vessels have been interpreted as depicting a pantheon of gods and goddesses or as royal ancestors impersonating supernatural beings. Adam T. Sellen and April Hawkis "Chapter 4: From Grave to Museum: A History of HM 1953 in Collections" (pp. 92-111, 17 figures, 5 endnotes, 35 references). HM 1953 was created sometime during the fourth or fifth century and produced in sets of four or five but excavated groups had so many "duplicates" that the original groupings were often divided and sent to different repositories. The provenance of HM 1953 is undetermined but "probably discovered in a tomb somewhere in the valley of Oaxaca" (p. 96) and the fabrication of the "fakes" is, likewise, unclear. Artifact collector Constantine Rickards Sr., who immigrated to Mexico in the 1850s to mine gold and silver in Oaxaca, passed away in 1905 and his son (1876-1950) born in Mexico, inherited the collection but had to sell it after the outbreak of the Mexican Revolution in 1910. A close friend, American anthropologist and archaeologist Zelia Nuttall, brokered a deal with the Royal Ontario Museum that was approved by Manuel Gamio but the corpus wound up in the British Legation due to the lack of an export permit. Mistakenly sent as personal effects, trunks with the Rickards collection came to Durango in Northern Mexico and finally sent to Canada, arriving on November 5, 1934, fifteen years after the original purchase. Some items were badly damaged in transit and "extensively repaired" on multiple occasions in the past.

"Part II." Laura Lipcsei "Chapter 5" Visual Examination and Material Analysis" (pp. 114-138, 41 figures, 1 endnote, 4 references). The author (ROM Conservation Laboratory) focuses on the comprehensive visual examination of the urn under different light sources (normal and ultraviolet) and magnifications. The vessel was found to be physically stable overall but with delaminations on the nose, scratches, chips, and worn surfaces. The urn came from an excavation context, quite likely scrubbed clean at some point in its post-excavation life, and reconstructed from several fragments. Adhesive residues and restoration materials were located and described in the conservation report and problematic components of the headdress identified. Lipcsei also details the construction phases of the urn, manufacturing characteristics, and technologies employed by the fabricators: hand-building using slab- and coil-building, mold-made ear spools, smoothing and luting, application of a grey clay-like wash or slurry over a buff colored fabric, polychrome painting (poorly preserved but identifiable pigments), and the vessel was low-fired earthenware (probably in an open pit or pyre kiln up to 1100°C.). UVA was used to detect foreign or newly assed materials.

Susan Stock "Chapter 6: X-radiography" (pp. 140-149, 8 figures, 9 references). Stock describes the analytical procedures, cautioning that X-radiography on ceramics may corrupt data relating to absolute dating using TL (p. 142). Computer radiography mitigates the need for darkroom processing and need of a viewer. Modern wires were detected with joints supported by wires and difference fabric compositions recorded, all of which indicate extensive restorations. "Only so much data can be obtained via two-dimensional X-rays of three- dimensional objects with overlapping elements. To better visualize joins and other aspects of HM 1953, we needed computed tomography (CT)" (p. 147).

Shawn Stapleton and Heidi Sobol "Chapter 7: Computerized Tomography Scan" (pp. 150-163, 9 figures, 7 references). The senior author is from Harvard University, while Sobol is from ROM. Procedures are detailed; CT scanning is interchangeable with the term computerized axial tomography (CAT). Several hundred 2-D projection images were collected. The projections are combined mathematically, using a technique called filtered back-projection, to create a 3-D representation of the object. In general, the more projections collected, the higher the quality of the resulting image, and the better able we are to see different structures clearly. Commercially available software package (Amira, FEI Visualization) was employed, regions suspected of repairs and alterations documented, permitting informed interpretations of structure, fabrication, damage, and repairs.

Angel Ramírez Luna "Chapter 8: Thermoluminescence" (pp. 164-175, 10 figures, 1 table, 1 endnote, 12 references). The author (Universidad Nacional Autónoma de México) explained the procedures and sampling method. The TL analysis suggests that the molecular structure of the minerals is not uniform throughout the urn; hence, there is s wide variation in material properties. These structural differences, when combined with the varied concentrations of the radioisotopes uranium (238U), thorium (232Th), and potassium (40K), provide further evidence that HM 1953 is a composite piece made from material with different chemical compositions.

Aaron Shugar "Chapter 9: X-ray Fluorescence Analysis" (pp. 176-188, 4 figures, 4 tables, 34 references). Shugar (SUNY Buffalo State, Art Conservation Department) discussed pXRF, the selection of 17 sampling loci, and the in-situ analysis focusing on areas on the urn thought to consist of different types of ceramic pastes. Twenty-one elements were detectable and used to discern three distinct groups of chemistries. The results suggest that this object is more likely a pastiche with ancient and more contemporary parts added to an ancient core. https://www.academia.edu/36691360/_2018_X-ray_Fluorescence_Analysis_-_Chapter_9_in_Real_Fake_The_Story_of_a_Zapotec_Urn._Eds_Justin_Jennings_and_Adam_T._Sellen._Toronto_Royal_Ontario_Museum._Pg_176-189

Kay S. Sunahara and Robert Mason "Chapter 10: Petrographic Analysis" (pp. 190-205, 12 figures, 1 table, 25 references). Both authors are at ROM. The chapter provides an overview of the history of ceramic petrography, the methodologies they employed, and Oaxacan geology to define four major petrofabric groups based on ten samples found in the urn (core, ornamental plaques, etc.). The groups are defined in detail in terms of granulometry, grain sizes, grain sorting, and mineral inclusions (photomicrographs of the thin sections are provided). They also compare their data (mineral abundance) with the petrographic studies performed by Shepard (1967), Feinman et al. (1989), Fargher (2007), and Minc et al. (2016).

Laura Lipcsei "Chapter 11: De-restoration" (pp. 206-225, 25 figures, 3 references). Lipcsei discusses the dismantling of the urn and necessity of documenting the components with written and photographic records. The possibility of ancient Zapotec repairs is considered as well as more recent conservation. Appendages (legs and one arm did not fit the original core of the vessel, some pieces (a loincloth) had been removed, others modified (one earspool was repaired in antiquity and the other was recent), some new pieces were added (the nose). Modern adhesives such as PVA (available only since 1940) and clay and animal glues had been used in the recent reworking. It was clear that the original object had been paired with ancient disparate fragments and a grey wash and orange soil applied to attain "antiquity."

Aaron Shugar and Rebecca Ploeger "Chapter 12: Pigment and Adhesive Analysis" (pp. 226-242, 12 figures, 19 references). The studies involved the use of vibrational spectrography (FTIR and Ramen), ATR-FTIR, XRF, and optical microscopy with polarized light. Each procedure is explained and previous studies of Mesoamerican ceramics noted. There was only limited evidence of pigment on HM 1953; six pigment samples were obtained and the test results described. No attempt was made to identify any binding material. Seven adhesives specimens (mostly modern cellulose nitrate and polyvinyl acetate) and "rubbery putty" were examined by UVA, FTIR, and microchemical testing. https://www.academia.edu/36691359/_2018_Pigment_and_Adhesive_Analysis_-_Chapter_12_in_Real_Fake_The_Story_of_a_Zapotec_Urn._Eds_Justin_Jennings_and_Adam_T._Sellen._Toronto_Royal_Ontario_Museum._Pg_226-243_Shugar_and_Ploeger_

Carlos Morales Merino, Stephan Röhrs, Adam Sellen, Kay Sunahara, Robert Mason, Maria Gaida, and Ina Reiche "Chapter 13: Linking HM 1953 to a Possible Companion Urn in Berlin" (pp. 244-257, 12 figures, 2 tables, 12 references. The authors represent European and one Mexican museums, and ROM, all of which have Zapotec urns in their collections. Various studies (including petrographic and TL) were reviewed and the acquisition history of Berlin Urn IV Ca 26836 (collected by Eduard Georg Seler between 1887 and 1911) and its possible companions in the Howard Leigh Collection Cat. No. 1224 is detailed. The Berlin urn is described in detail, along with 15 pXRF examinations, and three petrographic thin section studies (at ROM). The two urns are superficially similar but Berlin samples collectively comprise a petrofabric (with an absence of granophyric feldspar) distinct from those found in the ROM urn. Alas, the Rb/Fe ratio measured with the µ-XRF is not comparable with measurements from the ROM because of the different instrument settings. All of the components of the Berlin urn were made from the same clay. Lastly, Adam T. Sellen, Justin Jennings, and Laura Lipcsei provide "Chapter 14: Conclusions." 258-265, 1 figure, 4 references) review the analytical results presented in "Part II" and attempt to write the urn's "biography" – both its earlier and later life. The urn was refabricated around the beginning of the twentieth century and in one workshop, perhaps by the same person. "While more work is needed to identify the location of these workshops and their associated artisans, thin-section petrography of the modern additions to HM 1953 point to the vicinity of Santa Maria Atzompa, a community about 5 km from the city of Oaxaca that in pre-Hispanic times was a satellite of the ancient city of Monte Albán" (p. 264).

This is a unique monograph and demonstrates the importance of a comprehensive analysis using a wide range of scientific techniques focusing on a single vessel. It would be very valuable for pedagogy in ceramic studies as it provides wide-ranging view of numerous aspects of pottery analysis including collection history, provenance, and curation and conservation, as well as analytical

techniques. The mention of Santa Maria Atzompa is intriguing since this community of potters has been studied on and off since the late 1950s and ranks high in Mesoamerican longitudinal ceramic ethnoarchaeological studies along with Dean E. Arnold's 45-years work at Ticul, Yucatan, Mexico (three major books cited below) and Eduardo Williams's 25-year effort *Tarascan Pottery Production in Michoacán, Mexico An Ethnoarchaeological Perspective* (Oxford: Archaeopress Archaeology, Archaeopress Publishing Ltd, 2017). Atzompa has been studied by women, all as dissertation research leading to publication in Vanderbilt Publications in Anthropology: Jean Clare Hendry (1957, 1992); Charlotte Stolmaker (1973, 1996); Ramona Pérez (1997); and Mary S. Thieme (2001, 2009). Thieme's *Continuity and Change in a Domestic Industry: Santa Maria Atzompa, A Pottery Making Town in Oaxaca, Mexico* (Fieldiana Anthropology n.s. 41, Chicago: Field Museum of Natural History) was reviewed in *SAS Bulletin* 33(1):15-16 (Spring 2010). Arnold's three books have been reviewed in *SAS Bulletin* 32(2):24-27 (2009); 38(1):2-5(2015); and 41(2):16-19 (2018): *Maya Potters' Indigenous Knowledge: Cognition, Engagement, and Practic*e, Boulder, CO: University Press of Colorado, 2018; *The Evolution of Production Organization in a Maya Community*, Boulder: University Press of Colorado, 2015; *and Social Change and the Evolution of Ceramic Production and Distribution in a Maya Community*, Boulder, CO: University Press of Colorado, 2008); a review of William's Tarascan volume is also published: 41(1):17-17 (2018).

BOOK REVIEWS

David V. Hill, Associate Editor

The Archaeology and History of Pueblo San Marcos: Change and Stability, edited by Ann F. Ramenofsky and Kari L. Schleher. 2017. University of New Mexico Press, Albuquerque. 328 pages, color plates, figures, maps, and tables. ISBN: 978-0-8263-5834-9, $95 (Print, hardcover).

Reviewed by Deborah L. Huntley
Tetra Tech, Inc., Golden, Colorado

This highly anticipated volume presents the results of over a decade of research at San Marcos Pueblo, an important social, political, and economic center located along the Rio Grande north-central New Mexico. Present-day Kewa (formally Santo Domingo) and Cochiti people have ancestral ties to this large town, which was occupied from the 14th century into the 18th century, persisting after the Pueblo Revolt of 1680. San Marcos Pueblo was an important producer of glaze-decorated pottery, which was circulated widely throughout the Rio Grande region.

This volume is the culmination of the San Marcos Project, co-directed by Ann Ramenofsky and Chris Pierce and assisted by numerous graduate students and volunteers. The volume incorporates many specialized studies of the architecture and material cultural of San Marcos Pueblo that originate from San Marcos Project. Three research questions that informed the project are interwoven throughout the volume: Pueblo organization, population change, and Spanish-Pueblo interactions.

The volume is organized into three sections. Following an introductory chapter by Ann Ramenofsky and Kari Schleher, the five chapters in Section I provide cultural, historical, and temporal background for the rest of the volume, situating the town within the context of the Galisteo Basin and Rio Grande physical and cultural landscapes. Chapter 2 (Ann Ramenofsky, Kari Schleher, and Ariane Pinson) reviews the long history of research at San Marcos and other Galisteo Basin pueblos and summarizes University of New Mexico San Marcos Project investigation strategies (mapping, surface collection, shallow midden excavations, re-excavation of one roomblock, documenting features exposed in an arroyo cut, and metallurgical studies). Chapter 3 (Richard Flint) uses documentary sources to explore the history of San Marcos Pueblo and the Galisteo Basin during the Spanish Colonial period. Chapter 4 (Ann Ramenofsky and Jonathan Van Hoose) presents a temporal reconstruction of San Marcos Pueblo's occupation based on relative seriation of glaze ware and utility ware rim sherds combined with radiocarbon and luminescence dating. Chapter 5 (Ariane Pinson) documents the architectural history of two roomblocks and three middens exposed in an eroding portion of San Marcos Arroyo. Her stratigraphic profiles demonstrating two construction episodes are bolstered by radiocarbon dates and ceramic cross-dating. Chapter 6 (Ariane Pinson and Shawn Penman) discusses the re-excavation of two sets of rooms excavated between 1912 and 1916 by Nels Nelson. The re-excavation allows reevaluation of the occupational sequence of Roomblock 13 and comparison with earlier occupations documented in Chapter 5.

Section II is devoted to the description and analysis of the San Marcos Project artifact assemblage. Chapter 7 (Dorothy Larson, Kari Schleher, Ann Ramenofsky, Jonathan Van Hoose, and Jennifer Boyd Dyer) summarizes the artifact assemblage, setting the stage for subsequent in-depth studies of ceramics and chipped stone. This chapter introduces the learning theory framework that is more fully developed in Chapter 8, and describes turquoise, European

artifacts, and Pueblo artifacts in European form recovered from San Marcos. Chapter 8 (Kari Schleher) discusses the Rio Grande Glaze Ware community of practice at San Marcos Pueblo, considering both glaze ware technology and design styles. This chapter includes beautiful color plates of whole vessels. Chapter 9 (Anne Compton) details lithic technology at San Marcos based upon a sample of the total assemblage. This chapter examines the issue of technological change versus continuity following Spanish contact. Chapter 10 (Ann Ramenofsky, Anastasia Steffen, Jeffrey Ferguson, Phillipe LeTourneau, and Adam Okun) presents the results of obsidian sourcing, obsidian hydration, and technological studies. Chapter 11 (David Vaughn) explores the topic of Spanish metallurgy at San Marcos and within Colonial New Mexico as a whole. This chapter combines archaeometallurgy and documentary sources, resulting in an innovative approach to understanding Native-Spanish mining-related interactions. An inventory of documented Native-Spanish mining-related interactions in the 16th and 17th centuries is provided in Appendix I.

The four chapters in Section III provide different approaches to reconstructing past population histories at San Marcos Pueblo and beyond. Chapter 12 (Ann Ramenofsky) outlines methodological considerations for reconstructing past population sizes and densities. This chapter also presents evidence for five occupation periods at San Marcos Pueblo based on reconstructed population trends. Chapter 13 (Ariane Pinson) is a thought-provoking study of roomblock construction and decay that is informed by Pinson's analysis of the San Marcos profile (Chapter 5) and a model of sealed Middle Eastern tells. Her study has implications for site formation processes at San Marcos and similar large towns, where roomblock collapse may obscure earlier occupations. Chapter 14 (Scott Ortman) uses an innovative, multi-step Bayesian probability density analysis to produce a population curve for San Marcos Pueblo. The curve shows five population surges that closely align with the occupation periods outlined in Chapter 12. Chapter 15 (Ann Ramenofsky) revisits the contentious issue of proposed catastrophic population loss from Spanish-introduced infectious diseases during the 16th century. This chapter provides documentary and archaeological evidence indicating that Pueblo populations were in fact stable until the mid-17th century.

This volume has several strengths. First, it highlights the rich interpretations that can be made using data gathered from surface collections and limited, targeted excavations combined with innovative approaches to using those data. Second, the volume presents a wealth of raw data that will be useful for future studies, including but not limited to lithic technology and raw material use, ceramic technological studies, obsidian sourcing, ceramic seriation, radiocarbon dating, obsidian hydration, metallurgy, and site formation processes. Third, there are many examples throughout the volume of how archaeology and documentary sources can be combined to create more compelling interpretations. Finally, it is commendable that this volume includes alternative and sometimes disparate results obtained from similar datasets – most notably the population reconstructions in Section III – opening a dialogue rather than presenting a monolithic interpretation.

In conclusion, this volume is essential reading for scholars of the Protohistoric period in the Rio Grande region, and provides much of value for Southwestern archaeologists in general. Non-Southwesternists will likely appreciate the volume's successful combination of documentary and archaeological sources and approaches to past population reconstruction.

Human Adaptation in Ancient Mesoamerica: Empirical Approaches to Mesoamerican Archaeology, edited by Nancy Gonlin and Kirk D. French. 2016. University Press of Colorado, Boulder. Xxix + 374 pages, 72 figures, 24 tables. $60.00 (hardback), ISBN: 978-1-60732-391-4. $48.00 (e-book), ISBN: 978-1-60732-392-1.

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Human Adaptation provides a summary of research by scholars trained in the Department of Anthropology of the Pennsylvania State University. Cultural ecology is the common thread running through this volume. Editors emphasize the empirical nature of their study. Empiricism is predicated on testability, which, in turn, depends on interpretive and conceptual frameworks; a healthy interplay of empirical data and conceptual frameworks is vital for current archaeology. Chapters in this volume reflect different aspects of this data-interpretation conundrum through conscious, unconscious or unacknowledged assumptions.

After a very interesting historiography of cultural ecological studies (Section I), the volume is organized according to four themes (section II-IV): Water and Land; Population and Settlement Studies; Reconstruction and Burial Analysis; and Political Economy. Four chapters deal with research at Copan, Penn State's representative project led by Bill Sanders and David Webster, and five chapters deal individually with Palenque, Piedras Negras, Tikal, Mixteca Alta, and Teotihuacan. Methodological approaches vary considerably across the studies, from the

highly interpretative study of water control at Teotihuacan (Chapter 2 by Evans and Nichols) to the descriptive study of a residential group at Copan (Chapter 7 by Widmer and Storey).

Archaeometric methods are variously incorporated in five chapters, to which I focus the remainder of this review. In Chapter 3, French and Duffy apply hydrological approaches to understand the human impact on environment at Palenque. Authors model watersheds with simulations and measure the combined effect of land cover (consequence of human activities) and rainfall on water supply. They conclude that Classic period Palenque did not suffer water shortages despite high degrees of deforestation and urbanism, and was therefore not abandoned due to drought. While successful in their application, the original question regarding whether or not drought caused site abandonment is too simplistic, and it is highly desirable to develop research questions and interpretative frameworks to which hydrological methods can be more fruitfully applied.

In Chapter 4, Wingard examines changes in the carrying capacity of maize agriculture using simulations and soil analysis in the Copan Valley. He concludes that agricultural productivity dropped during the ninth century AD due to land shortage and degradation, but not enough to cause full-scale abandonment of the valley. The valley's continuous occupation is supported by settlement, stratigraphic, and chronometric evidence presented in Chapter 5 (Freter and Abrams). Wingard highlights the complementarity among different researchers and lines of evidence. This has always been a strength of Penn State archaeology. However, I see it as problematic that the simulation treats the Copan Valley as a self-sufficient, closed system when current evidence suggests that Copan was situated in extensive interregional exchange networks. This chapter would benefit from addressing more fully untested assumptions of the simulation.

Chapters 8 (Reed and Zeleznik) and 10 (Straight) illustrate contrasting approaches, each with advantages and disadvantages. Reed and Zeleznik build preconceived models of social organization (class, ranked, stratified, and house models) against which to evaluate the data. Authors interpret the social organization of the middle strata at Copan based on multiple lines of evidence, including mortuary and isotopic data from 736 burials. They demonstrate multifaceted social relations between individuals and between residences and claim that Copan was transitioning from a ranked to stratified society. Analysis and results are interesting, yet their preconceived models are not well-grounded in anthropological literature and have limited utility (e.g., a house society may be ranked or stratified, meaning such models are not mutually exclusive). Additionally, diachronic changes are not addressed. In Chapter 10, Straight combines INAA with a metric analysis to characterize ceramic vessels from Tikal. Results suggest that similar ceramics were produced by multiple groups of artisans and widely distributed across Tikal's territory. These findings are important because they reveal problems with previous models of political economy. A discussion of alternative explanatory models of production, exchange, and consumption would strengthen the chapter.

An empirical basis is fundamental for theory building and nuanced interpretations. Penn State archaeology has and continues to contribute high-quality data obtained through continuous and collective efforts, as is convincingly shown in this volume. It serves as a model for how we can advance archaeological practice. As we progress in this regard, we must improve conceptual frameworks and test the assumptions underlying such frameworks

SAS BULLETIN

NEWSLETTER OF THE SOCIETY FOR ARCHAEOLOGICAL SCIENCES

We wish everyone Happy Holidays! See you in the new year!