Comments: The State of Archaeological Science in the United States of America; A Method for the Recognition and Documentation of Ceramic Fabrics by Means of a Low-Resolution Digital Microscope

J. Theodore Peña – University of California, Berkeley

In the first part of this contribution I present some general comments regarding the state of archaeological science in the United States of America. In the second I present an overview of a method that my research group based at the University of California, Berkeley has elaborated that involves the use of a low-resolution digital microscope to document pottery fabrics that may be of interest to conference participants.

I will begin by briefly characterizing the nature of the university system in the USA as this relates to research and training in archaeology, since many in attendance may not be familiar with the situation there and a basic understanding of this is essential to any proper appreciation of the status of archaeological science in that country. The vast majority of practicing archaeologists in the USA are employed in public archaeology - referred to there as Cultural Resource Management (CRM) - with only a minority employed in academic positions, that is, with an appointment in the system of higher education, which includes both public and private colleges and universities. Most practicing archaeologists will have earned an undergraduate degree – the Bachelor of Arts (BA) – with a major (concentration in their coursework) in anthropology, which in the USA is recognized in the traditional scheme as subsuming four subfields – socio-cultural anthropology, archaeology, biological anthropology, and linguistics - followed by graduate training in a department of anthropology, leading first to a Master of Arts (MA) degree and then a doctorate (PhD), with the latter a requirement for consideration for a position at a college or university. Research and training in classical archaeology, which due to geographical considerations necessarily represents what is, in effect, a wholly academic pursuit, are housed for the most part within an entirely different set of academic structures. Most practitioners of Greek or Roman archaeology will have completed a BA with a major in classical languages, classical civilization, or classical archaeology, followed by an MA and PhD either in a specialized classical archaeology "track" (program of study) within a classics department's

graduate program, or in one of a small number of interdepartmental programs in classical or Mediterranean archaeology. They generally find employment in a department of classics, which in the USA are concerned primarily with teaching and research in classical languages and literature, with archaeology generally representing a minor adjunct area. Alternatively, practitioners of Greek or Roman archaeology may pursue their undergraduate and graduate training in a department of art history (a few of which have a dedicated track in ancient art or ancient art and archaeology) and obtain a position in a department of this kind. It is important to note that there is but a single department of archaeology in the USA - at Boston University – in which students earn a BA, MA, and PhD in archaeology rather than in a field of which archaeology is understood to represent a sub-area.

The significance of the situation just described for the topic at hand lies in the fact that in order to obtain a position as an archaeologist within the academic system in the USA a person is obliged to pursue a broad preparation in anthropology, classical studies, or the history of art, with little opportunity to obtain a high degree of specialization in any area of archaeology, let alone the highly specialized training required to become an active practitioner of archaeological science. This fact, in combination with the extremely modest amount of financial support provided to archaeological science by federal and state government, means that the practice of archaeological science, and innovation in archaeological science, in particular, are somewhat underdeveloped and stagnant in comparison with the situation in many of the nations of western Europe. Two recent publications - a book chapter by David Killick and a discussion piece by Killick and Paul Goldberg - present extremely interesting considerations of these problems as they relate to archeology as practiced within departments of anthropology in the USA along with some reasonable suggestions as to how the situation might be rectified.[1]

The general trend towards the reduction of support for university and museum research and training units in the USA over the past several years has seen the demise of what were some of the most important centers for the practice of archaeological science, including the Smithsonian Institution's Conservation Analytical Laboratory (CAL) in 1998 (reorganized and repurposed as the Smithsonian Center for Materials Research and Education [SCMRAE] and again more recently as the Museum Conservation Institute [MCI]) and the University of Pennsylvania's Museum Applied Science Center for Archaeology (MASCA) in 2009. Another

unfavorable development has been the discontinuation in 2008 of the University of Arizona's National Science Foundation-supported Integrative Graduate Education and Research Traineeship (IGERT) Program in Archaeological Science at the conclusion of its five-year funding cycle.[2] Other centers, such as the Missouri University Research Reactor (MURR) Archaeometry Laboratory,[3] the Center for Materials Research in Archeology and Ethnology (CMRAE), supported by a consortium of institutions in the Boston area,[4] and the Wiener Laboratory at the American School of Classical Studies in Athens[5] continue to function as important loci for training and research in archaeological science.

Encouraging are three new initiatives that promise to emerge as important vehicles for the training of students in archaeological and conservation science. These are the W.W. Keck Center for Instrumental and Biochemical Comparative Archeology at Millsaps College, in Mississippi, which provides training for students at the undergraduate level,[6] the Institute for Integrated Research in Materials, Environments and Society (IIRMES) at California State University, Long Beach,[7] which provides training for students at the undergraduate and MA levels, and the University of California, Los Angeles Cotsen Institute of Archaeology/Getty Program in the Conservation of Archaeological and Ethnographic Materials, which provides training for students at the MA level.[8]

In the second part of my comments I would like to describe a method that my research group has elaborated that involves the use of a digital microscope to document ceramic fabrics that may be of interest to many of those in attendance. The instrument that we are employing for this purpose is the Dino-Lite 413T, a compact, low-cost (ca. USD 475), easy-to-use device consisting of a low-resolution (1.3 MP) digital camera housed in a cylindrical case ca. 10 cm long by 3 cm in diameter that mounts on a tabletop stand. It interfaces with a computer via a USB 2.0 connection to run the associated DinoCapture software. (Figure 1) A pair of pliers is used to detach a small (ca. 0.5 x 0.5 cm) chip from a sherd in order to obtain a fresh, more or less flat fracture surface. Several of these chips are glued to a notecard with the flat surface oriented up and parallel to the card's surface and provided with a written identification label. The microscope is then used to produce a photomicrograph of the chip's surface at a magnification of 50X. (While the instrument is capable of producing images at magnifications of up to 200X, the height of the chip, depth of field considerations stemming from the unevenness of the fracture

surface of most chips, and the desirability of obtaining a representative view of a ceramic object's fabric combine to make magnifications in the ca. 40-50X range optimal.) The software automatically places a scale bar in the image's lower left-hand corner. Once the chip cards have been prepared it is possible to produce photomicrographs of ca. 80-100 chips in the course of an hour, and a team of two persons working in tandem - one producing chip cards and the other making the photomicrographs and archiving these on the computer - can easily produce ca. 500 images in a normal day's work.

The images, which are stored in the instrument in JPEG format with a file size in the 200-300 KB range, are renamed with the associated identification information and saved to folders on the computer for archiving and eventual examination and characterization using Adobe Photoshop. By opening a photomicrograph in Photoshop, applying the Grid option, and then comparing the grid squares projected onto the image with the scale bar in the image's corner it is possible to quickly and accurately estimate the size and abundance of the inclusions and voids in the specimen's fabric. To give some idea of the nature of the images that can be obtained by this method I present a figure that contains six images captured means of this method. (For presentation all six images have been sharpened and cropped, resulting in the removal of the scale bar.) (Fig. 2) The three images in the top row are specimens of Italian Sigillata, one in the notably fine-textured fabric characteristics of Arretine products, one in the somewhat coarser fabric characteristic of certain Tiber Valley productions, and one in a notably micaceous volcanic fabric that may originate in the Bay of Naples. The three images in the bottom row are specimens of thin-walled ware, including one in a slightly gritty, carbonate fabric common in assemblages from the Rome area, one in a ferruginous fabric containing sparse volcanic and carbonate inclusions common at Pompeii, and one in a carbonate fabric containing sparse volcanic and carbonate inclusions also common at Pompeii.

By opening several (e.g., 15) of these images simultaneously in Photoshop and employing the Cascade or Tile option, (Fig. 3) it is possible to compare the fabrics of a sizable group of specimens, identify and eliminate outliers (e.g., by moving these to a different folder), and arrive at a compositionally homogeneous set of specimens. These practices greatly facilitate the recognition/definition of ceramic fabrics and the assigning of large number of specimens to these. The images captured by means of this quick and inexpensive method constitute a

permanent record that can be consulted at a later date, circulated to other researchers, and published in electronic or print media. The widespread adoption of this or some similar method would do much to facilitate the presentation and intercomparison of research results, eliminating significant obstacles to the advancement of our understanding of the pottery record of the ancient Mediterranean.

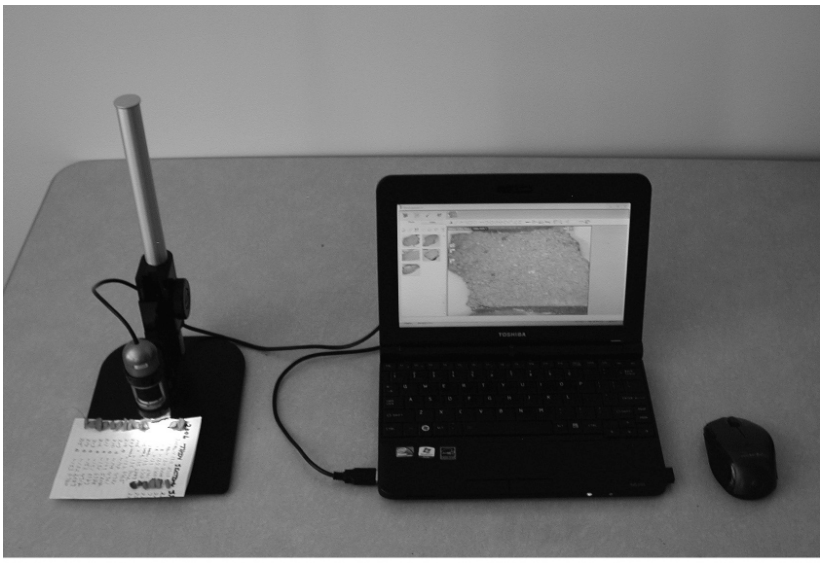

Figure 1: Top: View of Dino-Lite 413T digital microscope mounted on tabletop stand and connected to netbook computer with chip card positioned for photographing. Bottom: Detail of Dino-Lite digital microscope mounted in stand.

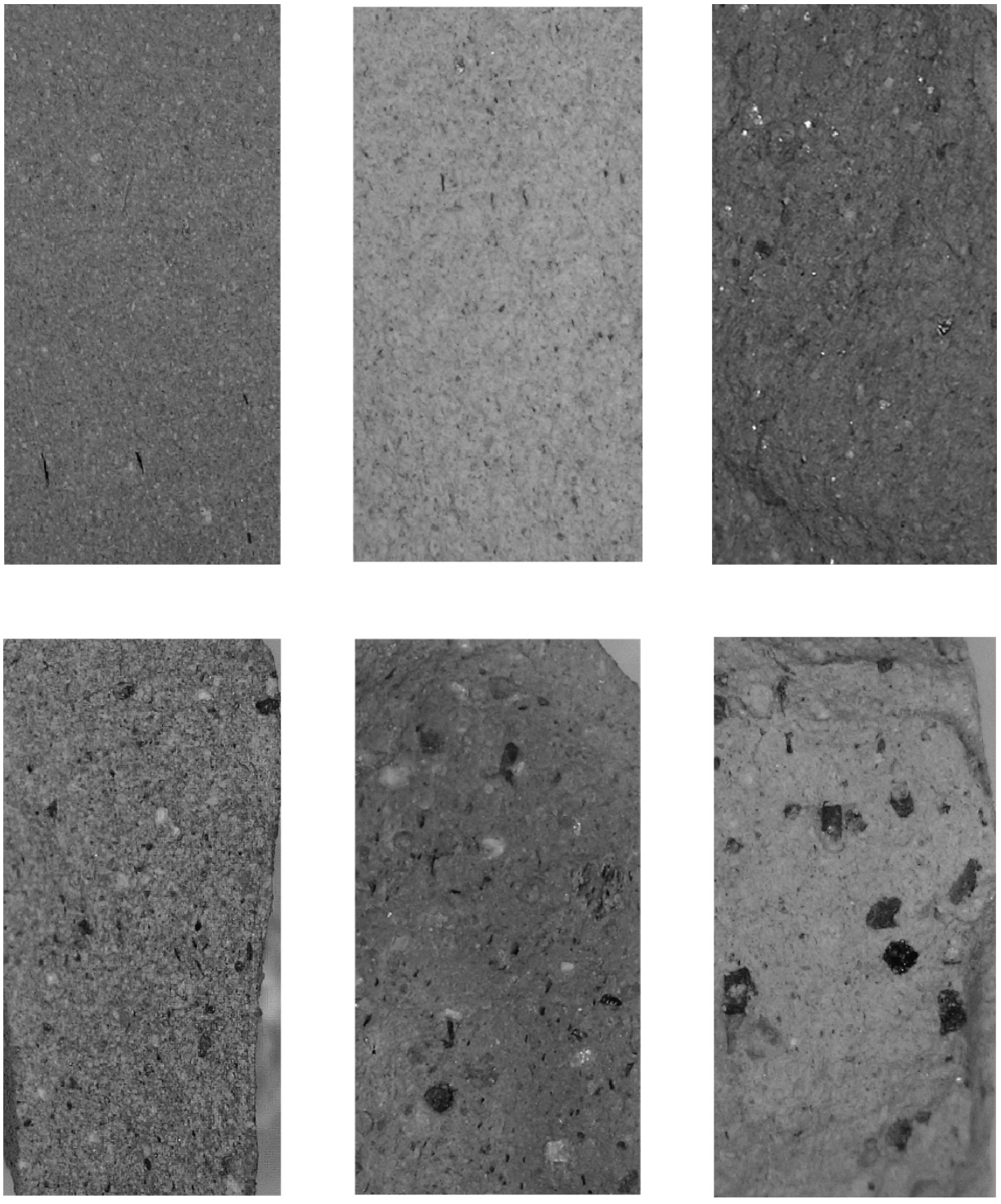

Figure 2: Examples of photomicrographs of pottery chips produced with Dino-Lite 413T digital microscope at magnification of 50X. Top row: three examples of Italian Sigillata. Bottom row: three examples of thin-walled ware.

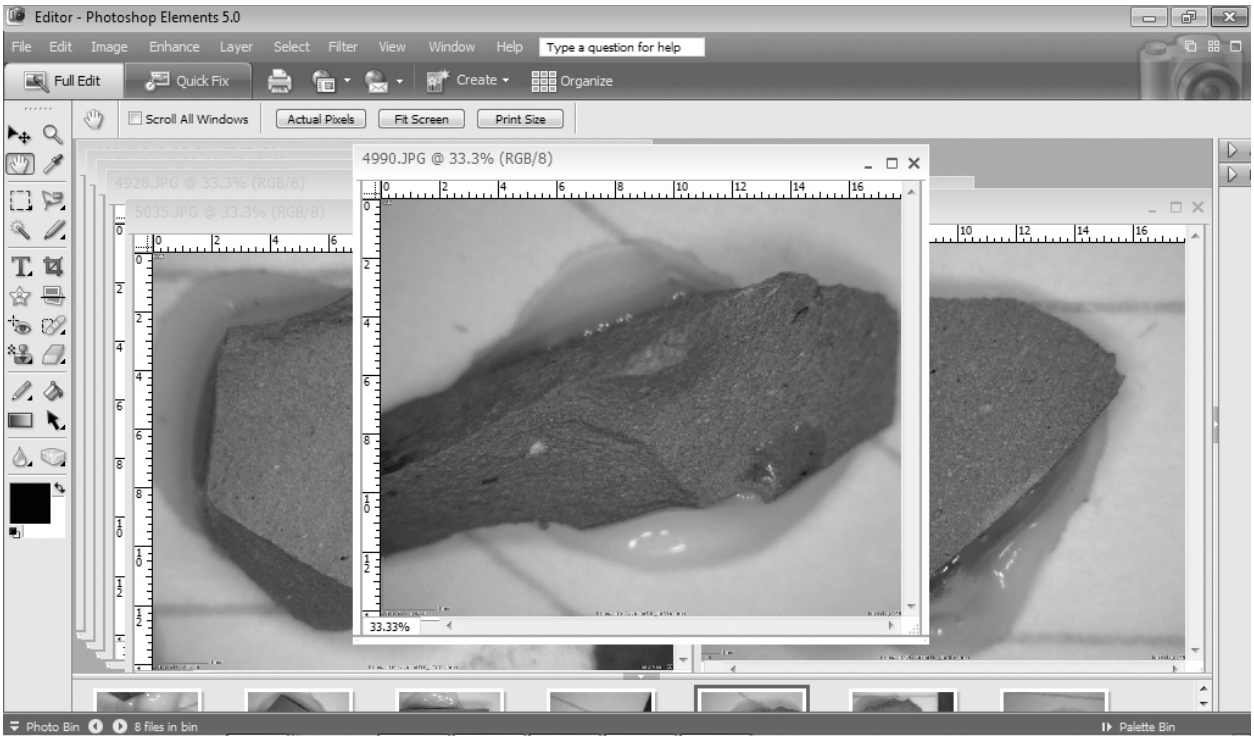

Figure 3: Screen capture view of several photomicrographs of chips of examples of Italian Sigillata produced with Dino-Lite 413T digital microscope opened in Adobe Photoshop using Cascade option.

Bibliography

Killick 2008: D. Killick, Archaeological science in the USA and in Britain, in A. Sullivan (ed.) *Archaeological Concepts for the Study of the Cultural Past*, Salt Lake City, pp. 40-64.

Killick, Golodberg 2009: D.J. Killick and P. Goldberg, A quiet crisis in American Archaeology, *SAA Archaeological Record* 29, pp. 6-10, 40.

http://saa.org/AbouttheSociety/Publications/TheSAAArchaeologicalRecord/tabid/64/Default.aspx

---

[1] Killick 2008; Killick, Goldberg 2009.

[2] http://datamonster.sbs.arizona.edu/IGERT/igert_archive/index.php

[3] http://archaeometry.missouri.edu/

[4] http://web.mit.edu/cmrae/

[5] http://www.ascsa.edu.gr/index.php/Wiener-Laboratory/

[6] http://www.millsaps.edu/academics/sociology_anthropology_news_a_look_inside_the_keck_lab.php

[7] http://www.iirmes.org/

[8] http://www.ioa.ucla.edu/conservation-program/introduction