POST-BRONZE AGE CERAMIC DATA AT ILION, FROM IN-FIELD USE TO DIGITAL PUBLICATION

Billur Tekkök, John Wallrodt, and Sebastian Heath

Abstract

The authors present a non-technical overview of the database structures that record information about the Post-Bronze Age ceramic assemblage at Ilion. Its purpose is not to fully document the system used at Troia, but instead to identify practices that can be useful in other contexts. The article particularly stresses that it is important to assign a primary identity to all sherds that will be subject to individual study and that this identity can be re-used in such record keeping processes as drawing and photography. Further use of such identities in print and digital publication is likely to make online linking of ceramic data to contextual information easier in the future.

Zusammenfassung

Die Autoren präsentieren einen nicht-technischen Überblick über die Struktur der Datenbasis, die die Information über die nachbronzezeitliche Keramik-Sammlung in Ilion enthält. Unsere Absicht ist nicht, das in Troia benutzte System, vollständig zu dokumentieren, sondern die Methoden zu charakterisieren, die in anderem Zusammenhang nützlich sein können. Der Artikel legt Wert darauf zu betonen, daß es wichtig ist, allen Scherben, die bearbeitet werden sollen, eine erste Bezeichnung zuzuteilen und daß diese Identität in anderen Unterlagen wie Zeichnungen und Fotografien wieder benutzt werden kann. Der weitere Gebrauch solcher Identitäten im Druck und digitalen Publikationen macht wahrscheinlich die online-Verknüpfung von keramischen Daten mit textlichen Informationen in der Zukunft leichter.

This article[1] discusses the database structures that support in-field processing and subsequent publication of Post-Bronze Age (PBA) ceramics at Ilion.[2] Although grounded in a specific project, the following is not a complete description of the data management system employed by the PBA team at the site. During the more than twenty years of the project's work, technologies and methods have changed and the authors, along with others, have continued to adapt our specific systems to the increasing capabilities of the available tools. Accordingly, the database we use in the field accommodates that history while also enabling record-keeping processes that are idiosyncratic to our work. Many details of implementation are therefore not of interest beyond the project participants, a situation that is likely matched at many other excavations around the Mediterranean and elsewhere.

Our goal in the following discussion is instead to broadly describe the database structures that enable us to record and utilize the corpus of ceramic knowledge the project has assembled over the course of its work. It will also be clear to the reader that the language we employ is, with few exceptions, not overtly technical. We try to describe these structures in such a way that they can be readily compared to the work of similar projects. Finally, we are not advocating adoption of any specific system. By offering a discursive overview of the Troia Post-Bronze

[1] The authors wish to thank Prof. Ernst Pernicka, director and Prof. C. Brian Rose, director of the the Post-Bronze Age team for permission to work at Troia. Much of the work described here was undertaken while the late Professor Manfred Korfmann was director.
[2] The term Ilion is used to refer to the Greek and Roman city, Trioa refers to the site and archaeological project as a whole.

Age ceramic database, we hope to contribute to an ongoing discussion that may lead to greater interoperability of archaeological information.

Archaeological research at Troia is driven by large-scale goals, such as establishing the size of the Late Bronze Age city, or the investigation of cult practice in the Greek and Roman periods.[3] As undertaken on a daily basis in the individual trenches, a main purpose of excavation is to identify coherent stratigraphic units and remove them in such a way that their relationship with surrounding units is recorded, with all artifacts and other relevant physical evidence from a unit retained for later study. In this regard, the work at Troia falls within the mainstream of modern archaeological practice.

Relationships within the Post-Bronze Age Ceramic Data

As is the case with the archaeological investigation of other ancient Mediterranean cities, the most abundant category of artifact that the Troia project processes, records, and stores is its pottery.[4] The PBA ceramic database currently contains more than 57,000 records that provide information for more than 400,000 sherds of pottery, tile, and related ceramic objects. The database we use to hold this information is relational in design.[5] Unique identifiers are used to link information about distinct categories of archaeological information that are efficiently divided between tables containing repeated records, each of which stores similar information.

The assignment of unique identifiers to each stratigraphic unit is an essential part of the excavation process. Like most excavations, the PBA team maintains a database of all units along with information such as location and date of excavation. Pottery information is stored in a table consisting of records that identify the stratigraphic unit from which the pottery comes, and which also provide further information about these sherds. As an introduction to this widely employed concept, Table 1 indicates that the stratigraphic unit KL16/17.0417, which was excavated at Troia in 1998, contained two sherds of the common Late Roman ware African Red Slip (ARS) and that both of these are of form Hayes 45. Table 1 can also be taken as an abstract representation of a row within a database table, one that is in turn divided into columns.

Such a row in a table can easily be associated with additional information about KL16/17.0417, such as its location on the site, the dates of excavation, etc.; indeed, such linking is a fundamental capability of a modern archaeological database.[6]

Some commentary on this table structure partially illustrates our approach to recording ceramic information. The first is simply a matter of presentation within this chapter. While Table 1 uses fully spelled out terms, such as "African Red Slip," the actual project database used abbreviations such as "ARS" or, in the case of a base, "b" and "bf" for a body sherd. Other projects will have different abbreviations, but that level of detail falls outside the scope of this paper.

More importantly, our goal is to have each column hold a single piece of information. Application of this principle is essential for those columns that will be used either to form relational links with other tables or to serve as terms in searches expected to produce accurate results. Counting rims or other vessel parts is a capability common to most ceramic databases, one that we will examine more closely below. Here, we wish to make the point that accurate searching requires the separation of information about individual sherds into discrete indivisible units. Accordingly, Table 1 splits the conceptually simple phrase "2 ARS bases" into three columns, each making an indivisible assertion about the pottery being described. Without such division into discrete units of information, it would be difficult to identify the numeric component of these statements.[7]

Stratigraphic Unit	Ware	Generic Form	Typology	Part	Count
KL16/17.0417	African Red-Slip	Dish	Hayes 45	base	2

Table 1 Schematic ceramic database.

[3] Rose 2011, see this volume.

[4] Horejs – Jung – Pavuk 2010.

[5] Codd 1970. In this article we adopt the terms "table", "row" and "column" in place of the more technical terms, "relation", "tuple" and "attribute", used in the computer science community. Eiteljorg 2008, chapter III is an introduction to relational database design for archaeologists.

[6] Kadar 2002.

[7] Prior to 1996, the PBA database did rely on textual descriptions of the ceramics in a stratigraphic unit. Frustration with that system led to the development and application of the principles described here.

More substantive is the question as to whether a database that records quantities of vessel parts can provide useable information. Issues related to the quantification of ceramic data have long been discussed by archaeologists working in the old world.[8] Peña has recently offered a review of the fundamental concepts and a trenchant criticism of their application, at least within the field of Roman ceramics.[9] To paraphrase his strongly worded assessment, he concludes that "any study" comparing quantitative pottery data that relates to two or more stratigraphic units and that was obtained by only counting sherds "is not statistically valid".

At Ilion we count sherds, and this is likely the case at many other field projects. Given Peña's unambiguous statement that this method is invalid, it is important to ask if the collection of our data is worth the effort. We think yes, but wish to emphasize that we do not mean this as a challenge to Peña's evaluation of quantification methods. Rather, we accept his premise that the use of such data can be flawed. We will, however, take this opportunity to illustrate circumstances in which a database such as that generated in the field by the PBA team can be a basis for effective and useful interrogation of excavation results. We further believe that such preliminary processing is an important component of speeding the process of subsequent publication.

By way of example, we can say that 3,885 sherds of the common Roman period red-slipped table ware known either as Çandarli or Eastern Sigillata C (ESC) have been explicitly recorded in the database. This number compares to 302 of the late Roman ware Phocaean Red-Slip (PRS) and 190 of African Red-Slip (ARS).[10] These are gross numbers generated by counting total sherds with no account of weight or percentage of the rim circumference preserved. Nonetheless, such numbers complement the architectural and numismatic evidence indicating that Ilion was prosperous in the middle Roman period, and that its urban fabric was ruptured by an earthquake in the early sixth century AD. Had the city continued to thrive, one would expect greater amounts of both Phocaean Red-Slip and imported African Red-Slip from later periods. Such vessels are well known from Constantinople, which continued to thrive into the Byzantine period.[11]

Looking more closely at the particular forms further confirms the contribution of ceramic studies to defining the chronology of the end of Roman Ilion. Both African Red-Slip and Phocaean Red-Slip are well-studied wares with highly developed typologies that allow many forms to be quite closely dated. For ARS, a preliminary counting of identified forms shows 153 sherds of forms dating from the third through early fifth century, and only 6 unambiguously dated to the sixth century. The same trend is seen with Phocaean Red-Slip. The database records sherds from more than sixty-five Hayes form 3's ranging in date from AD 400 to 550, but only 8 examples of Hayes form 10, all of which date after the late sixth century at the earliest. Even accounting for the approximation of numbers and the ambiguity of dating, the implication of these very different search results seems clear: Ilion saw a major reduction in fineware imports from the fifth to the late sixth centuries. As we have previously said, this observation is part of constructing an image of urban decline following the early sixth-century earthquake. Our main point in including these preliminary numbers is to show that our database is structured in such a way that it can contribute to such historical discussions and suggest future research questions.

Site-wide searches are an important tool that can illuminate large-scale trends at the site, but these searches do not take account of the stratigraphic units within which the pottery was recorded. As noted above, however, all sherds are assigned to such a unit. A closer look at the implementation of the relationship between sherds and unit allows further illustration of how the project represents and uses its ceramic data.

In general, we divide the data recorded about each sherd into two broad categories:

1) sherds whose descriptions exist only as attributes of the stratigraphic unit from which they were excavated; and

2) sherds that have their own unique identifier and can therefore be individually addressed within the database and project workflow.

The nature of the distinction between these categories can be easily understood by looking at records drawn from the Troia PBA database, and we return to the stratigraphic unit KL16/17.0417 to supply our examples.

As noted above, 'KL16/17.0417' is the unique identifier of a stratigraphic unit excavated at Troia in July of 1998. Within the context of the project, such units are known by the German term *'Behälter'* or 'holder', though a more generic term is employed here. KL16/17.0417 represents

[8] Orton 1993; Slane 2003.

[9] Peña 2007, 154.

[10] For definition of these wares see Hayes 1972.

[11] Hayes 1992.

the fill of a pit deposited after the destruction of a house in Ilion's predominantly domestic Lower City. On the basis of the pottery within the fill, this episode of destruction dates to the late third century AD and may be associated with the activity of the Germanic group known as the Herulians, though a full discussion of this point is beyond the scope of this paper.

Ceramic Information as an Attribute of its Stratigraphic Unit

Subsequent to excavation, the pottery from KL16/17.0417 was washed, allowed to dry, and then brought into the pottery processing tent, where it was counted and arranged in bags for storage.[12] As recorded in the ceramic database, a total of 476 sherds were counted at this time. Table 2 shows an adapted excerpt of this data that adds to the information in Table 1.

Individually Identified Sherds

Table 3 adds the concept of "Sequence Number" to the database. Using the conventions of the Troia project, the last five sherds now have unique identifiers formed by the concatenation of the stratigraphic unit and the sequence number. Note that the two ARS bases now appear in individual rows with sequence numbers 6 and 5. Furthermore, one of the Çandarli Hayes form 4 sherds has been assigned sequence number 2 and is now described as a full profile.

Stratigraphic Unit	Ware	Form	Part	Count
KL16/17.0417	Coarseware	Tile	Unclassified	32
KL16/17.0417	Coarseware	Unclassifed	Body Sherds	28
KL16/17.0417	Black Glaze	Kantharos	Handle	1
KL16/17.0417	Aegean Thin Walled	Cup	Base	1
KL16/17.0417	African RS	Unclassified	Body Sherd	1
KL16/17.0417	African RS	Hayes 45	Base	2
KL16/17.0417	Çandarli	Hayes 4	Rim	5

Table 2 Selected data for KL16/17.0417.

For the purposes of this discussion, these records are arranged in order of increasing specificity of the information recorded for each entry. The first line indicates that 32 unclassified fragments of tile were counted within the deposit. The second line indicates the presence of 28 unclassified courseware body sherds. The subsequent lines record sherds for which specific wares were recognized, including the two ARS Hayes 45 bases included in Table 1.

It is certainly the case that the material described here could be the object of more specialized study; but as recorded in this schematically specified table, they cannot be addressed outside the context of the stratigraphic context to which they belong. To put this in practical terms: at Troia, pottery described at this level of detail is stored in canvas bags identified as holding material from a particular stratigraphic unit, in this case KL16/17.0417. While it is possible to retrieve and examine this pottery as a group, it is not possible to retrieve any particular sherd with confidence. With this level of detail, a request to pull all black-slip kantharoi from the unit can be satisfied, but not a request to pull "the exact one examined last year by a particular visiting specialist."

All these numbered sherds can be confidently identified and retrieved for subsequent documentation and study. We have found this system to be easy to implement and to offer a useful balance between the impossibly large amount of work required to number all sherds and the need to identify certain pieces with unambiguous confidence.

[12] Holtorf 2002, 56–59 examines the implications of this generic process for ceramic studies.

Visual Documentation

One fundamental relationship to implement is that between a sherd and its visual documentation, which most commonly takes the form of drawings and photographs. this instance the drawing was first drawn in pencil, then inked by hand. The current practice is now to trace such images in a vector drawing program such as Adobe Illustrator (Fig. 2).

Stratigraphic Unit	Sequence Number	Ware	Form	Part	Count
KL16/17.0417		Coarseware	Tile	Unclassified	32
KL16/17.0417		Coarseware	Unclassifed	Body Sherds	28
KL16/17.0417		Black Glaze	Kantharos	Handle	1
KL16/17.0417		Çandarli	Hayes 4	Rim	4
KL16/17.0417	11	Aegean Thin Walled	Cup	Base	1
KL16/17.0417	9	African RS	Unclassified	Body Sherd	1
KL16/17.0417	6	African RS	Hayes 45	Base	1
KL16/17.0417	5	African RS	Hayes 45	Base	1
KL16/17.0417	2	Çandarli	Hayes 4	Profile	1

Table 3 Pottery database with added sequence numbers.

Subject ID	Drawing Sheet	Drawing Type
KL16/17.0417:11	1769	Profile Drawing
KL16/17.0417:6	1770	Profile Drawing
KL16/17.0417:5	1770	Profile Drawing
KL16/17.0417:2	1008	Profile Drawing

Table 4 Simple drawing database structure.

At Troia, the workflow for each sherd selected for drawing is now relatively straightforward. Giving a sherd to an illustrator results in a profile drawing of that piece on a drawing sheet, which is itself assigned a number. This in turn leads to database records that pair sherds and sheets (Table 4).

As with the ceramic database, additional fields, such as artist or date drawn, can be added to a related table to fit the needs of an individual project. The physical manifestation of this relationship is seen in Fig. 1, which shows a small portion of a scan of drawing sheet 1769.

The 'KL16/17.417:11' appearing next to the profile drawing is an unpadded version of the full unique ID. In

This process produces an individual file whose name matches the sherd number with the important caveat that the '/' and ':' characters are converted into '-'. This last observation suggests that in the future, projects may want to avoid characters, such as '/', that have a reserved meaning in the context of computer file systems. At Troia, we avoid use of the colon character because of our preference for Apple Macintosh computers, which in some circumstances use ":" to indicate separate directories. The association between sherds and photographs is implemented by a pairing of subject and image, in which a photograph is analogous to a drawing sheet (Fig. 3).

Pottery as Small Finds

At Troia, as at many field projects, objects that are particularly well preserved or otherwise felt to be sufficiently distinctive, are designated as small finds and assigned a separate number. This aspect of post-excavation processing has undergone considerable change since the early days of the project, so this section describes an idealized process not burdened by the need to accommodate earlier recording schemes.

The small finds collection is divided into major categories defined by either material, technique, or a combination of both. Each category is identified by its own separate sequence of numbers. Accordingly, "ST0010" is

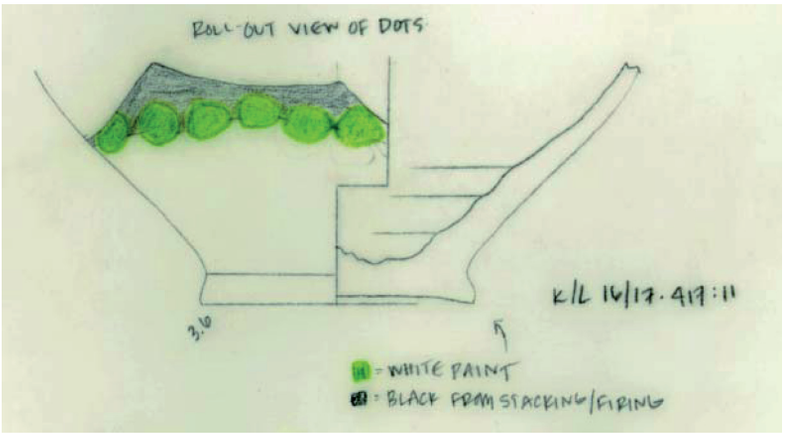

Fig. 1 Uninked drawing of sherd KL16/17.417:11.

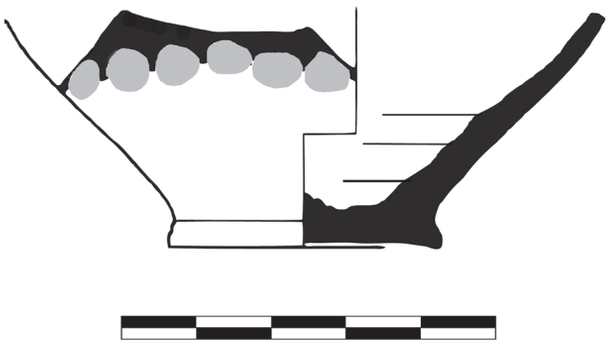

Fig. 2 KL16/17.417:11

Fig. 3 Photograph showing sherd number K17.0759:9. Troia PBA Digital Image 004248

the tenth stone object catalogued, 'C0267' is a coin and "P0150" is a ceramic vessel. The implementation of these distinct sequences highlights the fact that a major reason to assign small find numbers is to facilitate their separate storage. At Troia, coins are kept together in an environment that is relatively stable in terms of humidity, a requirement for the proper curation of these objects. Likewise, all ceramic small finds are stored together in locked storage. Since these finds are registered with the Turkish government, this arrangement makes it easy to audit the integrity of the collection.

At Troia, there are two paths by which a ceramic object can become a "small find". In the first, the object is recognized as distinctive by the excavator in the field and is removed as a separate stratigraphic unit. This is a choice driven by record keeping needs. Alternately, the process of washing and identifying pottery can reveal joins between sherds that allow enough of a vessel to be restored that it ought to be designated a small find so as to facilitate its proper storage. In both cases, it is possible that joining sherds will come from different stratigraphic units.

Stratigraphic Unit	Sequence No.	Small Find	Ware	Form	Part	Count
KL16/17.0417	2	P0656	Çandarli	Hayes 4	Profile	1

Table 5 Pottery database with added small find number.

Whenever an object becomes a small find by either route, the relationship with the other material from the stratigraphic unit must be preserved. At Troia, the PBA small finds database indicates which 'Behälter', to use our localized vocabulary, is the stratigraphic unit that would have contained a small find had it not been separately processed. When one is looking for all pottery from a unit, it is necessary to check which P-series small finds are associated with that unit as well; a process that is automated within our FileMaker implementation. An alternate approach would be to assign sherd numbers to all ceramic small finds. When a sherd number is also a small find that can be indicated in the ceramic database. Table 5 extends the adapted ceramic data to implement this structure by adding a "Small Find" field. It is trivial to link the small find database and the ceramic database on this shared value. When the sherds that make up a small find come from different stratigraphic units, each sherd will have an individual sherd number and link to the composite small find via the "Small Find" field. This approach preserves all stratigraphic relationships. While the doubling of the identities assigned to a single object might seem to be a concern, it is important to remember that the small find number is predominantly an indicator of storage location. It is the combination of stratigraphic unit and sequence number that can insure the integrity of relationships recognized during excavation. Ideally, as this object moves from cataloguing to drawing, the unit and sequence number will be used to identify it.

This approach is implemented for the PBA Ceramic Study Collection, which consists of sherds that illustrate both the most common and certain unusual types of pottery found at Ilion. Here, every sherd in the collection is assigned a standard sherd number. Additionally, each sherd is marked with a number that indicates in which box of the study collection it is stored. As with small finds, a sherd can have additional identities – a small find number or a study collection number – but these do not interfere with effective tracking of the object so long as these additional numbers are layered on top of a primary scheme that maintains stratigraphic relationships. It is useful to accommodate different modes of storage, but it is extremely important to ensure that such complexity does not lead to future difficulty in accessing both information and the physical objects themselves.

Towards Publication

The goal of an archaeological field project is necessarily publication of its results. By allowing straightforward tracking of stratigraphic information, descriptive records, and visual documentation, we have found that the structure of our database has facilitated the publication of the pottery recovered during excavation.[13] This can be seen in two abbreviated catalog entries adapted from the forthcoming publication of the Hellenistic and Roman architecture and stratigraphy from the Lower City.[14]

1. Aegean Thin-wall Painted Cup Base (3rd Century AD)
P.H. 2.9; D. base 3.6; Th. 0.25. Fig. 2.
KL16/17.0417:11. Single sherd preserving complete base. The fine fabric is unevenly fired to brown with frequent small white inclusions and occasional mica on surface, with distinct lighter section at the base. A band of .045 high painted white dots, with 7 at least partially extant, separates the lower lighter colored area from the higher darker one.

Added white decoration is well known on thin-walled vessels. Cf. Hayes 2008, no. 1608.

2. Çandarli Hayes Form 4 Profile (3rd Century AD)
P.H. 3.3; Est. D. r. 17 (1/2 preserved); Th. 0.02.
KL16/17.0417:2. Small find number: P0656. Five joining fragments preserving complete profile. Fine red (2.5YR 7/6) fabric with occasional small white inclusions and more common small voids.

Hayes 1985, 78, pl. XVIII. 4.

To be very clear, catalog entries such as these include information generated by ceramic specialists sometimes working outside the context of the project's FileMaker database. They therefore represent a combination of da-

[13] A list of ceramic publications by members of the PBA team is available at http://classics.uc.edu/troy/grbpottery/html/bibliography_ilion.html.
[14] In preparation by C. B. Rose, B. Tekkök and S. Heath.

tabase-assisted publication and carefully crafted scholarly output. Note, however, that the catalog entry maintains and publishes the unique identifiers assigned to each sherd, including the small find number 'P0656' in entry #2. During the process of publication, maintaining these identities facilitates the very practical task of assembling profile drawings and photographs. After publication, these identifiers remain the primary means of accessing the sherd itself, should that ever become necessary. While the fact of publication, along with the catalog number, is recorded in the FileMaker database and can be searched, that new identifier does not become the primary means of referring to the object. This maintains simplicity going forward.

We also believe that such consistency of identification will be important as more of the data from the PBA team becomes available online. As of this writing, the most substantial publicly available collection of digital records for ceramics from Ilion is the publication Greek, Roman and Byzantine Pottery from Ilion (Troia) – abbreviated GRBPIlion.[15] This work consists of pre-published catalog entries; entries that are in preparation for print publication; and a growing selection of entries describing important sherds not currently intended for inclusion in any other study, with many of these coming from the PBA study collection. The intent of GRBPIlion is to provide an overview of the major categories of pottery found at the site, with the categories often corresponding to a well-recognized ware – e.g., Attic Red-Figure. Each category has an introductory paragraph, followed by a catalog of illustrative sherds. Fig. 4 features a screen capture from the site; the profile drawing shown is of the same amphora neck and handle appearing in Fig. 3. In all cases, the digital publication reuses the sherd, small find, and study collection numbers previously assigned.

The profile drawings likewise make use of the sherd number to derive a file name. While some ad hoc photography was done for GRBPIlion, the great majority of the photographs are identified by the number first assigned to them by the project. Indeed, the digital publication usually includes a copy of the original project photography at full resolution.

As the amount of information from the project increases, we expect that this reuse of identifiers will greatly ease the process of linking between disparate types of information. Our intention is to anticipate an environment in which it is easy to see which coins or other category of small find were found with the pottery from a stratigraphic unit and to further explore that same question for adjacent units.

Conclusion

Our goal in this article has been straightforward: to stress that simple database constructs can promote in-field use and subsequent publication of ceramic data. We particularly stress that it is important to assign a primary identity to all sherds that will be subject to individual study. This identity should follow naturally from the stratigraphic context of the object. A primary identifier can be used in conjunction with other numbers that indicate where a sherd is stored, but it is useful to maintain the original unique ID for tracking a sherd through drawing and photography. Such a system will promote well-organized collection and rapid retrieval of information, which will in turn lead to speedier publication. We also note that within such a system, quantification of sherd numbers can provide preliminary assessment of an assemblage and also assist in identifying tractable research goals.

[15] Heath/Tekkök n.d.

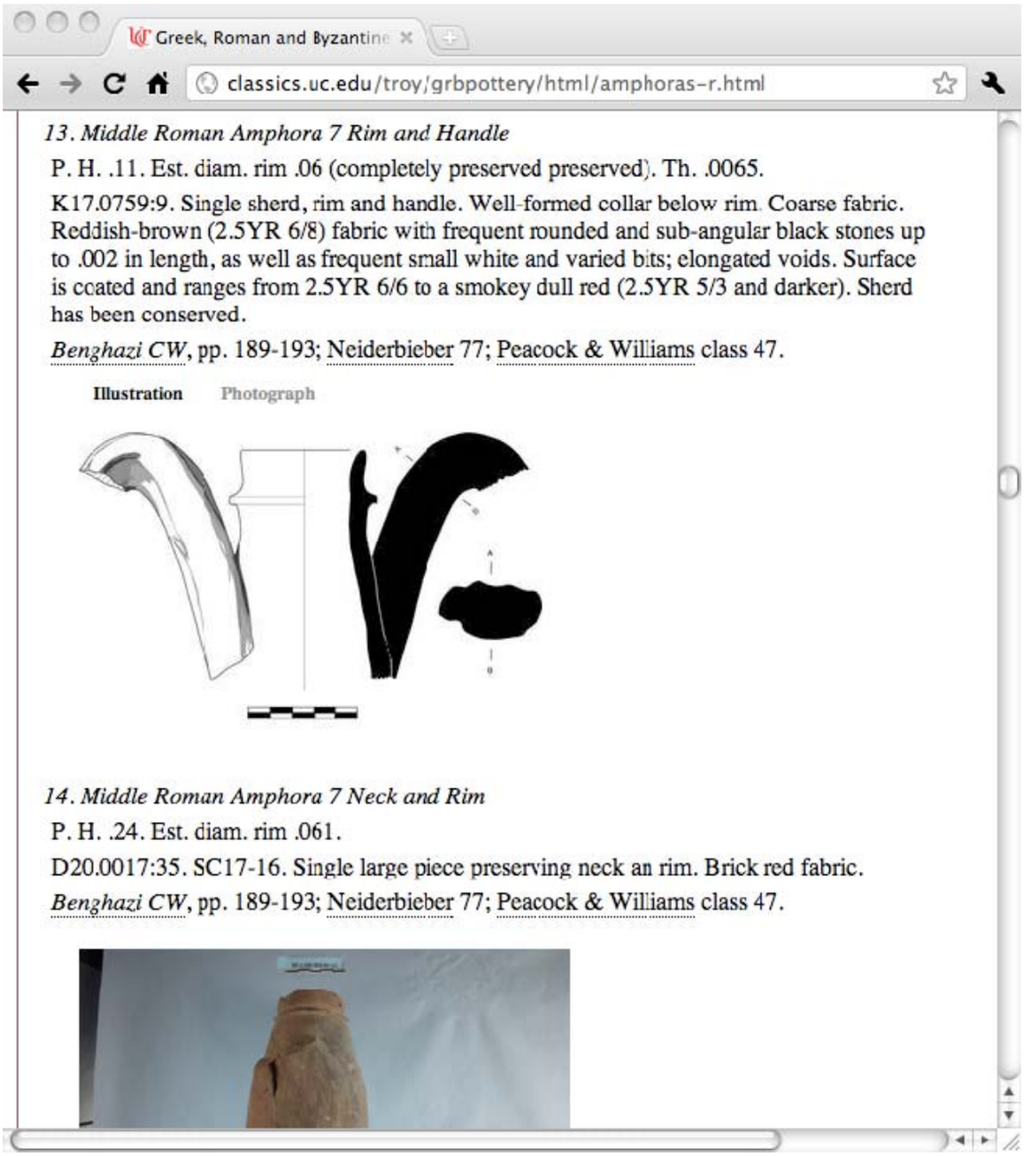

Fig. 4 Page from Greek, Roman and Byzantine Pottery at Ilion (Troia); showing entry for sherd K17.0759:9.

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Prof. Dr. Billur Tekkök
Baskent University
Faculty of Fine Arts, Design and Architecture
Department of Art History and Museology, Chair
Baglica Kampusu, Baglica
TR 06530 Ankara
tekkok@baskent.edu.tr

John Wallrodt
Classics Department
University of Cincinnati
PO Box 210226
Cincinnati OH 34221
USA
John.wallrodt@uc.edu

Prof. Dr. Sebastian Heath
Institute for the Study of the Ancient World
New York University
15 East 84th Street
New York, NY 10028 USA
sebastian.heath@nyu.edu