McDONALD INSTITUTE CONVERSATIONS

Authenticity and cultural heritage in the age of 3D digital reproductions

Edited by Paola Di Giuseppantonio Di Franco, Fabrizio Galeazzi and Valentina Vassallo

Authenticity and cultural heritage in the age of 3D digital reproductions


Star Carr
head dress

McDONALD INSTITUTE CONVERSATIONS

Authenticity and cultural heritage in the age of 3D digital reproductions

Edited by Paola Di Giuseppantonio Di Franco, Fabrizio Galeazzi and Valentina Vassallo

with contributions from
Nicola Amico, Frederick Baker, Gareth Beale, Eleni Bozia, Mark Elliott, Kevin Garstki, Sorin Hermon, Stuart Jeffrey, Peter Jensen, Jody Joy, Sarah Kenderdine, Nicoletta Miltiadous, Franco Niccolucci, Paola Ronzino and Lola Vico

This book was funded by the EU 7th Framework Programme (7FP), DIGIFACT 625637 Project (http://cordis.europa.eu/project/rcn/187953_en.html) and ADS3DV 625636 Project (http://cordis.europa.eu/project/rcn/187952_en.html). The book will be Open Access, thanks to FP7 post-grant Open Access (https://www.openaire.eu/postgrantoapilot).

Published by:
McDonald Institute for Archaeological Research
University of Cambridge
Downing Street
Cambridge, UK
CB2 3ER
(0)(1223) 339327
eaj31@cam.ac.uk
www.mcdonald.cam.ac.uk

ISBN: 978-1-902937-85-4

Cover design by Dora Kemp, Fabrizio Galeazzi and Ben Plumridge.
Typesetting and layout by Ben Plumridge.

Cover image and p.ii: Collages created using images from within the book by Fabrizio Galeazzi.

Edited for the Institute by James Barrett (*Series Editor*).

Contents

Contributors

Nicola Amico
Science and Technology in Archaeology Research Center (STARC), The Cyprus Institute
20 Konstantinou Kavafi Street, 2121, Nicosia, Cyprus /
VAST-LAB – PIN
Piazza Ciardi 25, Prato, PO59100 Italy
Email: nicola.amico@pin.unifi.it

Frederick Baker
McDonald Institute for Archaeological Research, University of Cambridge
Downing Street, Cambridge, CB2 3ES, UK
Email: fb346@cam.ac.uk

Gareth Beale
Department of Archaeology, University of York
King's Manor, York, YO1 7EP, UK
Email: gareth.beale@york.ac.uk

Eleni Bozia
Department of Classics and Digital Worlds Institute, University of Florida
137 Dauer Hall, University of Florida, P.O. Box 117435, Gainesville, FL 32611, USA
Email: bozia@ufl.edu

Paola Di Giuseppantonio Di Franco
School of Philosphy and Art History, University of Essex
Colchester, CO4 3WA, UK /
McDonald Institute for Archaeological Research, Cambridge
Downing Street, Cambridge, CB2 3ES, UK
Email: pd17425@essex.ac.uk

Mark Elliott
Museum of Archaeology and Anthropology, Cambridge
Downing Street, Cambridge, CB2 3DZ, UK
Email: mje29@cam.ac.uk

Fabrizio Galeazzi
Department of Archaeology, University of York
King's Manor, York, YO1 7EP, UK
Email: fabrizio.galeazzi@york.ac.uk

Kevin Garstki
Department of Social and Cultural Studies, Marquette University
Lalumiere Language Hall 340, P.O. Box 1881, Milwaukee, WI 53201, USA
Email: kevin.garstki@marquette.edu

Sorin Hermon
Science and Technology in Archaeology Research Center (STARC), The Cyprus Institute
20 Konstantinou Kavafi Street, 2121, Nicosia, Cyprus
Email: s.hermon@cyi.ac.cy

Stuart Jeffrey
The Glasgow School of Art, University of Glasgow
167 Renfrew Street, Glasgow, G3 6RQ, UK
Email: s.jeffrey@gsa.ac.uk

Peter Jensen
Department of Archaeology and Heritage Studies, Aarhus University
Moesgård Allé 20, DK-8270 Højbjerg, Denmark
Email: peter.jensen@cas.au.dk

Jody Joy
Museum of Archaeology and Anthropology, Cambridge
Downing Street, Cambridge CB2 3DZ
Email: jpj32@cam.ac.uk

Sarah Kenderdine
Digital Humanities Institute, College of Humanities, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
Email: sarah.kenderdine@epfl.ch

Nicoletta Miltiadous
Department of Antiquities, Cyprus
1 Museum Avenue, P.O Box 22024, 1516, Nicosia, Cyprus
Email: nicolettaele@gmail.com

Franco Niccolucci
Science and Technology in Archaeology Research Center (STARC), The Cyprus Institute
20 Konstantinou Kavafi Street, 2121, Nicosia, Cyprus /
VAST-LAB – PIN
Piazza Ciardi 25, Prato, PO59100 Italy
Email: franco.niccolucci@pin.unifi.it

Paola Ronzino
Science and Technology in Archaeology Research Center (STARC), The Cyprus Institute
20 Konstantinou Kavafi Street, 2121, Nicosia, Cyprus /
VAST-LAB – PIN
Piazza Ciardi 25, Prato, PO59100 Italy
Email: paola.ronzino@pin.unifi.it

Valentina Vassallo
Science and Technology in Archaeology Research Center (STARC), The Cyprus Institute
20 Konstantinou Kavafi Street, 2121, Nicosia, Cyprus
Email: v.vassallo@cyi.ac.cy

Lola Vico Lopez
Science and Technology in Archaeology Research Center (STARC), The Cyprus Institute
20 Konstantinou Kavafi Street, 2121, Nicosia, Cyprus
Email: lola.vico@gmail.com

Figures

Foreword

The era of digital replication

Sarah Kenderdine

> A digitally recorded copy… can be both a lode of 'forensically accurate information' and a vehicle for provoking a 'deep emotional response.' (Zalewski citing Lowe 2016).

With our increasingly sophisticated processes of digital replication, the debates surrounding issues of aura and authenticity of the copy have emerged with vigour in the public domain. Let us consider the case of The Next Rembrandt. Purportedly devised by advertising executive Bas Korsten as part of an advertising campaign for ING Bank in 2016, The Next Rembrandt is the product of a computer program that utilizes data derived from 168,263 Rembrandt painting fragments to compose and 3D-print a textured, 'painted' image (Brown, 2016). The Next Rembrandt is considered by its creators as new work of 'art' in the sense that it is not a composite of features from Rembrandt originals, but the result of a pattern recognition program that has generated new features. However, the responses to The Next Rembrandt have been polarizing. While Korsten hoped the project would be 'the start of a conversation about art and algorithms', mixed public and critical responses to the images signified the strength of traditional concepts of fine art, genius and authenticity and, the reverence for auratic masterpieces prevalent in society today. The inevitable comparison between The Next Rembrandt and actual Rembrandts resulted in the accusation of 'fakery' and the presumption that Korsten and his team have been engaged to reduce artistic 'genius' to a series of imitable features. Jonathan Jones of The Guardian wrote:

> What a horrible, tasteless, insensitive and soulless travesty of all that is creative in human nature. What a vile product of our strange time when the best brains dedicate themselves to the stupidest 'challenges', when technology is used for things it should never be used for and everybody feels obliged to applaud the heartless results because so revere everything digital… What these silly people have done is to invent a new way to mock art. (Jones, 2016)

Despite Korsten's insistence that he has 'creat[ed] something new' through algorithmic processes and that 'only Rembrandt could create a Rembrandt', Jones clearly resents the perceived implication that 'great art can be reduced to a set of mannerisms that can be digitised' (Brown, 2016; Jones, 2016). For detractors of digital facsimiles, several key structures of art are at stake in The Next Rembrandt including, the aura of the masterpiece, that which is deserving of the 'Rembrandt Shudder', the impact of the artist's psyche on the work of art and the exclusive rights of the original and authentic art object to be a result of 'genius'. Aura is tied to authentic originality and context, and the possibility of artificial processes for creation calls into question which aspects of the context and provenance of a work of art are most important to the category of 'art'. Jon McCormack et al. (2014) ask, 'Why dismiss outright that a machine and a human might share experiences that result in something meaningful and worth communication?' (p. 135). In Korsten's words: 'Do you need a soul to touch the soul?' Besides the implication that the creators have attempted to pilfer a portion of the aura of a Rembrandt, the sheer resemblance of the computer-generated piece to that of an actual Rembrandt prompts questions of the importance of authentic experience. Jones's outrage is at least in part motivated by the notion that The Next Rembrandt is a fake – even though it is not a copy or computer-generated duplicate of an extant composition.

These forceful debates sit within a period in our history where iconoclasm, the destruction of cultural property for political ends, is a weapon of choice. While the annihilation of heritage and its keepers have been with us for 1000s of years, it remains one of the most powerful political & socio-cultural weapons of our times. Director General of UNESCO Irina Bakova says we are currently witness to extreme forms of cultural cleansing. And she reminds us that education about heritage is a cultural emergency and this should be taken a political and security imperative. Add to this crisis, climate change catastrophes, natural disasters and destruction of sites through mass tourism, digital replication has emerged as the key topic for cultural heritage in the present. The authors of the chapters in this book are at the heart of a potential revolution of safekeeping of cultural objects and heritage sites, afforded by high quality digital facsimiles. The assemblage of chapters provides us much-needed theoretical scaffold to validate 'the copy' in perilous times.

High-fidelity digital copies have often struggled to escape the stigma of data-driven, didactic visualizations. Stuart Jeffrey argues, for example, that digital objects have been perceived to possess an inability to inherit 'aura' due to a neglect of creative imagination (Jeffrey, 2015). He identifies five key traits that digital objects must overcome: their lack of physical substance compared to real objects, their lack of native location, the ease of their infinite reproducibility, their inability to degrade and the difference between original ownership and digital licensing. Through critical theory and a series of case studies, data standards and fieldwork techniques, the book addresses issues raised by Jeffrey and others concerning diverse themes such as authority, authenticity and aura, new materialism, circulation and reproducibility and the experience of (digital) aura. Each chapter is part of an emerging and critical restructuring of how we perceive the copy in relation to the original. As a collection of perspectives on these issues, it is both timely and essential reading.

References

Jeffrey, S., 2015. Challenging Heritage Visualisation: Beauty, Aura and Democratisation. *Open Archaeolo*gy 1, 144–52.

Jones, J., 2016. The digital Rembrandt: a new way to mock art, made by fools, The Guardian, 7 April 2016: https://www.theguardian.com/artanddesign/jonathanjonesblog/2016/apr/06/digital-rembrandt-mock-art-fools.

McCormack, J., Bown, O., Dorin, A., McCabe, J., Munro, G., & M. Whitelaw, 2014. Ten Questions Concerning Generative Computer Art. *Leonardo* 47(2), 135–41.

Zalewski, D., 2016. The Factory of Fakes, The New Yorker, 28 November 2016: http://www.newyorker.com/magazine/2016/11/28/the-factory-of-fakes

Introduction

Why authenticity still matters today

Paola Di Giuseppantonio Di Franco,
Fabrizio Galeazzi and Valentina Vassallo

> This blind man, an old friend of my wife's, he was on his way to spend the night… Something about the church and the Middle Ages was on the TV… the TV showed this one cathedral… Then something occurred to me and I said: 'Do you have any idea what a Cathedral is?'… 'Cathedrals' the blind man said. He sat up and rolled his head back and forth. 'If you want the truth, bub, that's about all I know… But maybe you could describe one to me?'…'Hey, listen to me. Will you do me a favor? I got an idea. Why don't you find us some heavy paper? And a pen. We'll do something. We'll draw one together. Get us a pen and some heavy paper. Go on, bub, get the stuff,' he said… He closed his hand over my hand. 'Go ahead, bub, draw,' he said… 'Close your eyes now'… 'Don't stop now. Draw'… Then he said, 'I think that's it. I got it.' 'Take a look. What do you think?'… My eyes were still closed. I was in my house. I knew that. But I did not feel like I was inside anything. 'It's really something,' I said. (Raymond Carver, *Cathedral*, 1).

Defining authenticity

The idea for this book came after a session organized by the editors at the 2015 Annual Meeting of the European Association of Archaeologists (EAA), entitled 'Re-defining Authenticity in the Age of 3D Digital Reproductions'. The book includes contributions from some of the panellists attending the session and from invited scholars who have been working on the theme both theoretically and through specific projects. The general scope of this book is to introduce and discuss the epistemology of the concept of authenticity with the focus on how it can be defined and 'achieved' through digital replicas. The challenge of this work is to analyse the concept from different perspectives and with different multi-disciplinary contributions, together with theoretical debate. This volume represents the first attempt to collate an organic collection of contributions on authenticity and the digital realm in heritage and archaeology.

Why authenticity? This is a much debated concept as it is assumed today that authenticity is defined by Western views of heritage. To study the etymology of the term, in a fascinating paper Lionel Trilling (1973, ii) goes back to the medieval term *sincerity*: 'Before authenticity had come along to suggest the deficiencies of sincerity and to usurp its place in our esteem, sincerity stood high in the cultural firmament and had dominion over men's imagination of how they ought to be'. Long debates on how heritage should be defined have brought authenticity into play. While organizations such as ICOMOS and UNESCO (to name just two of the best-known) have institutionalized the term, conflicting and sometimes more decentralized views have criticized, even denied, the existence of authenticity (going back to Baudrillard and his idea of heritage as 'a real without origin or reality: a hyperreal'; 1994, 1). Even though efforts have been made recently by members of UNESCO to incorporate conflicting views of heritage and authenticity, we believe that they have failed at least in part, since what Laurajane Smith defines as Authorised Heritage Discourse (AHD; Smith 2006) is principally defined by the idea that we need to preserve the authenticity of our heritage. For this reason, we believe that a study of authenticity is central not only to the definition of heritage, but also to the practice of digital heritage. Digital heritage practices have the power to replicate infinitely the AHD or, conversely, to find new ways to re-define the authenticity of heritage and incorporate conflicting views on this concept.

Heritage and museum specialists have institutionalized authority to protect and preserve the authenticity of the past, especially in the Western world (e.g. NARA Document 1994; Venice Charter 1964). While audiences, communities and the public usually engage with this institutionalized past, new media, 3D technologies and the internet can, potentially, challenge the AHD. The use of 3D replicas for the preservation, analysis and dissemination of cultural heritage is well established today. The practice of digitally replicating heritage goes hand-in-hand with the central question of if and how the 'authenticity' of heritage can be 'reproduced', which is also an ontological question on how we define authenticity and an authentic object. As is well expressed by Andrea Witcomb (2010), contemporary discussions on the impact of multimedia technologies on both museums and archaeology and heritage more broadly tend to assume a radical difference between the virtual and the material world, a difference that is conceived in terms of a series of oppositions. The material world carries weight – aura, evidence, passage of time, the signs of power through accumulation, authority, knowledge, and privilege. Replicas, on the other hand, are perceived as the opposite of all of these – immediate, surface, temporary, modern, popular, and democratic. In other words, this discussion emphasizes a dichotomy between original (authentic) artefacts and inauthentic replicas. This discussion is based on the assumption that while original artefacts possess an 'aura' – arising from their uniqueness as an effect of a work of art being uniquely *present* in time and space – once the objects are reproduced they become merchandise, and as a consequence they lose their aura. This point is connected to the idea of *authenticity*: if there is no original, it is never fully present anywhere. Authenticity cannot be reproduced, and disappears when everything is reproduced. Benjamin (1968) argues that even the original is depreciated, because it is no longer unique. Along with their authenticity, objects also lose their authority. The masses contribute to the loss of aura by seeking constantly to bring things closer. They create reproducible realities and hence destroy uniqueness.

The contributions to this book, however, suggest that these dichotomist distinctions between originals and replicas are far more complex than they might at first appear. As was well demonstrated by the international discussion that resulted in the NARA Document (1994), the *authenticity* of cultural heritage is culturally mediated and implies specific *significance* and *values* that are applied to cultural heritage by *diverse* groups of people in specific and/or different *times*. Similar assumptions can be applied to the replica, whose level of authenticity can be defined based on its mode of production and consumption and the social values attached to the replica by different cultures and in different times (see the contributions of Jeffrey and Beale in this volume).

Based on these assumptions, some scholars even question Benjamin's statements about the loss of aura experienced by replicas and see instead a 'migration of aura' from the original to the copy. This claim is reiterated by most of the contributors to this volume. Recently, Bruno Latour and Alan Lowe considered how it might be possible to migrate the aura to the reproduction or reinterpretation of the original (Latour & Lowe 2011, 283). They underline the obsession of the age for the original, and how this obsession increases as more accurate copies of the original become available and accessible. Latour and Lowe argue that 'the real phenomenon to be accounted for is not the delineation of one version from all the others but the whole assemblage of one − or several − original(s) *together with* its continually rewritten biography' (Latour & Lowe 2011, 278). The possibility of retrieving the aura from the flow of copies has to be reconsidered today.

Digital replicas have complex and dynamic relationships with the original heritage objects they represent. These involve forms of partial migration of aura and the generation of new types of value and authenticity (Jeffrey et al. 2015; Jones 2010; Joy 2002). 3D printing creates a further element of complexity as the digital object 'migrates' back into the material world.

In this monograph we intend to challenge and reconsider the notion of authenticity in digital archaeology and digital heritage studies. Our papers explore the concept of authenticity in a comprehensive way, engaging with theories relating to the commodification of ancient material culture, heritage-making processes, scholarly views, and community engagement. These papers also take into account current digital practices for the study of past material culture and how their use affects and redefines interpretation processes in archaeology. Various sub-themes related to the topic of authenticity are discussed in all the contributions to this volume: materiality vs constructivism theories, object biographies, authority vs power, and experience vs performance.

Materiality vs constructivism

According to Fiona Cameron and Sarah Kenderdine (2010), in the last few years much of the discourse about the relationship between cultural heritage and digital technology has been descriptive and introspective, focusing on projects and their technical considerations. In other words, the discourse has often started from a materialist view of authenticity that relies on the idea

that there is an objective basis for the definition of authentic cultural heritage. This is exemplified by the contribution of Sorin Hermon and Franco Niccolucci (Chapter 3) who were involved in the creation of the London Charter, an essential document for digital heritage practitioners as it sets out guidelines for a transparent process of digital replication and reconstruction of cultural heritage. The London Charter focuses on what we might call the reconstruction of surface-authenticity or the authenticity of surface, that is, the metric reconstruction of surface information. The chapter by Lola Vico Lopez (Chapter 2) shows how the London Charter, combined with guidelines dictated by other charters for the restoration of original monuments (e.g. Italian Restoration Charter), has influenced digital processes of 3D reconstruction.

Cameron and Kenderdine concur that there is a need to move away from the formalist notions of technology and materiality that make digital objects fit into the specific rubric of 'replicant' which has constrained their value, meaning, and imaginative use. Nonetheless, we believe that this formalism, as defined by the London Charter, is an essential starting point for both the specialists that study and try to reconstruct heritage from scientific cues, and those people that 'live' heritage through performance. This is because some societies (especially in the Western world) see metric digital reproductions of heritage as a crucial baseline for the 'authentic' experience when accompanied by a transparent description of the data-making and interpretation processes.

This aspect is well expressed in Chapter 5 by Peter Jensen, where he emphasizes how meta- and paradata, as defined in the London Charter, support the transparency of the interpretation process. Archaeologists and heritage practitioners make assumptions about heritage that are based not only on the archaeological context, but also the currently available scientific methods and practice. Meta- and paradata show in a transparent way how interpretations and representations evolve over time, as new data and new knowledge become available.

Object biographies

From the perspective of object biographies, the digital form of monuments and artefacts is simply another stage in their long life-span, which does not undermine the authenticity of these objects. As stated by Jody Joy and Mark Elliot in this volume (Chapter 1) and Jody Joy in previous works (2002), the copy simply emphasizes the spatiality and temporality of an object and implies a transferability of the aura (or part of it) from the original to the copy. This argument is also followed by Nicola Amico et al. in Chapter 9. While Bruno Latour and Alan Lowe argue that the aura can 'migrate' from the original to its potentially infinite copies (Latour & Lowe 2011, 278), to them the central question about authenticity and aura is not 'is it an original or merely a copy?' but 'is it well or badly reproduced?', thus reconciling accuracy and transparency (i.e. the material perspective toward the replica), with aura and experience (i.e. the constructivist view). They go on to say:

> [F]acsimiles, especially those relying on complex (digital) techniques, are the most fruitful way to explore the original and even to help re-define what originality actually is… To say that a work of art grows in originality thanks to the quality and abundance of its copies, is nothing odd: this is true of the trajectory of any set of interpretations. (Latour & Lowe 2011, 278–9).

From this perspective, the authenticity of an object is maintained thanks to this temporal and material fluidity. The continuous path through time and space of humanly made objects has been exhaustively studied by several scholars when trying to study 'things' through analysing their biographies (Holtorf 2002; Knappett 2002; Tringham 1994; Kopytoff 1986; Pred 1984). This concept of material fluidity needs to be reconsidered, however, in relation to the digital and the web, which favour an unprecedented dissemination of digital copies. We need to consider what happens to *the original* now that no great distinction can be made between the various digital copies that populate the World Wide Web, raising issues relating to distribution and copyright, authority and power. It is always more relevant in a web-connected world to keep track of the flow of the copies described by Latour and Lowe, and develop 'fluid' and 'transparent' biographies of 'things'.

Authority and power

As expressed at the beginning of this paper, archaeologists and heritage and museum specialists have authority to manage the original object/cultural heritage. Archaeologists are the first people to experience the object during its discovery. After studying the object and giving their personal/subjective interpretation, they give back to the public an 'authentic' piece of their cultural past. From the moment of its discovery, a set of power relations characterizes the life of the object out of the ground and identifies 'those people who have the ability and authority to "speak" about or "for" heritage … and those who do not' (Smith

2006, 12). As pointed out by Laurajane Smith in her book *The Uses of Heritage* (2006), archaeologists and conservation architects dominate the preservation and management of most heritage sites and places both on a practical level – since they have a significant presence in UNESCO and ICOMOS, government heritage bureaucracies and amenity societies – and on a philosophical level, due to 'the ability of both disciplines to claim expert authority over material culture' (Smith 2006, 26). Specialists decide how to manage and preserve the material heritage and its 'physical' authenticity.

When material heritage is taken inside a museum, new forms of authority and power come into play. Russo and Watkins (2007, 157) argue that in the modernist museum paradigm, the geographic address, with its defined real spaces, drew the visitors through its doors. These visitors engaged in an interaction with the artefact(s) and institution in a personal and physical way. Such engagement led to the definition of cultural experience, providing meaning through authenticity. The connection to reality, with its promise of authenticity, endowed the museum with authority. Physical boundaries, as well as hierarchies of practice, protected the territory the museum occupied and the social/cultural structures derived from this philosophy. This paradigm is still prominent in quite a few museums today, empowering curators and other museum specialists who become the authority entitled to handle the objects, reinforcing their status and right to touch. 'In contrast, the public – those people who are not entitled to touch – have grubby hands that potentially render objects filthy' (Candlin 2007, 95). In this way curators and museum specialists become the only intermediaries between the relics and the public, carrying 'the sacred flame of the institution – the museum … These same people question when anybody doubts the apostolic succession' (Taverne, quoted in Gibbons 2001). 3D digital and especially printed replicas offer new possibilities for tactile (virtual touch in the case of 3D digital replicas) interaction with tangible heritage. By extending the number of people that are entitled to touch the object, these innovative technologies force us to reconsider the traditional concept of authenticity.

More broadly, we believe that 3D digital and printed replicas have the potential to challenge the AHD (Smith 2006), providing the possibility of extending the interaction and critical participation of non-expert users/the public in accessing and using heritage, an aspect which, according to Laurajane Smith, was absent in the AHD which established top-down relationships between expert, heritage site and 'visitor' (Smith 2006, 34). These new tools also favour the creation and diffusion of 'subaltern' discourses about the nature, meaning and use of heritage, characterized by the participation of different communities in heritage management and conservation, as is well illustrated by both Stuart Jeffrey and Gareth Beale in Chapters 4 and 7.

Experience and performance

Most of the scholars dealing with the concept of authenticity as applied to tourism and the public focus on the nature of engagement and experience with objects, rather than a quest for authenticity in the objects themselves. From this perspective, 'authenticity' is defined by the 'experience' (Wang 1999, 352). This view has followed the idea that tourism leads to commoditization, which many writers consider destroys the authenticity of heritage (Greenwood 1977; MacCannell 1973; Boorstin 1964); instead a surrogate 'staged authenticity' (MacCannell 1973, 597) or 'pseudo event' (Boorstin 1964) is sold to tourists as an original cultural product, to respond to their genuine desire for authentic experiences.

A more positive approach toward this idea of the 'experience' is based on the assumption that visiting heritage sites and museums is a performance. People (visitors, audiences, communities) interact with cultural heritage for a variety of reasons and in a variety of ways, and this consumption of identity and place is as valid as the performances of heritage that are historically legitimized. Silverman (2015) defines the contemporary process of heritage performance as 'contemporary authenticity' and states how this process 'rather than being kitsch, inappropriately labelled post-modern, or demeaned as a simulacrum (as per Baudrillard) is a vital force driving much national and local culture and cultural entrepreneurship today.' (Silverman 2015, 85).

Even though it is true that a fundamental aspect of authenticity in heritage is its problematic relationship to the global tourism economy (Silverman 2015, 79), and digital reconstructions are a part of it, the papers in this book demonstrate that studies on the authenticity of the 'experience' with heritage relate not only to tourism, but also the concepts of performance and authorship.

The first of these harks back to the idea of aura and suggests that the aura of heritage is not necessarily intrinsic to the objects themselves, but must be constituted in performance (Joy 2002). When the replicas allow performance with heritage, the aura of the original partly migrates and new meanings help to regenerate the original aura. In a 3D digitally reconstructed environment, performance and experience are achieved through 'immersivity' and 'presence'. Embodiment is one of the key components of immersive systems which have been implemented

and used in heritage, based on the idea that both our experience and understanding of the past are mediated by our embodied experience with past remains (Dant 1999; Malafouris 2004). According to this idea, cognition depends on our bodily, sensory motor capacity to experience the material (Varela et al. 1991, 172–3). 3D immersive systems have therefore been designed following theories of embodiment (Forte 2014, 22; Camporesi & Kallmann 2013; Kenderdine et al. 2012; Galeazzi et al. 2010; Levy et al. 2010; Kenderdine et al. 2009; Forte 2008). Immersive systems allow for a sense of 'presence', as defined by Draper et al. (1998, 356): 'a mental state in which a user feels physically present within the computer-mediated environment'; and by Dawson et al. (2011, 389) as involving 'feelings of being transported to another place and time ("you are there")'. This presence is defined as 'physical', 'social', and 'cultural' (see Pujol & Champion 2012 and Dawson et al. 2011, which also provide a definition of 'presence'; see also Forte et al. 2006; Petridis et al. 2003; 2006; Di Blas et al. 2005).

The concept of authorship relates to the experience of making a digital object and also ties back to the concept of embodiment. Both Stuart Jeffrey and Kevin Garstki (Chapters 4 and 6) demonstrate how when a community select and digitally replicate heritage, the 3D digital replica is felt as more authentic. We believe that the process of reconstruction is a performance that enhances the migration of the aura through affective bodily interaction with an object. In fact, digital replication and reconstruction involves 'body-based image schemas' (Csordas 1994), that is the descriptions, metaphors and metonyms of the body that mediate between physicality and sociality, the material and the virtual, the real and the copy. These schemas mediate through the feelings involved in crafting a replica.

Structure of the book

This interdisciplinary edited volume gathers together 18 researchers affiliated to various international universities and research centres working in the fields of Heritage, Digital Heritage, Museum Studies, Archaeology, Archaeological Science, and Digital Archaeology.

The book aims to contribute to an ongoing commitment of the European Union to explore the role of 3D technologies for enhancing European heritage-making processes and to promote both access and preservation of heritage. This has been reflected in the funding of several research projects on digital media and 3D technologies, including the Marie Curie Intra-European Projects of two of the three editors of this volume. These projects have funded the publication of this volume. We believe that this monograph will generate great interest in the international academic community, providing a key reference text for all readers interested in authenticity, in particular cultural heritage and 3D reproductions.

The chapters cover a variety of themes in a logical sequence from the history of replicas (e.g. museum casts and architectonic replicas) to cases studies showing the multiple applications of digital replicas in archaeology and the heritage field. The book is divided in four parts:

Part 1. Histories

Here readers can explore the fascinating stories behind the predecessors of digital replicas: museum casts and architectonic replicas.

In Chapter 1 Jody Joy and Mark Elliot tackle the issue of the 'real replica'. These are the casts stored in museums: on the one hand they are considered not valuable because they are not 'authentic' or genuine objects from the past; on the other hand they are charming vintage reproductions of the past which can be contrasted with the modern replicas created using modern digital techniques. According to the authors, replicas can also be a valuable source of information for authentic objects that may now be lost, damaged or transformed. In a sense, these copies bring along their own biographies – their context of creation and use – and therefore can be studied as such. Joy and Elliot examine the use of replicas in museums and, among other purposes, their role as a teaching aid before the advent of digital technologies. The authors focus on a specific case study: the so-called 'Maudslay Casts', a group of plaster casts of Classical Maya monuments at the Museum of Archaeology and Anthropology (MAA), University of Cambridge. Through this case study the two scholars show changing attitudes towards replicas over time, and ask what will be the role of such casts in the digital era.

In Chapter 2, Lola Vico Lopez compares the axioms *authenticity/realism* with *virtual/real reconstructions*. The author argues that although principles and criteria for evaluating the quality of projects in terms of historical rigor and scientific transparency have been developed (e.g the London and Sevilla charters), these are intended as general guidelines and not as prescriptive rules or standards, in contrast to architectural restoration, which is considered a well-defined science. Vico Lopez wishes to 'demonstrate that virtual reconstructions share a part of the theoretical framework of the architectural reconstructions', based on authenticity and scientific transparency objectives, and therefore one can attempt to build a theoretical framework for virtual reconstructions. More specifically, she aims to

discuss critically the contraposition between real and virtual reconstructions, applying the rules of the most famous restoration charters to virtual reconstructions. Consideration is given to a review of terminology, considered an important factor in any discussion on authenticity applied to the architectonic restoration domain and now expanded to the virtual one. In this vein, an architectonic method for virtual reconstruction is applied to some case studies, together with a series of principles for identifying architectural authenticity in 3D digital modelling.

Part 2. Definitions

This part considers two apparently opposite definitions of authenticity in relation to digital replicas: the first (Chapter 3) is object-centred; the second (Chapter 4) is community-centred. As discussed above and shown later in the book, these definitions can be reconciled through practice and use.

In Chapter 3 Sorin Hermon and Franco Niccolucci discuss the London Charter, a document they wrote almost a decade ago, together with other scholars, which defines a set of principles to ensure methodological rigour for the use of computer-based visualization methods. They consider its outcomes for the research and communication of Cultural Heritage, and to what extent the Charter is still relevant. It defines authenticity from a materialist perspective, claiming a need for solid principles that justify the choices made by computer specialists who create digital replicas of cultural heritage. These principles allow for 'intellectual transparency' (Beacham et al. 2006), i.e. recognizing the replicas as the product of a scientific process. Liability and reproducibility are two basic requirements in any discipline, and they become even more meaningful in the digital frame. The London Charter principles help to address these issues in the scientific process and guarantee that the authenticity of a digital visualization outcome is expressed at its best.

Through the case study of the church of the Christ Antiphonitis (Cyprus), the authors outline the principles of the London Charter and how they were addressed for evaluating the 'authenticity' (for the authors, 'intellectual accountability and data transparency') in the digital (2D and 3D) visualization research project.

In Chapter 4 Stuart Jeffrey argues how the shift from analogue representations of the past to digital representations brings new challenges and resurrects the issue of the auratic quality of new technologies, as discussed in Benjamin's seminal essay on the aura in the age of mechanical reproduction (1968). Jeffrey provides a fascinating definition of authenticity, which is influenced by issues of authorship and ownership as well as technical matters affecting the longevity of digital data. Authorship (who created the record or representation) and ownership (who legally controls the object) are often controlled by organizations and institutions and the names of the individuals responsible are relegated to contextual information or metadata, or are entirely absent, illustrating the power relationships that exist between the actual data creators and their host organizations. Jeffrey argues for the active participation of the creator, stating that the digital record is not the result of an entirely objective and/or automated process in which the creator is essentially a machine operator. At the same time, the possibility to own a version of a cultural object or work of art is one of the easiest ways to feel closer to its creator. Jeffrey describes how in the domain of digital heritage objects, the 'status of ownership is already linked to authenticity as this is often considered as being constituted in part through regimes of value associated with authorizing institutions', but also proposes an emerging alternative approach that sees digital heritage objects produced for a specific audience (or better, co-produced with them), free to use and re-use for any purpose, clearly creative, explicitly authored, and reliably and permanently accessible.

Part 3. Practices

Here various issues relating to process and practice and how they might impact the use of replicas in archaeology and the heritage sector are explored.

In Chapter 5 Peter Jensen aims to answer important research questions regarding authenticity and practices of 3D documentation during archaeological fieldwork. As stated by the author, the use of the term authenticity when referring to archaeological documentation 'at first glance appears somewhat ambiguous'. This is because the concept has mainly been associated with the analysis of objects, replicas, and reconstructions/simulations of sites and monuments. Using as case studies excavations at three archaeological sites in Denmark – Skelhøj, Jelling and Alken Enge – Jensen clarifies how 'authenticity of the documentation has nothing to do with what is original, but simply how what we have now, the visual representation, relates to what was in the past; knowing that everything is derived.' He describes the para- and metadata contained in the documentation as crucial elements for the creation of open and dynamic interpretations. He is confident that this kind of transparent approach can be crucial in answering specific questions on the documentation and interpretation process: 'How certain am I?' and 'How well does this/my documentation reflect reality?', concluding that the inclusion of all available data and embedded semantic information

would enable the authenticity of 3D fieldwork data to be evaluated.

In Chapter 6 Kevin Garstki demonstrates how the authenticity of a 3D digital representation of an artefact relates to 'the full production process – all of the choices, inputs, and data manipulation that affect the final model.' He outlines the similar trajectories of photographic technology and 3D scanning technology applied to archaeological practices and argues that these cannot be considered as completely mechanical processes. The operator has a significant influence, also defined as 'technological authority', over the final product and this should be interrogated and revealed, aiming for transparency in the replication process. In the conclusions to his chapter, Garstki argues that the creation of any visual representation in archaeology (photograph or 3D model) is an attempt to convey visual data to another person who may not have access to the original. For this reason, to increase the accuracy of the visual data and 'avoid the assumptions of objectivity that often accompany the attribution of technological authority, we need to be as explicit as we can in how we produce these digital representations – from the decision of what 3D scanning technology to utilize to the edits we make of the final product.'

In Chapter 7 Gareth Beale discusses whether the concepts of authenticity, developed from the use of computer graphics in archaeology, are adequate when we try to describe and understand the role of digital image-making in an era of plurality, numerous methodologies, and different power relations. He discusses various uses of image-making within archaeological practice, considering the processes through which it is possible to negotiate new forms of authenticity. Three case studies are presented – the Basing House project, the Mesolithic microlith from Thorncombe Beacon, and the *Re-reading the British Memorial* project – through which the author describes different archaeological research models, such as interdisciplinary collaborations, community archaeology projects and public art projects. The author examines 'the different ways in which authenticity is created and maintained within archaeological representations', always emphasizing that in each example 'authenticity cannot be said to reside in the image itself but in the interplay between image maker, image and audience'. These chapters provide a link between the practice of creating replicas and their use, which is explored in the final part of the book.

Part 4. Uses

This part provides an overview of how digital replicas can be used for various purposes: knowledge production and research (Chapter 8), display and public engagement with archaeology (Chapters 9 & 10), and contemporary art practice using archaeological sites (Chapter 10).

In Chapter 8, Eleni Bozia discusses how in the work of archaeological epigraphists it is essential to find verifiable ways to determine the authenticity of historical artefacts. The author presents the study of *ektypa* (epigraphies' squeezes) and argues that 'their existence and usage as mediums of research redefine the traditional appreciations of authenticity'. Bozia also attempts to address the degree of authenticity *ektypa* afford, asking: 'Can an ektypon rival the original inscription?', and 'Does the 3D model of the ektypon bring us closer to the real artefact, or [does] it simply fake reality?' Taking into consideration the NARA (1994) document, particularly to explain traditional concepts of authenticity and how they affect the research point of view, she frames the question of authenticity in the literary and archaeological fields from two angles: on the one hand the nominal and expressive meaning of authenticity (Dutton 2003), and on the other hand the authenticity of experience (Phillips 1997). The author focuses on the *ektypa* through the application of the *Digital Epigraphy and Archaeology Project*, an online database for the digital preservation and analysis of the squeezes' 3D models, providing also a discussion regarding the levels of authenticity and reality(ies) of an artefact. She argues, moreover, that the nature of an artefact (and consequently its authenticity) is based on the way it is used which therefore presupposes different levels of authenticity (and non-authenticity).

In Chapter 9 Nicola Amico et al. discuss 3D digital replication with a particular focus on 3D printing and the creation of 3D physical replicas of museum artefacts. Through the case study of the so-called Kazaphani boat, a Cypriot Late Bronze Age pottery artefact in the shape of a boat, the authors emphasize the importance of 3D prints for the circulation and exhibition of fragile artefacts. Using this case study, the authors also try to redefine authenticity based on the public's experience with the 3D printed replica. The concept of authenticity is set within recent debates on the authenticity of 3D digital and physical reproductions of cultural heritage, with the focus on the specific concepts outlined by the World Heritage Operational Guidelines (UNESCO 2015): *truthfulness*, *credibility*, and *integrity*. In particular, the authors address the concepts of *integrity* and *transparency* in relation to the 3D digital and physical replication process, as these ensure the authenticity of the replica. Describing all the steps involved in the creation of the 3D digital and printed models of the Kazaphani boat, the authors trace the new identity of this object (i.e. its 'new aura'

and 'augmented authenticity'), which is also defined by the perception and perspective of the observer (i.e. museum visitor). Notably, the authors consider the museum visitor's experience from the point of view of the curators; they discuss how the curators chose to display the replica and how the display might be considered a guarantee of authenticity.

In Chapter 10, Frederick Baker uses the myth of Prometheus by Goethe, where the Titan dreams of making static human figures rise from the rock and come to life, as a parallel for the digital revolution and the creation of 360 Virtual Reality: the Digital Archaeologist is compared to a modern Prometheus. Through the case study of a virtual reality movie about the Copper and Iron Age rock art from Valcamonica, Baker explains how the story can be told in an 'authentic manner, that satisfies both academic and entertainment criteria'. Baker argues that different claims 'for the authenticity of digitally captured archaeological artefacts requires a nuanced approach and must start with the nature of digital archaeology itself'. The author starts therefore with the terminology, arguing between digital and virtual archaeology, adducing a different influence to the question of authenticity accordingly. In fact, the term virtual presupposes a dichotomy between virtual and real archaeology. The choice is for the term digital, where the digital visualization makes additions to fragmentary material and requires an interdisciplinary approach. Questioning 'How far should authenticity go, in a digital world where almost everything is technically possible?', Baker states there are two concepts of authenticity regarding the portrayal of the past: naturalism and alienation, which in virtual reality can work together.

This anthology gathers in one place the issues pertinent to scholars involved in the study and definition of authenticity for replicas of cultural heritage. As outlined above, the volume offers a variety of perspectives that reflect the multi-disciplinary nature of the topic. We believe that each chapter will contribute to more general debates on the concept of authenticity and will influence future studies on the topic. We greatly appreciate the efforts of our contributors to articulate theories, as we believe that the practice of digital heritage and archaeology is still in need of a solid theoretical background.

References

Baudrillard, J., 1994. *Simulacra and Simulations*. Translated by Sheila Faria Glaser. Ann Arbor. Michigan (MD): University of Michigan Press.

Beacham, R., Denard, H., & F. Niccolucci, 2006. An Introduction to The London Charter, in *The e-volution of Information Communication and Technology in Cultural Heritage, Proceedings of VAST 2006*, eds M. Ioannides, D. Arnold, F. Niccolucci, K. Mania. Budapest: Archaeolingua, 263–9.

Benjamin, W., 1968. *Illuminations*. New York: Schocken Books.

Boorstin, O.J. 1964. *The Image: A Guide to Pseudo-Events in America*. New York: Harper and Row.

Cameron F. & S. Kenderdine, 2010. Introduction, in *Theorizing Digital Cultural Heritage: A Critical Discourse*, eds S. Kenderdine & F. Cameron. Cambridge (MA): MIT Press, 1–18.

Camporesi, C., & M. Kallmann, 2013. A Framework for Immersive VR and Full-Body Avatar Interaction, in *Proceedings of IEEE Virtual Reality (VR)*, 79–80.

Candlin, F., 2007. Don't Touch! Hands Off! Art, Blindness and the Conservation of Expertise, in *Handling Objects in Museum and Heritage Contexts*, ed. E. Pye. Walnut Creek, CA: Left Coast Press, 89–106.

Csordas, T.J., 1994. Introduction: The body as representation and being in the world, in *Embodiment and Experience: The Existential Ground of Culture and Self*, ed. T.J. Csordas. Cambridge: Cambridge University Press, 1–24.

Dant, T., 1999. *Material culture in the social world: values, activities, lifestyles*. Buckingham, Philadelphia (PA): Open University Press.

Dawson P., Levy R., & N. Lyons, 2011. 'Breaking the fourth wall': 3D virtual worlds as tools for knowledge repatriation in archaeology. *Journal of Social Archaeology* 11(3), 387–402.

Di Blas, N., Gobbo, E., & P. Paolini, 2005. '3D worlds and cultural heritage: realism vs. virtual presence', in *Museums and the Web 2005: Proceedings, Toronto: Archives and Museum Informatics*, eds D. Bearman & J. Trant, published 31 March 2005 at http://www.archimuse.com/mw2005/papers/diBlas/diBlas.html.

Draper, J. V., Kaber, D. B., & J.M. Usher, 1998 'Telepresence', *Human Factors* 40(3), 354–75.

Dutton, D., 2003. Authenticity in Art, in *The Oxford Handbook of Aesthetics*, ed. L. Jerrold. New York: Oxford University Press, 258–74.

Forte, M., 2014. 3D Archaeology. New Perspectives and Challenges. The Example of Çatalhöyük, *Near Eastern Archaeology* 2, 1–29. DOI: 10.13140/2.1.3285.0568.

Forte, M. (ed.), 2008. *La villa di Livia, un percorso di ricerca di archeologia virtuale*, Roma: Erma di Bretschneider.

Forte, M., Pescarin, S., & L. Pujol, 2006. 'VR applications, new devices and museums: visitors' feedback and learning. A preliminary report', in *The e-volution of information technology in cultural heritage. Where hi-tech touches the past: risks and challenges for the 21st century. Proceedings of the 7th International Symposium on Virtual Reality, Archaeology and Cultural Heritage, Vast 2006*. Nicosia, Cyprus: Eurographics, 64–9.

Galeazzi, F., Di Giuseppantonio Di Franco, P., & N. Dell'Unto, 2010. 3D Cybermaps of Western Han Mural Tombs, in *Cyber-Archaeology*, ed. M. Forte. Oxford, UK: BAR International Series 2177, 97–108.

Gibbons, F. 2001. British Museum turns to national treasure, *The Guardian*. Accessed 19 December 2016: https://www.theguardian.com/uk/2001/sep/15/arts.highereducation.

Greenwood, D.J., 1977. Culture by the Pound: An Anthropological Perspective on Tourism as Cultural Commoditization, in *Hosts and Guests*, ed. V. L. Smith. Philadelphia (PA): University of Pennsylvania Press, 129–39.

Holtorf, C., 2002. Notes on the Life History of a Pot Sherd. *Journal of Material Culture* 7(1), 49–71.

Kenderdine, S., Forte, M., & C. Camporesi, 2012. Rhizome of Western Han: an Omnispatial Theatre for Archaeology, in *Revive the Past. Computer Applications and Quantitative Methods in Archaeology (CAA). Proceedings of the 39th International Conference, Beijing, 12–16 April*, eds Z. Mingquan, I. Romanowska, Z. Wu, P. Xu, & P. Verhagen. Amsterdam: Pallas Publications, 141–58

Kenderdine, S., Shaw, J. & A. Kocsis, 2009. 'Dramaturgies of PLACE: Evaluation, Embodiment and Performance in PLACE-Hampi' in *Proceedings of the International Conference on Advances in Computer Entertainment Technology*. Athens: ACM, 249–56.

Knappett, C. 2002. Photographs, Skeuomorphs and Marionettes: Some Thoughts on Mind, Agency and Object. *Journal of Material Culture* 7(1), 97–117.

Kopytoff, I. 1986. The cultural biography of things: Commoditization as process, in *The Social Life of Things: Commodities in Cultural Perspective*, ed. A. Appadurai. Cambridge: Cambridge University Press, 64–91.

Jeffrey, S., Hale, A., Jones, C., Jones, S., & M. Maxwell, 2015. The ACCORD project: Archaeological Community Co-Production of Research Resources, in *Proceedings of the 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology*, eds F. Giligny, F. Djindjian, L. Costa, P. Moscati, & S. Robert. Oxford: Archaeopress Archaeology, 289–95.

Joy, J. 2002. Biography of a medal: people and things they value, in *Material Culture: The Archaeology of Twentieth-Century Conflict*, eds J. Schofield, W. Gray Johnson, & C.M. Beck. London: Routledge, 132–42.

Jones, S. 2010. Negotiating authentic objects and authentic selves: beyond the deconstruction of authenticity. *Journal of Material Culture*, 15(2), 181–203.

Latour, B. & A. Lowe, 2011. The migration of the aura, or How to explore the original through its facsimiles, in *Switching Codes. Thinking Through Digital Technology in the Humanities and the Arts*, eds T. Bartscherer & R. Coover. Chicago: University of Chicago Press, 275–97.

Levy, T., Petrovic, V., Wypych, T., Gidding, A., Knabb, K., Hernandez, D., Smith, N. G., Schlulz, J. P., Savage, S. H., Kuester, F., Ben-Yosef, E., Buitenhuys, C., Barrett, C. J., Najjar, M., & T. DeFanti, 2010. On-site Digital Archaeology 3.0 and Cyber-Archaeology: Into the Future of the Past – New Developments, Delivery and the Creation of a Data Avalanche, in *Cyber-Archaeology*, ed. M. Forte. BAR International Series 2177. Oxford: Archaeopress. 135–53.

MacCannell, D., 1973. Staged Authenticity: Arrangements of Social Space in Tourist Settings. *American Journal of Sociology* 79(3), 589–603.

Malafouris, L., 2004. The Cognitive Basis of Material Engagement: Where Brain, Body and Culture Conflate, in *Rethinking materiality: the engagement of mind with the material world*, eds E. DeMarrais, C. Gosden & C. Renfrew (eds). Cambridge: McDonald Institute for Archaeological Research, 53–62.

NARA Document. 1994. UNESCO NARA Document on Authenticity. Accessed 5 January 2017: http://whc.unesco.org/document/9379.

Petridis, P., Pletinckx, D., Mania, K., & M. White, 2006. The EPOCH Multimodal Interface for Interacting with Digital Heritage Artefacts, *Lecture Notes in Computer Science* 4270, 408–17. DOI 10.1007/11890881_45

Petridis, P., Mania, K., Pletinckx, D., & M. White, 2003. Evaluation of the EPOCH Multimodal User Interface, in *Proceedings of the ACM Symposium on Virtual Reality Software and Technology (VRST 06)*. New York, NY: ACM, 116–22.

Phillips, D., 1997. *Exhibiting Authenticity*. Manchester: Manchester University Press.

Pred, A., 1984. Place as a Historically Contingent Process: Structuration and the Time-Geography of Becoming Places. *Annals of the Association of American Geographers* 74(2), 279–97.

Pujol, L. & E. Champion, 2012. Evaluating Presence in Cultural Heritage Projects. *International Journal of Heritage Studies* 18(1), 83–102.

A. Russo & J. Watkins, 2007. Digital Cultural Communication: Audience and Remediation, in Theorizing Digital Cultural Heritage: A Critical Discourse, eds F. Cameron & S. Kenderdine. Cambridge (MA): MIT Press, 149–64.

Silverman, H., 2015. Heritage and Authenticity, in The Palgrave Handbook of Contemporary Heritage Research, eds E. Waterton & S. Watson. New York (NY): Palgrave Macmillian, 69–88.

Smith, L.J., 2006. *Uses of Heritage*. London: Routledge.

Trilling, L., 1973. *Sincerity and Authenticity*. Boston: Harvard University Press.

Tringham, R., 1994. Engendered places in prehistory. *Gender, Place & Culture* 1(2), 169–203.

UNESCO 2015. Operational Guidelines for the Implementation of the World Heritage Convention. Accessed 18/01/2017: http://whc.unesco.org/archive/opguide12-en.pdf.

Varela, F.J., Thompson, E., & E. Rosch, 1991. *The embodied mind: cognitive science and human experience*. Cambridge (MA): MIT Press.

Venice Charter 1964. ICOMOS International Charter for the Conservation and Restoration of Monuments and Sites (The Venice Charter). Accessed 5 January 2017. https://www.icomos.org/charters/venice_e.pdf.

Wang, N., 1999. Rethinking Authenticity in Tourism Experience. *Annals of Tourism Research* 26(2), 349–70.

Witcomb, A., 2010. The Materiality of Virtual Technologies: A New Approach to Thinking about the Impact of Multimedia in Museums, in *Theorizing Digital Cultural Heritage: A Critical Discourse*, eds S. Kenderdine and F. Cameron. Cambridge (MA): MIT Press, 35–48.

Part 1
Histories

Chapter 1

Cast aside or cast in a new light? The Maudslay replica Maya casts at the Museum of Archaeology and Anthropology, Cambridge

Jody Joy and Mark Elliott

On the second or third day of one of the writer's first job as a museum curator he was shown around a store. At the end of the tour there was one area he had not visited. When he asked his new colleague 'what's in there?' their reply was 'only casts, let's not bother'. To his shame, it took him a few months to venture into that room and when he did he was greeted by a myriad of casts of objects from assorted periods and locations.

These two reactions, ambivalence from one museum professional contrasted with fascination at an eclectic mix of old casts by another, exemplify some contemporary attitudes towards replicas. On the one hand, 'they are only replicas'. They are mere copies and not as valuable as 'authentic' objects from the past. With increasing pressure on store space, following this viewpoint many museums and other institutions have discarded their collections of replicas to make room for so-called authentic objects. On the other hand, replicas such as casts possess a certain attraction or charm. They are relics from a bygone age, produced using outmoded technology, standing in stark contrast to the new digital techniques employed to create ultra-modern replicas such as 3D prints. Some replicas are also valued as sources of information about 'authentic' objects which are now lost or have been damaged or transformed. Replicas then, occupy an indeterminate state. They are copies and therefore seen as not as valuable as 'genuine' objects from the past. Yet many are now quite old, with their own biographies, contexts of creation and use, and are objects worthy of study in their own right.

In this chapter, we examine the use of replicas in museums and for other purposes such as teaching before the advent of digital technologies. Many different types of replica exist and each object and each category of replica has its own history which it is not possible to reproduce in a single book chapter. Instead, we have chosen to focus on a single case study, a group of plaster casts of Classical Maya monuments at the Museum of Archaeology and Anthropology (MAA), University of Cambridge, where they have come to be known as the 'Maudslay Casts'. Through this case study we will show how attitudes towards replicas in general – and these replicas in particular – have changed over time. We will conclude by questioning what future roles the casts might have in a digital world.

Studies tracing the biographies of 'authentic' objects have often been conceptually split between the context in which the artefact was originally made, used and discarded and their 'afterlives' following their re-discovery and incorporation into archaeological narratives and institutions such as museums (see Joyce 2015). Following the lives of replicas has the apparent advantage that there is no tension between their 'original' context and 'afterlife'. But as we will show, it is not so simple. The antiquity and complex life stories of some artefacts that were at least created as 'replicas' can often reveal particular tensions and contradictions that are worthy of scholarly attention, and which certainly impinge upon curatorial practice. We also have in mind Joy's (2002) observation that something of the 'aura' of the original can be passed on to a replica given a particular set of circumstances, and indeed Alfred Gell's conception of the art index and the tensions between replica and prototype, as well as what he describes as the 'distributed agency' of a maker through her artwork, which may perhaps be equally attributed to the artwork through its 'copy' (Gell 1998; Chua & Elliott 2013). Throughout our discussion, we subscribe to Latour's (1999) 'circulating reference' – the notion that the translation and articulation of relations surrounding objects produces references, that themselves circulate, accumulate and interact. Latour's analytical model and his ethnographic object is the pedocomparator – a grid that abstracts soil samples from their 'reality' (in this case the Amazonian

rainforest) and recombines them to make that reality more visible and analytically accessible. The potential analogues for museums and replicas – particularly those Maudlsay made in another forest in the Americas – are manifold.

The Maudslay casts

Among the first objects accessioned into the collections of MAA, in 1884, were a group of monumental plaster casts of Maya sculpture, taken during Alfred Maudslay's expeditions to the sites of Quirigua in Guatemala and Yaxchilan in Mexico. Like casts of Classical sculpture, the Maudslay Casts were reproductions of originals which were otherwise unobtainable, or inaccessible to scholars and students at Cambridge.

Classic Period Maya (AD 250–900) sculpture was primarily made from limestone and was intended for public display and ritual use. It took various forms ranging from large upright *stelae* erected in plazas and courtyards in Maya cities, to wall panels or door lintels occupying the interiors of palaces and temples. Images included portrayals of deities, rituals and ceremonies and depictions of rulers, with hieroglyphic texts often accompanying such scenes (Fash 2004, 6; Houston & Inomata 2009, 91).

Maya sites were never really 'lost' but they were difficult to access under Spanish control and overgrown by dense vegetation. But by the mid-nineteenth century they became more accessible to foreign visitors under new national governments in Guatemala and Mexico (Houston & Inomata 2009, 11). An illustration of the interest in these sites is that in 1854, enquiries were made by the British consul in Guatemala to report on the feasibility of removing pieces of Maya sculpture. The prime minister at the time, Lord Palmerston, was anxious that Britain should not lose out on these objects at the expense of countries such as the United States. But a report on the feasibility of moving the sculptures concluded they were too heavy and it would be too expensive to remove them to Britain (Graham 2002, 79).

By the late nineteenth century, independent researchers such as Maudslay, as well as institutions like the Peabody Museum at Harvard University, began to document and record Classic Maya sites (Houston & Inomata 2009, 11). Maudslay was a Cambridge graduate and spent some time in the colonial service in Fiji, Tonga and Samoa. Swapping careers, he resigned from overseas service in 1880 and travelled to Guatemala later that year with the intention of exploring and recording Maya sites, organizing six expeditions to Guatemala and Mexico over the next thirteen years (Graham 1993, 70). Writing a decade after his first visit to the ruined Maya city of Quirigua in Guatemala, Maudslay wrote, 'it was the unexpected magnificence of the monuments which that day came into view that led me to devote so many years securing copies of them, which, preserved in the museums of Europe and America, are likely to survive the originals' (quoted in Graham 2002, 82). While these reflections, separated by years of activity from the original encounter or indeed the production of the casts themselves, must be treated with caution, the impact of the casts on Maudslay and his motivations is evident. Nevertheless, it is clear as Graham (1993) asserted, Maudslay's intention when making his casts was to '…have them displayed for educational and scientific purposes, and second, to ensure that the images, threatened by erosion, would be preserved indefinitely' (Graham 1993, 71). A third motivation is also apparent. Maudslay was a keen photographer but the variable jungle light made it impossible to precisely capture the detail and deep relief of the sculptures using the photographic technologies of the time. The heat and humidity were also less than ideal conditions for draftsmen to produce the accurate line drawings that Maudslay required (Graham 2002, 108). Taking casts allowed accurate drawings to be made, away from the jungle in good working conditions (Graham 1993, 71).

Since it had already proved impractical and too costly to remove objects, it was also seen as a good deal easier to make casts. Nevertheless, one should not underestimate the difficulties involved. Maudslay understood that taking casts was a highly skilled task and on planning his second expedition employed the services of Lorenzo Giuntini, a professional *formatore* or plaster-worker based in London who served the still vibrant market for plaster reproductions of classical antiquities. In preparation for the expedition nearly four tons of Plaster of Paris was purchased which was specially packed and delivered to Guatemala well ahead of time (Graham 2002, 110). The methods used to create casts and moulds were difficult and time consuming and Fash (2004) described well the conditions and considerable effort expended to create them and get them back:

> Hauling reams of paper, plaster, and supplies; labouring in uncomfortable jungle conditions to make the paper moulds; drying them by huge fires; and transporting them over trails on mule back or by labourers without damage required a staunch perseverance on the part of these explorers and moulders (Fash 2004, 11).

Back in London in the summer of 1884, the moulds were laboriously reassembled by Giuntini to reconstruct each monument, before the full-sized plaster

casts could be made. This created accurate but large, heavy and fragile plaster casts which, as we will see, are far from ideal for museum storage and display. At the time Maudslay and Giuntini were producing their casts other institutions such as the Peabody, the Smithsonian Institution and Berlin Museum collaborated and competed with one other to sponsor expeditions to produce their own casts (Fash 2004; Shields 2015). As Fash (2004) stated in relation to the casts of Aztec and Maya sculpture in the Peabody Museum at Harvard University, 'often lost upon us today is the tremendous investment not just of time, effort, and planning that went into producing and transporting the moulds and casts, but the financial investment' (Fash 2004, 8). This shows just how valued casts were at this time amongst leading institutions and the public, with casts and photographs appearing prominently in public expositions such as the Chicago Worlds Columbian Exposition of 1893, which were seen by millions of people (Shields 2015, 30–3, Fig. 2.2). Plaster casts provide a precise one-to-one replica that is aesthetically pleasing. Once the moulds have been taken, plaster is relatively cheap and multiple copies can be produced. Casts also have considerable didactic value as it is possible to display many different objects side by side for comparison.

The casts at MAA

The casts were presented to the Museum by Maudslay soon after they were made, late in 1884, only months after the institution had been established. They are contemporaneous with some of the casts of Classical sculpture (later to become part of the collections of the Museum of Classical Archaeology) which were exhibited in the adjoining galleries (Beard 1994).

The following history of the casts has been compiled using evidence gleaned primarily from Museum Annual Reports and other archival documents. The casts were first displayed in Gallery H of the then Museum of Classical and General Archaeology, located on Little St. Mary's Lane (Annual Report 1885). As is shown in Figure 1.1, the skylight of the original building had to be adjusted to accommodate the tallest stela, and the casts occupied an enormous area of the gallery. In a letter from Maudslay to the then curator of the Museum, Baron Anatole von Hügel, marked 'Sunday 1885', he remarked on the display: 'the casts look wonderfully well. I only wish they would build a new museum five times as big and they should have the splendid collection I have now on the way to England'.

There the casts stayed until a new building was constructed for the Museum on Downing Street, following a split from the classical archaeology collections (Beard 1994). Owing to their 'unwieldy bulk', the

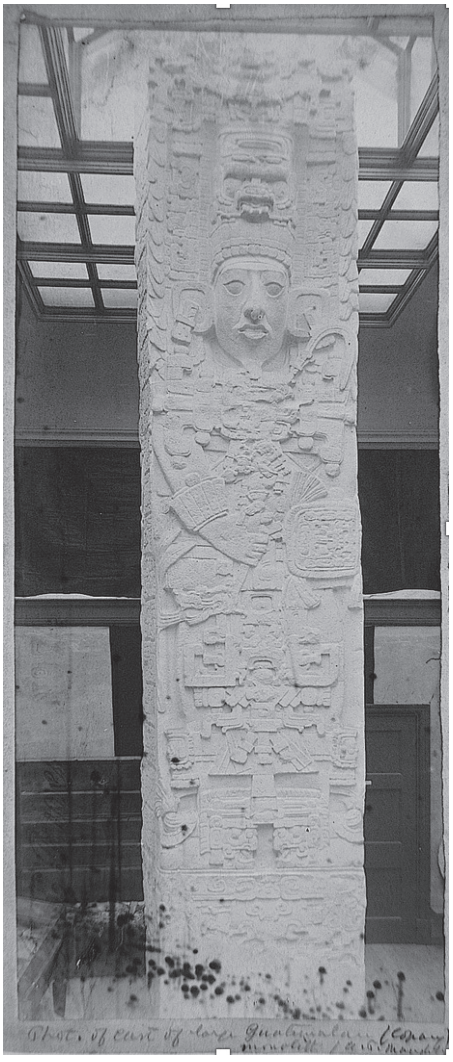


Figure 1.1. *Stela E from Quirigua in the old Museum of Archaeology and Anthropology, Little St Mary's Lane, Cambridge, 1885.*

casts were some of the first objects to be relocated and were in position by the spring of 1912 (Annual Report 1912), well ahead of the official opening in 1913. In fact, the main hall of the new museum was especially designed for the American exhibits, specifically the accommodation of the larger objects including the Maudslay Casts (Annual Report 1911). Here there was space to accommodate the 10 metre-high stelae, and the enormous zoomorphic sculptured rock could be seen from every angle from the mezzanine above (Fig. 1.2). The design of this striking space also proved useful when the Museum finally acquired its longed-for Haida totem pole in 1925 (Fig. 1.3).

The large gallery was even named after Alfred Maudslay in tribute to his many donations to the

Figure 1.2. *The Maudslay Hall, MAA,* c. *1970, showing the Winchester Cathedral choir screen and the Maudslay casts including Zoomorph P.*

Figure 1.3. *Casts seen in the Maudslay Gallery located either side of the Haida totem pole. Photograph taken by Gwil Owen* c. *1978.*

Museum but the casts were specifically singled out in the annual report:

> …Mr Maudslay subsequently enriched the Museum with a set of magnificent casts of Guatemalan sculptured monuments taken by himself from the originals… This museum is the only one in the country in which such important illustrations of American archaeology are exhibited (Annual Report 1913).

As a further illustration of the importance of the casts to the Museum, one of the objects, a cast of 'Zoomorph B' from Quirigua, Guatemala, was built into the wall above the entrance of the corridor from the Maudslay Hall to the Babington Gallery (Fig. 1.4).

The annual reports make it clear that by 1920, although the Museum was open to students and the public, following the move, artefacts had still not been fully unpacked and displayed. For example, one of the galleries was being used as a store room and the Maudslay Hall continued '…to show the miscellaneous, unsorted mass of specimens, which were there stored for safekeeping at the time of the removal of the Museum from Little St. Mary's Lane' (Annual Report 1920). In June 1920 the Board of Anthropological Studies and the Antiquarian Committee were amalgamated and reconstructed as the Board of Archaeological and Anthropological Studies and on the 24 November the newly formed Board indicated their desire to recruit more students (Annual Report 1920). As a result, more space in the Maudslay Hall was given over to teaching university students with galleries and didactic displays laid out specifically for them. Subsequently, the Maudslay Casts now had to share space with the local archaeology collections and a hotchpotch of other objects from the Swiss Lakes, the Near East and China.

Parallel, yet different, trajectories can be seen for the related collection of Maudslay's plaster casts and paper squeeze moulds at the British Museum (Joyce 1938). Maudslay originally donated the casts to the South Kensington Museum (now the Victoria and Albert Museum) in 1886 and they were displayed for a short time before they were dismantled and placed in storage, with discussions soon initiated to negotiate the transference of the casts to the British Museum (Joyce 1938). According to Shields (2015, 36), this was very much against Maudslay's wishes and he attempted to transfer many of the South Kensington casts to Cambridge. This proposal was rejected by Cambridge on the grounds of the costs of the long-term display of such large objects. The discussions between the South Kensington and British Museums continued for 30 years or so until the casts finally officially became part of the British Museum's collections in 1922 and it was not until 1923 that any of the casts were put on public display (Joyce 1938, 6). Significantly, just as at MAA, Maudslay's contribution to Maya archaeology was also recognized at this time as the casts were set up in a space known as The Maudslay Room (Graham 1993, 73).

During the Second World War many objects from MAA were removed for safekeeping, some were taken to south Wales and others to a chalk cave in the nearby Cambridgeshire village of Balsham. The Museum was closed for a while in 1939 following the outbreak of war, but after it became clear that Cambridge was not in immediate danger, it reopened with objects '… arranged in such a way that… [they] could be quickly packed again if necessary' (Annual Report 1945–6). The dispersal of the collections during the war provided the opportunity for carrying out an extensive programme of re-organizations. The Maudslay Hall was once again devoted to American archaeology and ethnography containing, '…the Maudslay collection of large Central American casts and the British Columbian totem pole…' (Annual Report 1945–6). The re-organizations and refurbishments were largely completed by November 1947 and the Maudslay Hall re-opened to the public in July 1948.

There are few remarks about the Maudslay Hall in the annual reports throughout the 1950s and 1960s except for a mention in the 1955 annual report that the gallery was redecorated for the first time since the Museum was built!

Cast aside?

Major alterations to the Museum were undertaken in the mid-1970s when the collections were significantly reorganized and a long-term plan for display was instigated. Between 1975 and 1976 much of the collection in store was relocated to a new store at the old Shorts Factory on Madingley Road and in 1977 three of the six galleries at the Museum were converted into storage and office space.

Reorganization of displays and collections were not the only changes that occurred at this time. Visitor numbers are reported in the annual reports for the first time and more members of staff were recruited. Prior to this period much museum work was undertaken by honorary keepers – unpaid period and regional experts who gave up their time to curate specific collections. These changes are reflective of a move towards professionalization and a growing concern for accommodation of the general public as well as university students.

By the late 1970s, prompted by the continuing growth of the collections and this professionalization

Figure 1.4. *Zoomorph B from Quirigua, Guatemala built into the entrance corridor to the Babington Gallery (Museum Accession Number 1885.3.8). Photograph by Josh Murfitt, August 2016.*

of activities at the Museum, a radical reorganization of the Maudslay Hall was also proposed and it was to become the ethnography gallery. Both as big, dominant unwieldy things, and as 'archaeological' objects, but also perhaps because they weren't 'real', the casts were no longer a good fit. This marked the beginning of the end for the display of the casts in the Maudslay Hall and several options were suggested for their removal from display, from transplantation to the lawn outside the Museum, to disposal.

Advice was sought from several experts as to the historical value of the casts. For example, in a letter in the archives dated 18 October 1976, one expert from the Institute of Archaeology, London, Warwick Bray, stated:

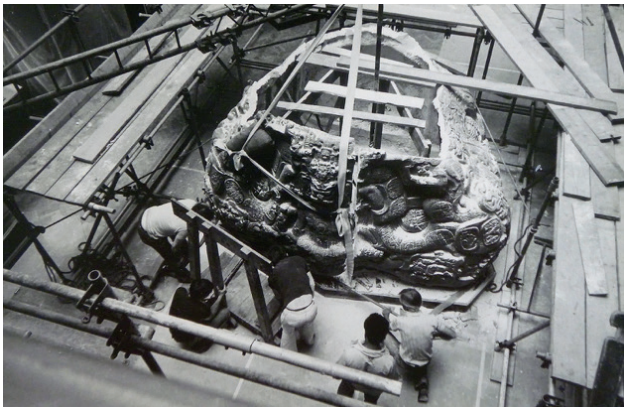
> They are good casts, and in some cases I believe they show detail which has deteriorated on the original monuments… they can be studied in the same way as the originals

> and much better than photos. There is hardly any material of this country for students to look at. Would you consider disposing of original stelae? If not, you should keep these. For teaching, study, and sheer tourism they are almost as good as the originals, which will never leave Guatemala. In fact, they are considerable treasures in their own right – even if they are big and clumsy and take up space which could accommodate yet more Polynesian clubs or Saxon pots. Treat them with respect.

In a letter dated 28 October 1976 Professor Gordon Willey of the Peabody Museum expressed similar sentiments and provided information about the fate of similar casts in his own institution:

> The casts which you describe from the Cambridge Museum are pieces of considerable scientific value. There are not many such casts anywhere. Indeed, it may be that yours and ours are the only ones in existence on these particular pieces. We, too, have been concerned what to do with our Maya casts. Many of them, especially those from Quirigua, are extremely large and they take up a lot of room. We have removed some to storage, others still remain on exhibit, but we have not destroyed or jettisoned any of them… In brief, I strongly recommend that you maintain possession of these casts either on display or in storage.

In the end, the value of the casts was recognized and they were not destroyed, instead they were deconstructed and distributed once again. The zoomorph was sent on long-term loan to the Museum of Mankind in London (Figs. 1.5 & 1.6), and the stelae were cut into panels and moved to a new purpose-built location in the Museum's external store. It is worth quoting the 1979 annual report at length as it provides a good indication of the work this involved:



Figures 1.5 & 1.6. *Dismantling the cast of Zoomorph P for transport to London. Summer 1979. MAA Archives.*

> The Maudslay Gallery was prepared for the removal of the Mayan casts, which, because of the amount of disruption involved, meant that the Museum had to be closed from 18 June until end of September. The sky god was cut into sections and removed to the Museum of Mankind between 18 and 21 June. On 22 June Mr Smith, Mr Baynes, Mr Osbourne and Mr Lewis began to dismantle the remaining casts. This operation was completed on 17 August… The removal of the casts was only possible because the General Board also gave approval for the construction of a large extension of the Shorts store, part of which was designed to house them in sections. Construction at Shorts went on concurrently with the work in the Museum and was sufficiently completed to receive the casts on schedule (Annual Report 1979).

A number of the letters in the archives providing advice as to what should be done with the casts also tell us about the fate of similar casts in collections elsewhere. As professor Willey's letter quoted above shows, some of the casts in the Peabody Museum were removed to storage and published accounts elsewhere show that some were also moved to other institutions or even destroyed (Fash 2004, 13). Another letter from the American Museum of Natural History, New York stated that in a refurbishment during the 1960s, although some of the larger casts were retained – with the ceiling of the exhibition hall raised to accommodate them – several other large casts from Quirigua were destroyed.

Throughout their time in the Maudslay Hall there are few mentions of how the casts were received by students and members of the public. The remaining photographs of the casts on display show they occupied an imposing position in the gallery and no doubt made a notable impression on students and visitors. It is impossible to determine how many people they may have inspired but we do know that Maudslay's studies and the casts he commissioned made a significant contribution to the decipherment of Maya hieroglyphs throughout the twentieth century (Elliott & Thomas 2011, 69).

Cast in a new light

The majority of the casts still remain in the Shorts Store today. MAA was extensively refurbished again in 2012, culminating in the creation of a new front door, special exhibitions gallery, museum shop and the refurbishment of the Clarke and Andrews Galleries. As a symbol of the importance of the Maudslay Casts to the history of the museum, a display was created in the newly refurbished Andrews Gallery of World Archaeology, where a cast of Stela E from Quirigua, Guatemala depicting the face of king K'ak' Tiliw Chan Yopaat and part of his headdress is displayed alongside contextual information highlighting the importance of the casts and Maudslay's contribution to Maya

Figure 1.7. *A new display in the Andrew's Gallery of World Archaeology, featuring a section of the 1883 cast of Stela E from Quirigua, Guatemala. Photograph by Josh Murfitt, August 2016.*

Figure 1.8. *A cast taken from lintel 16 of House F at Yaxchilan, Mexico, is now suspended high up on the wall of the Clarke Gallery. Photograph by Josh Murfitt, August 2016.*

archaeology (Fig. 1.7). Here the replica is cast in a new light, telling a story of the Museum and a revaluing of the activities of collectors and collecting. The casts have become objects with complex biographies and indeed biographical objects (Hoskins 1998) – part of an assemblage that creates a distributed biography of Maudslay and the Museum. A section of one of the casts taken from lintel 16 of House F at Yaxchilan, Mexico, is also now suspended high up on the wall of the Clarke Gallery above books sold in the museum shop (Fig. 1.8), as part of a group of objects themed as 'welcome' or 'entrance' artefacts – from a Kanak door post from New Caledonia to a statue of Ganesh from India. Contextual information about the cast is limited but at least people are able to see it and its prototype's previous position as part of an entrance way (in the mind of the curator) is to some extent perpetuated.

The re-display of some of the casts at MAA is reflective of a wider trend which has seen other institutions re-assess and re-value their collections of plaster casts. For example, following a stock-taking of their cast collection, in 2001 the Peabody Museum opened a new exhibit titled *Distinguished Casts: Curating Lost Monuments at the Peabody Museum* (Fash 2004, 4). Regardless of major changes in the archaeological knowledge by which they were originally understood, the casts are still of considerable interest to academics and continue to be objects of knowledge creation. In the years since Maudslay made his casts, the monuments have suffered from damage, vandalism, weathering and erosion and

some details recorded in the casts are no longer visible on the originals (Elliott & Thomas 2011, 69). Consequently, there has been a renewed academic interest in the Maudslay Casts, for example with scientists from the University of Bonn undertaking a project to digitally scan each of the casts during the summer of 2016.

Despite this renewed interest the casts still represent a considerable curatorial challenge. As a survey of the casts made by Maudslay held at the British Museum revealed, they are not immune to the effects of time (Mathews 1999). They are fragile but heavy objects and are particularly susceptible to damage when they are moved and they require innovative storage solutions if they are to be preserved into the future.

Changing meanings

The casts index an intriguing period in the history of archaeology and the Museum. Maudslay is one of the great names in the history of Maya archaeology and the casts and photographs he brought back from his expeditions were one of the bases for the decipherment of Maya texts. The casts will therefore always be associated with his achievements. They are a record of monuments that have subsequently been damaged and preserve details which no longer survive on the originals. They also tell us about outmoded techniques of artefact replication and hint at the ethics, or practicalities that made Maudslay produce casts, rather than transplant the originals to Britain.

The Maudslay Casts have been in the Museum's collections almost since its foundation and they are part of its story; they have had a tangible impact on the fabric of the building and its efficacy as an institution. The decision first to modify an existing building and second to design a new one able to accommodate the casts, demonstrates their fundamental importance in the early years of the Museum. It also tells us something about the position of the replica in the late nineteenth century, suggesting that authenticity meant something different and to really *see* an object may have meant something rather different to museum-goers then than it does today.

The values placed on the casts changed over time and varied between institutions. For example, Shields (2015, 37) suggested that part of the reason why there was a delay in the transference of the casts from the South Kensington Museum was that at that time at the British Museum there was a 'hierarchy of cultural objects', whereby less value was placed on Mesoamerican artefacts than those from the Classical World.

By the mid–late twentieth century, different institutions tackled the challenges of displaying and accommodating such large objects in different ways, set against a backdrop of extensive pressure on museum space and a revaluing of objects in favour of 'authentic' artefacts. At MAA the casts that were not built into the building were cut up and removed to storage. Letters in the archive show their continuing survival was under considerable threat at this time, but in the end the Museum and University provided extensive investment to ensure their continuing preservation. Nevertheless, changing priorities of the Museum and wider attitudes in favour of authentic objects at the expense of replicas meant that the casts were consigned into storage for 30 years, where the majority still remain today. The recent re-display of a section of one of the casts owes as much to its power to tell a story of the Museum itself as Maudslay's original intention that the casts should inform the general public about Maya society. Yet Maudslay's objectives are more broadly exemplified by the manner in which the casts are now valued because the originals have suffered from damage and erosion. Digital technologies such as digital scanning opens the casts up to further interpretations, facilitating new types of interaction with the casts outside of the museum and its stores.

Contemporary role of replicas

As the inclusion of replicas in a recent British Museum exhibition on the Celts demonstrates (Farley & Hunter 2015), they still have a place in museums. In this instance casts of early medieval monuments were prominently displayed as many of the 'original' objects are located in places like churchyards and cannot be removed. Like the Maudslay Casts and casts taken of statues from the Classical world (see Beard 1994), replicas are generally more 'ethical' and do not carry the same negative associations as artefacts removed from their original locations, such as the Parthenon Marbles.

One question particularly pertinent to the current discussion is how different are traditional replicas such as casts from digital reconstructions and 3D prints of objects? The casts are products of once cutting-edge but now antiquated technologies, intended to make faraway or otherwise unattainable artefacts accessible to researchers and students, in the same space as other things from other places. This brings us back to the Latourian analogy of the pedocomparator where, like the museum gallery or the grid-like shelves of the reserve collection, displacement, fragmentation and reassembly makes comparison possible. Unlike Latour's pedocomparator or the conventional image of museum collections, Maudslay and Giuntini's casts are not 'real' artefacts but simulacra: their value as evidence thus even more ephemeral, as 'better' technologies become available.

Like the production of casts, digital technologies can be costly. The scramble to take moulds and produce casts of Mesoamerican sculpture by institutions such as the Peabody Museum during the late nineteenth century, is similar to the rapid adoption of digital technologies with many institutions such as MAA undertaking programmes of object scanning and producing three dimensional representations made available to the public through platforms such as Sketchfab (https://sketchfab.com/MAACambridge). Like casts, once a scan has been completed many 3D prints can be produced. Significantly, this new generation of replicas is an attempt to overcome barriers to the accessibility and visibility of artefacts that originally entered museum collections in order that they could be accessible and visible to researchers and visitors. Scanning of the Maudslay casts themselves presents a new dimension to the increasingly convoluted story: replication of a replica now engaged with as an artefact like any other. One might, in passing, reflect on how much of the artefact's 'aura' is maintained in successive acts of replication.

The primary difference between traditional types of replica and digital ones is that digital technology can transport objects out of the museum into schools and people's homes. They also facilitate detailed study and close scrutiny without the need to visit dusty museum stores, providing the potential to revolutionize academic study of museum objects and greatly increase visitor access to objects currently locked away in museum stores. 3D prints also offer opportunities to transform visitor experiences. With the possibility to produce multiple replicas relatively easily and with costs coming down, handling of replica objects in museums is becoming increasingly popular.

Yet there are also disadvantages to digital technology. Traditional replicas are tangible objects. As we have seen, plaster casts have become historic objects in their own right and many are now well over 100 years old. Museums are already encountering issues related to the rapid transformation of technology, with data stored on outdated media such as floppy disks now difficult to access without specialist expertise. How accessible will digital scans of objects be in 20–30 years? Replicas like casts on the other hand will still be there in the stores, available for study. Other issues such as who owns digital data from scans also need to be ironed out as some institutions are wary of the potential exploitation of these data for commercial purposes.

Conclusions

Replicas like plaster casts do not seem to fit easily into the conventional narratives constructed about 'authentic' objects in museums. Almost always an index of something else, something that is not really there, the replica occupies a particularly precarious position in ethnographic and archaeological collections. By charting the different paths of the Maudslay Casts, we have seen how they have lost relevance and value, as well as gained significance; moving from prized specimens to unwanted junk, back to valued objects. The social life of these casts in the museum collection vividly illustrates the fluctuating status of replicas in such a context. Like Latour's pedocomparator where soil samples are taken from the field into the laboratory, the casts have been displaced from the Guatemalan jungle to a Cambridge museum. Unlike the pedocomputer, the casts are reproductions and as a reproduction, the aura of a replica is especially vulnerable: dependent on that of its prototype, and on perceptions of the materiality of the medium itself. Yet long-term incorporation in a museum collection can also transform an object from a replica to a museum piece. The Maudslay casts are a 'hybrid mixture' (Latour 1999, 38) of ancient Maya sculpture, nineteenth-century plaster casting technology, Maudslay, and the Museum.

References

Beard, M., 1994. Casts and cast-offs: the origins of the Museum of Classical Archaeology. *Proceedings of the Cambridge Philological Society* 39, 1–29.

Chua, L. & M. Elliott (eds), 2013. Distributed Objects: Meaning and Mattering after Alfred Gell. Oxford: Berghahn Books.

Elliott, M. & N. Thomas, 2011. Gifts and Discoveries: The Museum of Archaeology & Anthropology, Cambridge. London: Scala.

Farley, J. & F. Hunter, 2015. Celts: art and identity. London: British Museum Press.

Fash, B. W., 2004. Cast Aside: Revisiting the Plaster Cast Collections from Mesoamerica. *Visual Resources* XX(1), 3–17.

Gell, A. 1998. Art and Agency. An Anthropological Theory. Oxford: Clarendon Press.

Graham, I., 1993. Three Early Collectors in Mesoamerica, in *Collecting the Pre-Columbian Past: A Symposium at Dumbarton Oaks 6th and 7th October 1990*, ed. E. H. Boone. Washington, D. C.: Dumbarton Oaks Research Library and Collection, 49–80.

Graham, I., 2002. Alfred Maudslay and the Maya: A Biography. London: British Museum Press.

Hoskins, J., 1998. Biographical Objects: How Things Tell the Story of Peoples' Lives. London: Routledge.

Houston, S. D. & T. Inomata, 2009. The Classic Maya. Cambridge: Cambridge University Press.

Joy, J., 2002. Biography of a medal: people and the things they value, in *Materiel Culture: The Archaeology of Twentieth-Century Conflict*, eds. J. Schofield, W. G. Johnson & C. M. Beck. London: Routledge, 132–42.

Joyce, T. A., 1938. Guide to the Maudslay Collection on Maya Sculptures (2nd ed.). Oxford: Oxford University Press.

Joyce, R. A., 2015. Things in Motion: Itineraries of Ulua Marble Vases, in *Things in Motion: Object Itineraries in Anthropological Practice*, eds. R. A. Joyce & S. D. Gillespie. (School for Advanced Seminar Series.) Santa Fe: SAR Press, 21–38.

Latour, B., 1999. Pandora's Hope: An Essay on the Reality of Science Studies. Cambridge (MA): Harvard University Press.

Mathews, P., 1999. *Pilot Study of the Maudslay Casts in the British Museum, 1998* (Report to the Foundation for Advancement of Mesoamerican Studies, Inc.). Accessed 23 August 2016: http://www.famsi.org/reports/97082/97082Mathews01.pdf.

Shields, D., 2015. Multiple Collections and Fluid Meanings: Alfred Maudslay's Archaeological Photographs at the British Museum, in *Photographs, Museums, Collections: Between art and information*, eds. E. Edwards & C. Morton. London: Bloomsbury, 27–46.

Chapter 2

Authenticity and realism: virtual vs physical restoration

Lola Vico Lopez

Computer assisted design and imagery can achieve a very high level of realistic representation, depicting space, forms and colours in a manner that simulates and emphasizes the visual experience. This realistic representation may however not be authentic, nor a genuine reproduction of the artwork.

Technological development in the area of computer assisted design and animation, e.g. 3D digital modeling, has been much faster than theoretical development. Principles and criteria for evaluating historical analyses and hypotheses underpinning projects have been developed after virtual environments where used in archaeology. Although the London Charter (Beacham et al. 2006; Denard 2012) and the Seville Principles (2011) highlighted the principles of scientific visualization and the need for a formalization of reconstructive processes, these documents provide general guidelines but no prescriptive rules or standards to guide the practitioner.[1]

In contrast, architectural restoration is a well-established scientific field, with numerous practical applications. Since virtual restoration shares the notions of authenticity and scientific transparency with physical restoration, one can attempt to establish a theoretical framework for virtual restoration, based on the codes and standards developed for physical restoration.

The goal of this paper is to demonstrate how virtual restorations can borrow and adopt the theoretical framework of architectural restoration. A prerequisite in regards to this is to take a critical look at the contraposition between virtual and physical restorations. This will be framed and contextualized in the context of the Restoration Charters, whose articles can be applied to virtual restorations. In this paper, we will review and discuss the terminology and concepts that can be extrapolated to the virtual area, propose method for virtual restoration and illustrate these concepts and methods through practical case studies.

Concepts and terminology

In this section, we review key concepts of physical restoration and their relevance to the field of computer assisted design and imagery.

Authenticity

Umberto Eco (1968) used to say that restoration and philology share the same impulse: one conserves ancient literary texts and the other concerns ancient architecture, both in order to continue enjoying them. Every time a restoration is performed it partially changes the meaning of the building. Wondering whether the result is authentic could seem irrelevant, as authenticity works for mobile and transportable object, which is not the case of a building. In his treaty on general semiotics, Eco states that 'the taste for authenticity is an ideological product of a commercial society: privileging the original one is like privileging the first copy of a numbered edition of a book instead of the second: suitable for antiquarian booksellers but not for literary critics'.

The conservatism prevailing in architectural restoration theory nowadays has caused a relative non-interventionism among architects. A number of monuments are thus left abandoned and suffer from their physical environment. A fetishist conception of archaeological ruins is still frequent, which, as noted prof. Paolo Marconi (1993), comes from the 'fin du siècle' decadent romanticism. The overvaluation of the 'value of antiquity' that comes from the ancient heritage and Renaissance theme '*memento morti*' or '*et in arcadia ego*', generates a taste for the decadent aspect of archaeological ruins, prevailing on the restored monument. For example, there is still an excessive romantic valuation of moss-covered atriums and falling holes that was the specialty of Piranesi in the eighteenth century. This artist added an aura of mystery to the monuments with the presence of invasive vegetation such as mosses,

lichens and climbing plants covering the building, but in practice this romantic perception should be evaluated against the good conservation of monuments.

From the 1820's the reproduction of artworks or architecture became unpopular in Italy, considered as fakes (thus not authentic). Antiquarians were the only able to certify the authenticity of works of art. Their assessment was based, and is still based, on the autography of objects and on *morellians* details that are useful in the field of painting, but much less when assessing architectural sculpture and architecture. It can be argued that an excessive value is given by antiquarians to the notion of authenticity, as a means of raising the *antiquity value* of the objects. Considering the latter, Riegl declared that is the best recognizable and recognized value appreciated by the uneducated masses confronted with historical heritage (Riegl 1987).

Authenticity has two interpretations: on the one hand it is the measure of the genuineness of an object in its physical dimension, and on the other hand it is the correctness of its use compared to original conditions (Hajnóczi 1995). Authenticity may thus be considered either from the theoretical or practical aspect. At the Nara Conference in 1994, different visions on authenticity were discussed, stating that the term authenticity has different meanings, changing from one country to another. However, The Nara Document on Authenticity (UNESCO 1994) did not received widespread acceptance, and old restrictions reappeared in the Charter of Krakow (2000) six years later, recommending to avoid 'the reconstruction of whole parts of the building'.

If the multiple dimensions of authenticity are acknowledged, then one should not safeguard the physical appearance only, but also building techniques, original function, archaeological findings, and environs (Von Droste & Bertilsson 1995). This variety of views about authenticity results in different approaches to conservation. Some decide to preserve the original, even when it is incomplete, while others prefer to have a complete image of the original shape (even with the use of new material). And, for other groups yet, it is the location that is most important. A framework developed to address authenticity should take this diversity into consideration (Galla 1995).

From a theoretical perspective, it is advisable to clarify the meaning of authenticity that is best suited to the cultural heritage being examined before every restoration. This may be relative to various sources such as design and form, usage and function, traditions and techniques, location and settings, materials and substance, etc. The use of these sources permits the elaboration of the specific artistic, historic, social, and scientific dimensions of the cultural heritage (UNESCO 1994).

From a practical point of view, interventions on architectural heritage involve a complex catalogue of decisions, which must be studied and will have different approaches depending on the type of 'authenticity' that is sought, without excluding the complete reconstruction.

Architecture function and significance are connected and form the 'architectonic authenticity' that should prevail over 'material authenticity'. For example, a vault fulfilling its function as originally designed, even if rebuilt with new bricks, masonry and voussoirs is more authentic in terms of architecture, than a vault where the original construction materials have been preserved but cannot fulfil its function because materials have lost their mechanical capacity. In this regard, genuine values of architecture (form, space, structural system, materials, textures, etc.) that have been accredited by scientific research as originals, deserve to be preserved (or recovered, if lost), and transmitted to future generations.

Restauro is defined by Cesare Brandi as any intervention aimed at making a product of human activity more effective; as opposed to *preservation* which is *preventive restoration* (Brandi 1977). To use Brandi's own words, '[…] an activity dealing with extending the life of a work of art and restoring its appearance […] any operation that aims at putting back into effective order a product of human activity'.

The philological debate on *Virtual Restoration* began in 1994, when Gianfranco Fiaccadori (Moschini 2001), professor of philology, suggested the use of these two terms together to name the methodology that consisted in applying digital techniques in the field of restoration. With new data acquisition technologies and 3D digital models, there is no structural alteration of the cultural heritage object. Furthermore, given the power of computer assisted data acquisition, management and analysis, the documentation (González Moreno-Navarro 2000) of the artwork can be augmented (e.g. 3D digitalization of the entire artwork or building) and various sources and types of information can be simultaneously accessed, analysed and integrated in the conservation process.

According to Brandi (1977), the practitioner must act on the aesthetic appearance of the cultural asset, while documenting it from its historical dimension. In this sense, we shall use an instrument that does not alter the physical structure of the object, and so as to preserve their authenticity; which is one of the key issues in physical restoration.

Virtual restoration is generally not supported by the methods and restrictions that are applied to

physical restoration work, since there is no physical (material) intervention. The process however involves a number of hypotheses and interpretations which affect the authenticity of the result. In this regard, principles of the Charter of Restoration shall be considered, not because they preserve the heritage in its materiality, but because they preserve its meaning. The term immaterial applied to architecture advocates an architecture that fuses the immaterial and the material, and considers its consequences, challenging preconceptions about architecture, its practice, purpose, matter and use (Hill 2006).

Let's also remember here that as a result of the absence of physical interventions, virtual restoration does not provide any form of protection against the degradation caused by the physical environment.

Virtual reconstruction involves using a virtual model to visually recover a building or tangible object made at a given moment in the past. The process relies on physical evidence available, rigorous comparative inferences and other studies carried out by archaeologists and other experts in relation to archaeological and historical science (Seville Principles 2011). While virtual restoration considers the appearance, purpose and use of the original object, virtual reconstruction limits itself to a visual product, proposing a hypothesis of the physical appearance of the original object.

Anastylosis is an architectural term for a reconstruction technique whereby a damaged building or monument is restored using the original architectural elements to the greatest degree possible while new parts are made visible through the use of distinct material. With digital anastylosis, concepts linked to the meaning, usage and memory of the architecture heritage will be recovered, and they will appear in the Restoration Charter of 1987 (ICOMOS 1987a). Digital anastylosis allows the reconstruction of architecture only if based on evidence (in situ or documentary), validated typological parallels, or on established constructive and functional knowledge.

Virtual conservation can be applied to knowledge about purpose and use, as well to the representation of the object, but not to the object itself.

The term conservation is defined as follows in the Washington Charter for the conservation of historic towns and urban areas (ICOMOS 1987b): 'to conserve is the supreme preservation principle. Together with stabilization and safeguarding measures, conservation work that protects the fabric of a monument and prevents its further loss should therefore have absolute priority over all other measures. […] All those measures that serve the preservation of the fabric of a monument are to be counted as conservation work. Conservation includes consolidation of the historic fabric of a monument, and in general all measures preventing further decay and preserving the historic fabric'.

The last concept we review here is *ripristino*, best exemplified by Viollet-le-Duc, who stated in his Dictionary of French architecture from the eleventh to the sixteenth centuries that: 'to restore a building, is not to maintain, repair or rebuild, it is to re-establish it in a complete state that may have never have existed'. About its application to virtual technology, García Cuetos (2009) proposed that 'computer assisted creation, misnamed virtual reality, aims at being real and may thus be seen as a ripristino since some consider it as endowed with the emotional charge of the original monument itself.'

Principles and norms used in physical restoration and their relevance to the virtual environment

The Italian Restoration Charter of 1972

The theory and history of physical restoration, which started with experiments on the ancient monuments in Italy at the beginning of the eighteenth century, can provide a theoretical framework for virtual restoration.

The Italian Restoration Charter of 1972 by Brandi (1977) is the first document that describes the concept of reconstruction in the field of cultural heritage, building on the concepts of anastylosis and restoration. Articles 6 and 7 are of particular relevance here:

Article 6 prohibits any completion of unfinished work in style, analogical, in simplified form, or even if there are graphic or plastic documentation illustrating the intended form of the completed work. It stipulates that it will be forbidden to remove or demolish from the artwork traces left by its passage through time, unless these features are of limited scope and incongruous or disfiguring in relation to the historical values of the artwork, or if they are completions in style that counterfeit the nature of the work.

Article 7 allows anastylosis, only when carefully documented and completed by reconstructing missing sections with techniques clearly discernible to the naked eye such as using lighter or neutral materials, setting them at a different level from the original parts, or leaving in sight the original support, however never reconstructing ex novo missing figurative sections and inserting important features that will alter the figurative nature of the work.

According to these articles, the Charter accepted only partial anastylosis, not admitting any other type of possible reconstruction. A large number of interventions were excluded by Brandi given his conceptual consideration of the artwork. The theory proposed by Brandi was largely replaced by the 1987 Charter (ICOMOS 1987a) but his initial position had strongly marked the history

of Italian restoration and has also had a strong influence in Europe. The origin of this development in Italy is to be seen in the effects of numerous earthquakes during the 70s, leading to the need to document and maintain traditional buildings (Jiménez 1997).

Articles 2, 8 and 9 of Brandi's Restoration Charter (1977) also provide relevant elements for digital restoration of architecture.

Article 2. 'In addition to items listed in Art. 1 [architectural monuments, painting and sculpture even if in fragments, palaeolithic artifacts, figurative expressions of the popular cultures and contemporary art], the present guidelines will apply to the following categories of objects to assure their preservation and restoration: building complexes of monumental, historical, or environmental interest, in particular historical urban areas; art collections; historic furnishings and interior decors preserved in their traditional arrangement; gardens and parks of particular importance'.

Article 8. 'Any work done on the artwork […] must be executed in such way and with such techniques and materials that will not obstruct or prevent preservation or restoration work in the future. Moreover, every intervention on the artwork must be preceded by a written report that documents the artwork and explains the motivations for the work to be done'.

Article 9. 'The use of new procedures and materials for restoration, instead of those currently used or permitted, will have to be authorized by the Ministry of Education, with the explicit consensus of Istituto Centrale del Restauro. This institution's role will be to actively advise the same Ministry and to discourage the use of antiquated, damaging or untested materials and procedures, to suggest new ones, and to determine the need of outside resources in terms equipment and specialists not available within their organizations'.

Brandi restoration theory relies on the recognition of art in its physical substance and its dual aesthetic and historical dimension. The image of the artwork itself is immaterial, as reveals itself in every observer, each time it is perceived. An artist produced the artwork in a creative process that ended with its completion. From the recognition of this duality (matter and content) in which the content is the result of a completed process, stems Brandi's first principle that only the matter of an artwork may be restored. Restoration must aim at re-establishing the potential unity of the artwork, as long as this is possible without producing an artistic or historical faux and without erasing the passage of time. This is immediately relevant to virtual restoration. The reproduction of the initial shape of the monument through digital technologies or physical intervention shall not leave room for misunderstanding about modifications over time.

An important aspect to consider in the rules of restoration is the reversibility of the actions performed (article 8). In this regard, the digital model has a great advantage over traditional physical restoration interventions as this tool is not invasive and can serve to visualize and analyse various options prior to the physical intervention.

Applying architectural knowledge to virtual restoration

Drawing from the above, we propose seven principles for the recognition of architectural authenticity in 3D digital models.

i. Digital models, just like real architecture, depend on the environment and culture in which they take place. The insertion of virtual restorations of ancient heritage within current context implies an anachronism that can obstruct the perception of represented reality. In this regard, it is essential to contextualize the architecture in order to simulate an appropriate environment.

ii. Architecture is not only form but also expression; there is a dialectical relationship with its substance. The expression through digital models eases the disclosure of certain elements, since 3D spatial modeling avoids issues relating to two-dimensional coding systems.

iii. Architecture does not exist without structure: it is part of its nature and it is expressed through its laws. As in the case of buildings, when an architectural virtual model is prepared, explaining and documenting the structural performance of the building is essential.

iv. History is not only the language of architecture, it also carries its substance, therefore architecture will not be historicist, but historical. Digital models allow us to integrate historical information and new data, easing access, analysis and understanding.

v. Function drives the organic arrangement of the buildings, but can sometimes be partially disconnected from architecture. The virtual model allows us to explore interactively and in real-time the architectural space, including the access to different information levels. This helps understanding the building and allows us to integrate various levels of information.

vi. The stylistic unity represents a system of decoupled behaviour from the different architectural parts, and it is organized by contrast, denying linguistic monotony. Virtual models enable the representation of different parts of the building or heritage site and at different historical moments.

vii. Symmetry represents the harmonious relationship between the parts of a building also with respect to the whole artwork. The symmetry is therefore not a simple repetition or rotation, but the tautological use of structural components, represented autonomously and as a whole.

Towards a method for virtual restoration

In light of the foregoing elements that is, on the one hand the concepts of the Restoration Charters, and on the other hand the knowledge of the science of architectural design construction, Vico (2012) proposed a method for virtual restoration of architecture. The method builds on the physical architectural restoration to bring scientific rigor into the process of digital modelization.

The initial step is to describe the life of a building, from its original construction to its modification caused by use, change of styles or past conservation interventions, as a process of historical loss, consolidation and superposition of old and new elements. All these elements will inform and guide any new proposal. The method proposed by Vico (2012) follows the structural equilibrium and constructive rules, in addition to the philological method, studying every architectonical element from a dimensional and static approach as we deal with architecture which was built in the past.

Figure 2.1 displays the operating diagram of phase 3 of this method. This phase corresponds to a detailed level of visualization in which 2D hypotheses are made. Every element will be calculated individually but also in the general context.

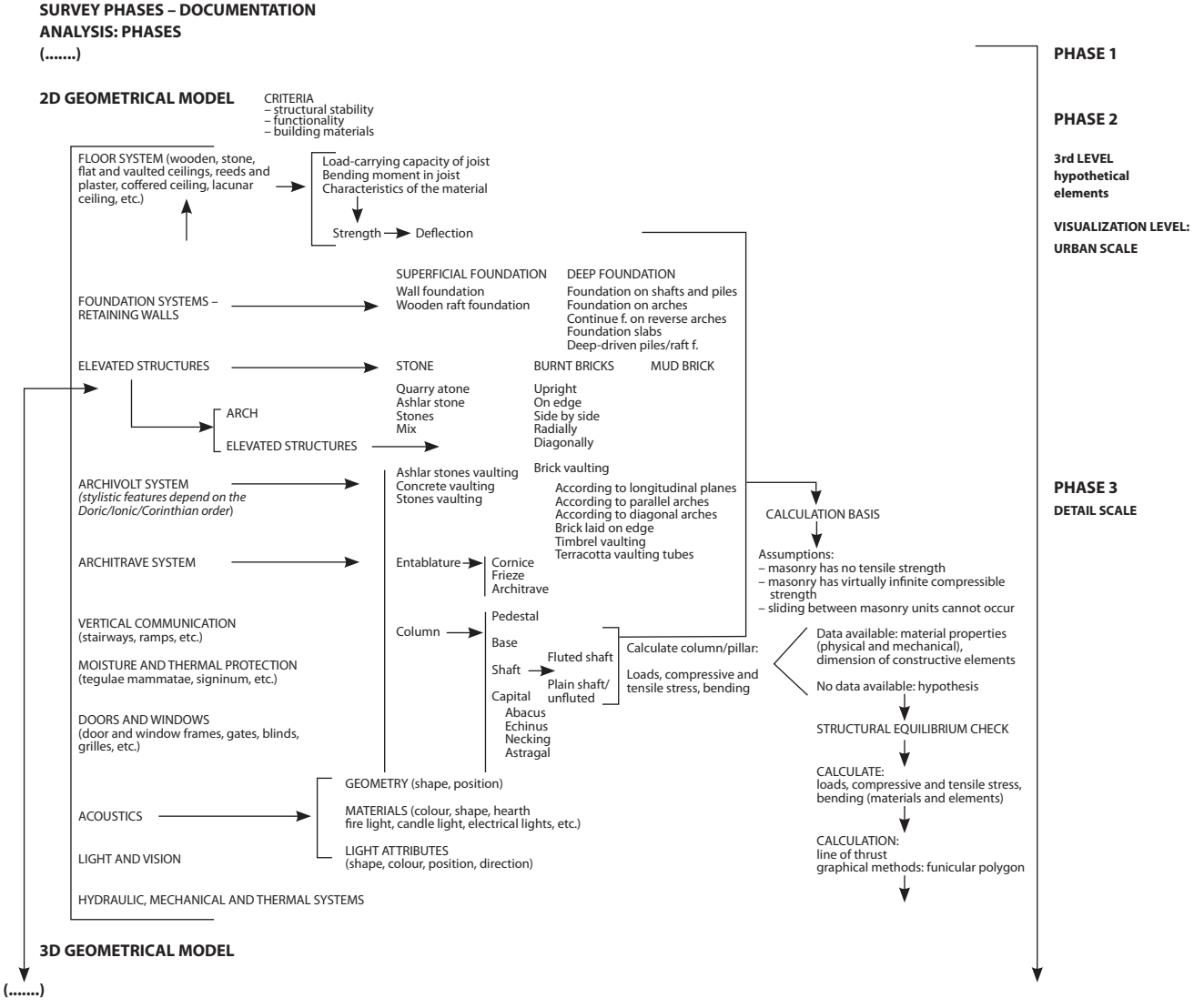


Figure 2.1. *Outline detail of the method of analysis for hypothesis elements in architectural 3D restoration (Vico 2012).*

The method proposed by Vico (2012) also provides guidance for the management and display of the information used in the virtual restoration process, and the related uncertainty. This addresses an important need in view of the discrepancies between the different techniques proposed for acknowledging and documenting uncertainty in restorations: in some cases, the validation of the 3D model is achieved through the assessment of consistency with documentary sources (Borra 2004); other modelers use stratigraphic approach (Demetrescu 2015); while in other cases yet, documentary sources are gathered according to *levels and classes* (Viscogliosi et al. 2006) or according to *typologies* (Dell'Unto et al. 2013). Basically, the decision is left to the choice of the modeler, and generally ignores architectonical criteria.

Case studies

In this section, we propose two case studies that illustrate the notions of authenticity in virtual and physical restoration. The first one also illustrates how the application of the method introduced above can effectively improve the authenticity of the proposed restoration.

Villa of Livia

In this example of the subterranean triclinium of the Villa of Livia in Prima Porta, we analyse a room built in the first century BC and rebuilt in 1937. This room was discovered in 1863 (Fig. 2.2), and was described by Sulze (1932). According to Messineo (Calci & Messineo 1984), the original dome which covered the triclinium collapsed with the earthquake of seventeenth century BC and the room was filled with debris. A new room was built posteriorly, on top of the ancient triclinium.

The reconstruction of 1937 covered the space with a barrel vault, with windows for light and ventilation. It was made without due consideration for the geometry of the room, or for the natural terrain. Furthermore, this restoration involved the loss of archaeological remains that were not documented.

In the virtual restoration based on the method described above, Vico (2012) opted for a lowered vault to cover the hypogeum triclinium, following the description of Sulze (1932) that is coherent from a typological and structural point of view. Furthermore, the proposal was based on an analysis of the structural elements that led to the collapse of the structure during the earthquake. By lowering the vault to 3.58 m. height as described by Sulze (1932), the horizontal component of the thrust increases and the vertical component of the thrust transmitted decreases, which is compatible with the way the structure collapsed.

This restoration hypothesis also relies on assumptions, but these are based on constructive logic which was not the case for the 1937 reconstruction. For example, the material used for making the vault is known to resist between 30 and 70 kg per cm^2, by comparison with other *opus caementicium* vaults contemporary in the same area.

It is suggested that the proposed restoration hypothesis is compatible with existing data, documentary sources available, terrain levels and architecture equilibrium (Fig. 2.3, centre, left), and thus more authentic than the 1937 physical restoration.

The House of the Silver Wedding

The House of the Silver Wedding is another example of how a lack of architectonic criteria is perceivable in real and virtual restoration. This Pompeian house

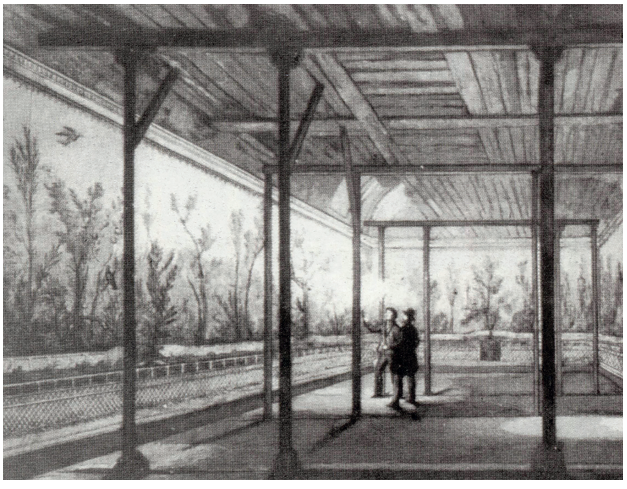


Figure 2.2. *Left: Triclinium after the restoration work, 1937. Right: Drawing by Cacchiatelli-Cleter 1865.*

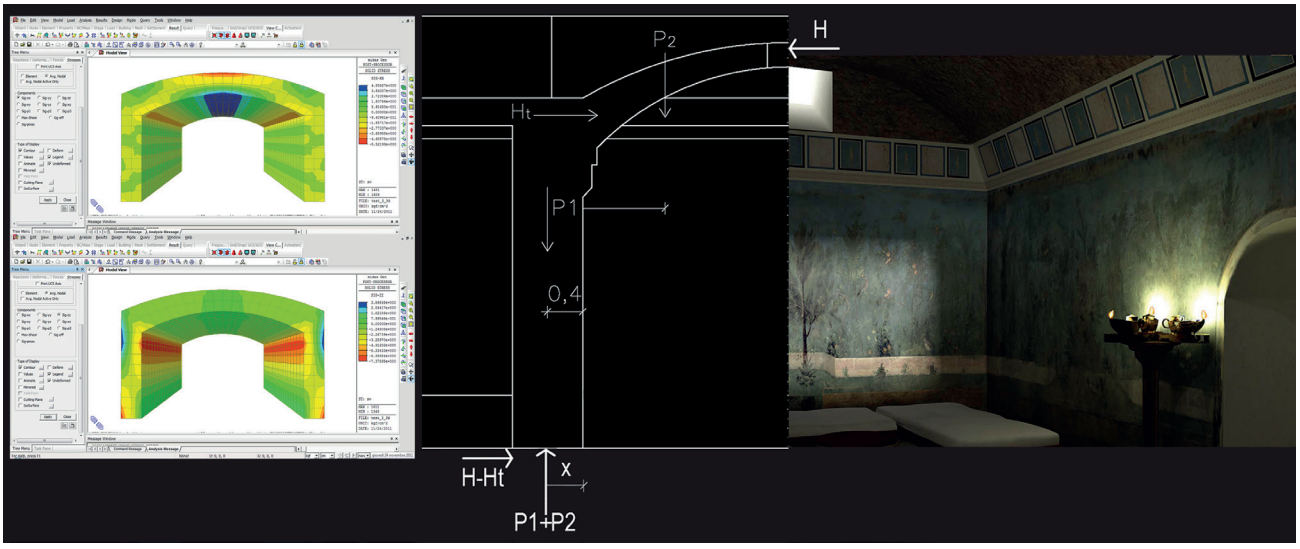


Figure 2.3. *Left side: MidasGen, stresses sig. Z-Z, X-X. Centre: structural analysis. Right: virtual restoration.*

was built around 300 BC and renovated in the early first century AD. Its architecture style is classical and it bears fine decoration. For example, the atrium has four tall Corinthian columns supporting the roof, and an ornamented exedra.

The house was subject to restorations in the 30's and 60's using iron and reinforced concrete. They transformed original roofs, lintels and wooden floors using new and highly perishable material and structures, since the iron, also in reinforced concrete, does not last more than 30 to 50 years at the most. Using wood, as in the original building would also have been preferable in view of lower maintenance requirements and better durability in case of earthquake, due to its light weight and elasticity.

In Figure 2.4, the left picture shows the Corinthian atrium after the first restoration of lintels with concrete but respectful of the original wooden architecture features, such as cymatium and gutter. The central image shows the Corinthian atrium after the restoration in reinforced concrete of the 60s, without any consideration for the original features of the wooden architecture, possibly guided by a conservative approach. In these two restorations, formal aspect

Figure 2.4. *Corinthian atrium of villa delle Nozze d'Argento, Pompeii. Left: restorationof the 30s. Centre: restoration of the 60s. Right: virtual restoration by C. Fabius.*

has been altered, as well as the building performance, and its language.

In comparison, the virtual restoration proposed by Caius Fabius (Fig. 4, right) is not authentic in terms of architecture: for example, the impluvium, ground levels, and the columns, bases and capitals are different from original.

Both case studies illustrate the many common elements between virtual and physical restoration. With the virtual restoration we can illustrate the process of developing a hypothesis (fig.3), but also create a historical fake altering the sense of architecture, even if virtual reality does not alter the physical structure.

Concluding remarks

The support of modern technologies allows the general public to have access to information and virtual restorations, which can reach high levels of realism in the representation of artwork. This is a valuable asset in communicating and valuing ancient architecture among the non-specialist.

Virtual restoration however is still a discipline under development in the area of archaeological research, and there is a strong contrast between the impression of realism that virtual models confer and the many uncertainties and hypothesis associated with their production.

As early as 1924, Adolf Loos warned against the tendency to create new architectural 'esperantism', saying that an architect is a builder who has learnt Latin. In 'Ornament and Education' (Loos 1924) the author contrasts the architect who has knowledge of the past to the modern architect who has only experience of the present to rely on. Knowing the architectural grammar is the first step to decoding and interpreting architecture. Because of its strong realism, virtual restoration can easily result in historical fakes, so it is important to work with a rigorous method to improve authenticity and *build* the virtual restorations and clearly document sources of information and hypotheses.

As it will be further discussed in this volume (Chapter 3), transparency in the process of data elaboration is essential: it requires us to work with an open and accessible system that enables the interested public to access all available data, as well as the analytical and decision making processes used to propose the restoration hypotheses. The 3D virtual model can incorporate much data associated with different elements, joined by a common reference system that allows the interrelation between databases. From a constructive point of view, it thus represents a very important tool for better understanding historical buildings. 3D virtual model also has advantages when it comes to the dissemination of this information to the wider public.

Following the constructive approaches introduced here, a virtual restoration of architectural elements can be done with a high level of certainty. Decorative aspects are however subject to greater uncertainty, since their reproduction depends on documentary sources and typological parallels. The decoration plays a key role in the perception of architecture, but the realism of the representation supported by 3D virtual model can overshoot authenticity, since the only way to control the hypothesis is by stylistics validation.

As opposed to physical restorations, 3D virtual models allow us to perform computer based simulations and analysis: once geometry is reconstructed, it is possible to simulate lights, acoustic or structural behaviour of the building and materials. This can be a first step towards physical restoration, allowing not only aesthetic simulations but also the analysis of functional aspects.

In physical restoration any intervention needs to be distinct from the original artwork composition and must bear a distinctive 'contemporary stamp' in order to preserve the authenticity of a structure. In addition, physical restoration must stop at the point where conjecture begins. In the virtual domain, restoration is not intrusive and can thus go further in proposing a ripristino of the artwork, if there is an explicit and scientific method to explain the level of authenticity of the intervention, and document the data and process that lead to the restoration hypothesis.

Notes

1 For a critical review with bibliography about the lack of scientific accuracy and methodological consistency in Virtual Reconstruction, see Beacham et al. (2006) and Denard (2012) in the new introduction to the London Charter, p. 57, footnote 2.

References

Brandi, C., 1977. *Teoria del Restauro*. Torino: Einaudi.

Beacham, R., Denard, H. & F. Niccolucci, 2006. An Introduction to the London Charter, in *The e-volution of Information Communication Technology in Cultural Heritage.* Short papers from the joint event CIPA/VAST/EG/*EuroMed 2006*, eds M. Ioannides, D. Arnold, F. Niccolucci & K. Mania. Budapest: Archaeolingua. Accessed 21 April 2017: http://www.londoncharter.org/downloads/

Borra, D., 2004. Sulla verità del modello 3D. Un metodo per comunicare la validità dell'anastilosi virtuale, in *Proceedings E-ArCom04*. Ancona: CLUA Edizioni.

Calci, C. & G. Messineo, 1984. *La Villa di Livia a Prima Porta*. Roma: De Luca editore.

Demetrescu, E., 2015. Archaeology stratigraphy as a formal language for virtual reconstruction. Theory and practice. *Journal of Archaeological Science* 57, 42–55.

Dell'Unto, N., Leander, A., Delle piane, M., Callieri, M., Ferdani, D. & S. Lindgren, 2013. Digital reconstruction and visualization in archaeology: case-study drawn from the work of the Swedish Pompeii Project. *Proceedings of the 2013 Digital Heritage International Congress* (1). Marseille: IEEE Explore Digital Library, 621–8.

Denard, H., 2012. A new introduction to the London Charter, in *Paradata and Transparency in Virtual Heritage Digital Research in the Arts and Humanities Series*, eds A. Bentkowska-Kafel, D. Baker & H. Denard. Ashgate, 57–71. Accessed 21 April 2017: http://www.londoncharter.org/introduction.html

Eco, U., 1968. *La struttura assente*. Milano: Bompiani.

Moschini D., 2001. Restauro virtuale, la tecnica per il recupero digitale delle informazioni nascoste. *Kermes* 41, 45–54.

Galla, A., 1995. Authenticity: Rethinking Heritage Diversity in a Pluralistic Framework, in *Nara Conference on Authenticity*, ed. K. E. Larsen. Paris: UNESCO World Heritage Centre, 315–22.

García Cuetos, M.P., 2009. *Humilde condición. El patrimonio cultural y la conservación de la autenticidad*. Gijón: Trea.

González Moreno-Navarro, A., 2000. Il restauro oggettivo, in *Il restauro fra identitá e autenticità. I principi fondativi del restauro architettonico*, eds. G. Cristinelli & V. Foramitti. Venecia: Marsilio, 98.

Hajnóczi, J. G., 1995. *The problems of authenticity and identity as reflected by preservation of Archaeological monuments. Ethics, principles and methodology*. ICOMOS 27.

Hill, J., 2006. *Immaterial architecture*. New York: Routledge.

ICOMOS 1987a. *International charters for conservation and restoration* (Paris charter 1987). Accessed 21 April 2017: http://www.icomos.org/charters/charters.pdf

ICOMOS 1987b. *Charter for the conservation of historic towns and urban areas* (Washington charter 1987). Accessed 21 April 2017: http://www.icomos.org/charters/towns_e.pdf

Jiménez, A., 1997. Enmiendas parciales a la teoría del restauro (I). *Loggia: arquitectura y restauración* 4, 10–19.

Charter of Krakow 2000. *The Charter of Krakow 2000. Principles for conservation and restoration of built heritage*: Accessed 21 April 2017: http://smartheritage.com/wp-content/uploads/2015/03/KRAKOV-CHARTER-2000.pdf

Loos, A., 1924. *Ornament and education*. Paris.

Marconi, P., 1993. *Il restauro e l'architetto, teoria e pratica in due secoli di dibattito*. Venezia: Marsiglio.

Riegl, A., 1987. *El culto moderno a los monumentos*. Madrid: Visor.

Seville Principles (2011). *International Principles of Virtual Archaeology. The Seville Plinciples 2011*. Accessed 21 April 2017: http://smartheritage.com/seville-principles/seville-principles.

Sulze, H., 1932. Die unterirdischen Räume der Villa der Livia in Prima Porta. *Mitteilungen des Deutschen Archäologischen Instituts, Römische Abteilung* 47, 174–92.

UNESCO, 1994. *Nara Conference on Authenticity*, ed. K. E. Larsen. Paris UNESCO World Heritage Centre.

Vico, L., 2012. *La restauración virtual según la interpretación arquitectónico-constructiva: metodología y aplicación al caso de la villa de Livia*: Ph.D. thesis.

Viscogliosi A., Borghini S. & R. Carlani, 2006. L'uso delle ricostruzioni virtuali tridimensionali nella storia dell'architettura: immaginare la Domus Aurea. *Journal of Roman archaeology*, supplementary series 61. Portsmouth, Rhode Island.

Von Droste, B. & U. Bertilsson, 1995. Authenticity and World Heritage, in *Nara Conference on Authenticity*, ed. K. E. Larsen. Paris: UNESCO World Heritage Centre, 3–15.

Part 2
Definitions

Chapter 3

Digital authenticity and the London Charter

Sorin Hermon and Franco Niccolucci

The London Charter (http://www.londoncharter.org/) published almost a decade ago, set-up principles for the use of computer-based visualization methods and outcomes in the research and communication of cultural heritage. In particular, it aims at providing a benchmark having widespread recognition among the various communities of use, promote related intellectual and technical rigor, ensure that computer-based visualizations can be properly understood, used and evaluated in order to scientifically contribute to the study, interpretation and management of cultural heritage assets and ensure access and sustainability for such outcomes. One of the main concepts addressed by the principles of the Charter is intellectual transparency, i.e. the formal representation of the reasoning process generating a visualization outcome, along with the primary data used and its transformation process. Accountability and reproducibility are basic requirements in any scientific discipline; consequently, the Charter details how these should be addressed. In other words, the authenticity of a digital visualization outcome can be expressed as its ability to comply with the principles of the London Charter.

Computer-based visualization of cultural heritage has already a long history of use in social sciences and humanities (Chalmers et al. 1995, Forte & Siliotti 1997, Barceló, Forte and Sanders 2000, Goodrick & Gillings 2000). What has started more than a quarter of century ago as a proof-of-concept, i.e. computer-aided 3D visualization of excavations stratigraphy is a valid tool for investigating archaeological remains (Reilly 1992), developed in the next decades into elaborate educational tools, where 3D models are used for academic teaching (Sanders 1999, Taylor-Helms et al. 2013, Lackovic et al. 2015), platforms and means of public dissemination and communication of cultural heritage (Silberman 2004, Karp 2005, Bruno et al. 2010), distinct field documentation methods (Olson et al. 2013, Athanasiou et al. 2013, De Reu et al. 2014, Hermon, Iannone and Amico 2014, Remondino & Campana 2014, Berggren et al. 2015), research methods (Niccolucci & Hermon 2013, Hermon & Niccolucci 2015, Hermon 2008, Hermon, Niccolucci and D'Andrea 2005, Hermon & Fabian 2002) and proper research environments where computer-based visualization is employed to elucidate research questions about the past (Forte 2010, Smith et al. 2013, Gaugne et al. 2014, Knabb et al. 2014, Sanders 2014).

In parallel with the growing adoption of computer-based visualization in the cultural heritage domain, a demand for an increased 'authenticity' of the visualization, from a cultural heritage perspective, was put forward (Frischer et al. 2002, Bakker et al. 2003, Bentkowska-Kafel et al. 2012). Guiding concepts were 'transparency of reasoning' (Damnjanovic et al. 2013) and 'credibility of research' (see also Niccolucci & Hermon 2010) and how these can be formalized (Niccolucci & Hermon in press, Niccolucci et al. 2015), implemented and published, along with the digital visualization product itself. In other words, the research community of the late nineties and early twenty-first century became aware that there is a need for solid principles guiding such efforts if the visualization outcome is to be recognized as the product of a scientific process.

Either fundamental, applied or a combination of both, any scientific research starts with a question – described in its aims and the expected result. A hypothesis is thus formulated and data is collected. It goes without saying that the collection of data (method, amount and quality) must be aligned with the research aims and the advanced hypothesis. Data is then analysed and synthesized, in order to corroborate or reject the formulated hypothesis. Such a process may be repeated several times, until the research is satisfied with the results or these are consistent in all

iterations. The final step of the process is the scientific publication, which according to its type, may or may not include raw data (seldom), highlights from the analysed data along with the processing method and, in most cases, a non-structured presentation of the reasoning process, which ultimately led to the published conclusions. Therefore, a basic requirement from any scientific publication, i.e. the ability to assess and evaluate the results published, is rarely fulfilled in its entirety.

The situation gets even more complex when the research involves computer-based visualization, in any or all of its stages – data collection, archiving, processing, deriving conclusions and publication. Such a research relies on digital data that either represents real features (an excavation area, artefacts, architecture components, etc.) or is the result of a digital (2D/3D) modelling process of assets with no, or partial correspondence in real life. In the first case, the authenticity of the digital surrogate representing an existing physical feature can be expressed (and quantified) in terms of accuracy the instrument involved in the data acquisition and its resolution, as well as the performance of the software involved in transforming a physical reading (laser-based, light-based or digital imaging being most common techniques) into a digital outcome (a point cloud). The same goes with an analogously captured data and later on digitized. The results depend on the accuracy of the data capture method and the transformation from analogue to digital. In the second case, where the digital data is the result of a reasoning process, the assessment of data quality is more complex (Hermon et al. 2006).

In the above-mentioned cases, the quality of data (usually a 3D point cloud) is expressed as the goodness-of-fit between the physical object and the digital one, i.e. how well the digital surrogate represents the physical reality. However, such replication is very limited in its nature, a digital surrogate being often limited to geometry features, some colour (light) properties and rarely material properties (elasticity, strength, toughness, acoustical, mechanical, and so on). In reality, there is no protocol defining a set of measurements and observation that can quantify the goodness-of-fit between a physical object and its digital surrogate. The short paragraph above described in more detail the complexity of the relationship between data acquisition, the physical assets (or the concept) analysed and its digital surrogate. It also exemplifies the need for intellectual accountability and transparency of research, elemental components in any discussion about authenticity. The same complexities exist for the other components of research – archiving, processing and drawing conclusions. And this is precisely why the London Charter has been written – to propose a set of principles to be followed by researchers, educators, curators and alike, who wish to employ computer-based visualization in the research and communication of Cultural Heritage.

The London Charter – preamble and current situation

The London Charter for the Computer-based Visualisation of Cultural Heritage was conceived in 2006, with the aim to provide a set of principle that would ensure the needed methodological rigour in cases when computer-based visualization is employed in the research and communication of cultural heritage. At that time, it was also important to provide a set of solid and long-lasting principles that would further promote such use of computer-based visualization in the domain of Cultural Heritage, while in the same time offering a sustainable solution to the issue of 'intellectual transparency' (Beacham et al. 2006). Moreover, such principles would have strengthened the professional norms of the newly emerging field as a research domain, particularly in terms of argument and evidence (Denard 2012, 2013). Since its initial publication in English, the Charter was translated and published in Italian, Spanish, German, Hungarian, Portuguese, Bosnian, Japanese, Chinese and Farsi, while Russian, French and Greek translations are currently undergoing a final editing process (http://www.londoncharter.org/). Its objectives are:

- Provide a benchmark having widespread recognition among stakeholders.
- Promote intellectual and technical rigour in such uses.
- Ensure that computer-based visualization processes and outcomes can be properly understood and evaluated by users.
- Enable computer-based visualization authoritatively to contribute to the study, interpretation and management of cultural heritage assets.
- Ensure access and sustainability strategies are determined and applied.
- Offer a robust foundation upon which communities of practice can build detailed London Charter Implementation Guidelines.

The first version of the London Charter was published in March 2006, following an international symposium (23–24 February) on 'Making 3D Visual Research Outcomes Transparent', convened at The British Academy, London, UK and hosted by AHRC 'Making Space' Project, King's Visualisation Lab, and co-sponsored and

organized by the AHRC ICT Methods Network and VAST-Lab, PIN, Prato, Italy, in the framework of the EU funded project EPOCH Network of Excellence and its standards activity. The next day, an experts seminar was convened at King's College London, during which the main principles of 'The London Charter for the Use of Three-dimensional Visualisation in the Research and Communication of Cultural Heritage', version 1.1, were established and a month later published online and through various scientific articles. A second version (2.1) was published three years later, capturing the debates and discussions triggered by version 1.1 (Niccolucci et al. 2010). A major development was the inclusion of other forms of digital visualization, '… embracing 2D, 3D, 4D and even hard-copy printouts or computer-generated physical objects such as replicas of museum artefacts…' (Denard 2012, 61). Thus, the London Charter became 'The London Charter for the Computer-based Visualisation of Cultural Heritage' and is currently the latest version available. Since its publication, The Charter's principles are applied in computer-based visualization projects around the globe (Lake 2012), some explicitly mentioning it (Hermon et al. 2007, Georgiou & Hermon 2011, Murteira & Rodrigues 2016), others implicitly relying on its principles (Gea at al. 2013).

The next paragraphs will details its principles and how these were applied to a visualization project, having dual scope of research and communication of Cultural Heritage.

The London Charter principles

The Charter is built around six fundamental principles that, if followed and implemented, they will assure the needed data transparency, intellectual accountability and re-usability of visualization outcomes, while in the same time these principles are the backbone for evaluating the authenticity of a visualization product, where authenticity is referred to as the ability to scientifically evaluate and assess a visualization outcome, be it digital or physical. The following paragraphs details these principles and how they were addressed in a research project where digital (2D and 3D) visualization played a fundamental role.

Description of the case study

The uniquely shaped octagonal domed church of the Christ Antiphonitis (Fig. 3.1) in the district of Kyrenia (Cyprus) was built in the twelfth century and decorated with frescoes along its interior walls. A new layer of frescoes was applied in the fifteenth to sixteenth centuries; two of these are exceptional for their artistic and historic value: the story of the Tree of Jesse (a pictorial genealogy of the Virgin) located on the southern wall of the octagon, and the Last Judgment, on the northern wall. Following the Turkish military invasion of Cyprus in 1974, looters stripped off big portions of its pictorial decoration and extracted them from the island, in order to be sold abroad. Since the end of the 1990s, due to efforts of Cypriot authorities, more than 70 fragments

Figure 3.1. *The church from outside.*

Figure 3.2. *Some of the repatriated frescoes.*

of its frescoes returned from USA and Europe to the Byzantine Museum of Nicosia (Fig. 3.2), where they are currently under conservation and restoration for future display. These were digitally documented using high-resolution ortophotos. The inner space of the church was documented by similar means, in order to virtually re-position the frescoes in their original locations. The virtual re-composition of the frescoes along the looted walls helped quantifying the missing parts, correctly re-locate virtually each fragment at its original position, obtain accurate colour information and prepare a digital musealization product, to be included in the permanent exhibition display at the museum (Abate et al. 2016).

Principle 1. Implementation. *The principles of the London Charter are valid wherever computer-based visualization is applied to the research or dissemination of cultural heritage.*

Since our project involves both research and dissemination, it is important to clearly define the implementation guidelines for each path. The research component includes guidelines on how the entire scientific process is to be documented. CIDOC-CRM is instrumental here, being an ontology developed to provide definitions and a formal structure for describing the implicit and explicit concepts and relationships used in cultural heritage documentation (Doërr 2003). Particularly relevant here is the extension CRMdig, defined in order to capture information on the creation of digital data (Theodoridou et al. 2010, Pitzalis et al. 2010). Consequently, such information was described through a metadata schema developed in our research group (Ronzino et al. 2012), which is based on the CARARE 2.0 metadata schema (D'Andrea & Fernie 2013). Such data is stored and online accessible through a repository of scientific data produced by our research group (Kolosova & Hermon 2013). The second aspect of our case study, dissemination, followed recommendations proposed by the V-MUST project on Virtual Museums (Hermon & Hazan 2013). They include, among others, a clear description of the target group and adaptation of content to such a group, an analysis of the exhibition environment, level of interactivity desired for such a type of dissemination product, degree of immersion and level of engagement of visitors.

Principle 2. Aims and methods*. A computer-based visualization method should normally be used only when it is the most appropriate available method for that purpose.*

The main aim of the research component of the project was to recompose the scenes of the two frescoes described above. Such a reconstruction is essential in assessing how much is still missing from each scene and how much is totally destroyed and irrecoverable; furthermore, once the virtual re-composition is completed, the interior of the church can be analysed in terms of visibility of the scenes from various angles and perspectives, illumination of each scene and relation with each other. Over 70 fragments, of various sizes and shapes were repatriated, in various preservation

Figure 3.3. *Documenting the fresco fragments.*

conditions. Since there were no accurate plans of the church and the only documentation available were black and white photos taken prior the desecration of the church, a first step of the re-composition process was to create a digital environment where the digital surrogates of the frescoes fragments can be relocated. Therefore, each fragment was photographed and ortophotos were created (Fig. 3.3). These ortophotos had to be positioned along the two walls of the interior of the church (north and south). Given the restriction of scientifically operating in the occupied area of Cyprus, the only way to capture the interior geometry of the church was by means of photogrammetry, which produced a dense point cloud (Fig. 3.4) upon which the ortophotos could be positioned.

Since the frescoes were removed in an unsupervised manner and were later cut in order to maximize the selling of separate pieces, they display different erosion patterns along their edges; moreover, the pictorial layer is damaged in many cases. Therefore, any attempt at automatic matching would have failed from the start. Therefore, the selected method was the creation of a 3D model of each interior wall, adding as texture the old black and white documentation photos, align them with the photos depicting the nowadays situation and, based on the above, align the ortophotos of the frescoes fragments (Figs. 3.5 & 3.6). Further assessments were done to evaluate the extent of missing frescoes (Fig. 3.7) and the overall extension of each scene.

Figure 3.4. *3D point cloud of the interior.*

Figure 3.5. *Last judgement scene (northern wall). 36 fragments were virtually re-located, which is 72 per cent of the scene.*

Figure 3.6. *Tree of Jesse scene (southern wall). 32 fragments were virtually re-located, which is 77 per cent of the scene.*

***Principle 3. Research sources**. In order to ensure the intellectual integrity of computer-based visualization methods and outcomes, relevant research sources should be identified and evaluated in a structured and documented way.*

The research sources employed in the visualization of the interior of the Antiphonitis church are a set of historic photos (black & white) taken prior its desecration, which served as a basis for the virtual re-positioning of the digital models of the repatriated fragments. All the other data has been collected by the authors of the research, i.e. sets of images of each fresco fragment and a set of images from capturing the interior of the church (Abate et al. 2016).

***Principle 4. Documentation**. Sufficient information should be documented and disseminated to allow computer-based visualization methods and outcomes to be understood and evaluated in relation to the contexts and purposes for which they are deployed.*

The visualization elements used in the research are ortophotos of each fresco fragment and the 3D model

of the interior of the church, needed in order to obtain accurate architectural details of northern and southern walls of the octagon, to later serve as reference frameworks for the re-composition of the frescoes fragments. The delineated area was documented using the Structure from Motion (SfM) approach. Photogrammetric rules were followed as much as possible, given the environment and operating conditions. The interested area was subdivided in blocks, which were documented separately by a set of images, using the same camera and same settings. Some 700 pictures were acquired from the ground level, in raw image format. The camera used, mounted on a tripod, is a Canon 600D with a 18-megapixel CMOS sensor (4.3 μm pixel size) with a Canon EF 20 mm 1:2.8 prime lens.

The ground sample distance (GSD) was calculated in ~1 mm at an average camera-object distance of 5 m, with an image scale of 1/250. Ground truth measurements were taken in order to scale the model. The image acquisition was performed without a proper light setup, in an environment with changing luminosity, during the opening hours of the site (10 am – 2 pm), when natural daylight illuminates the interior. The only possible shrewdness was to turn off the yellowish lights emitted by the chandelier hanging from the vault ceilings. A standardized colour chart was used for each image sequence. The masking procedure of

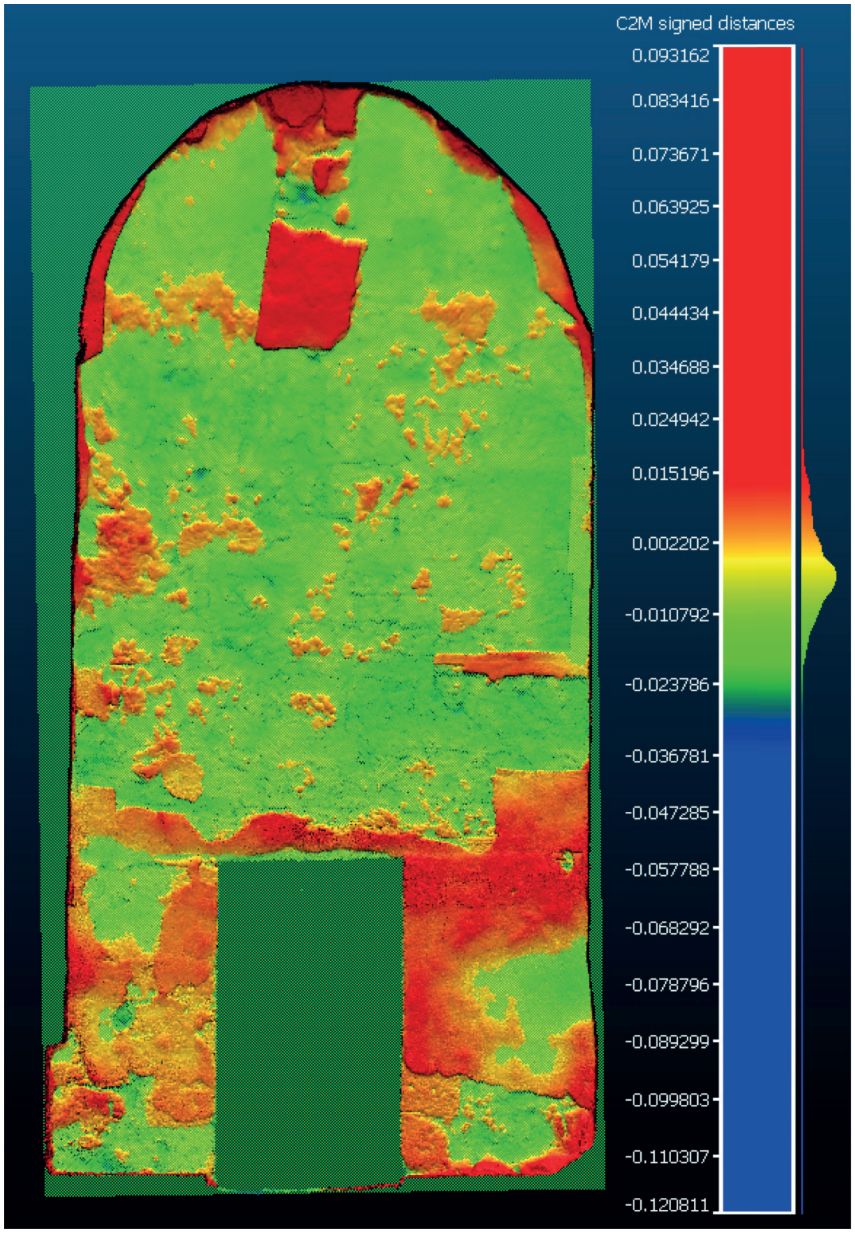


Figure 3.7. *Last Judgement scene wall. Red areas correspond to preserved in-situ frescoes, green ones to areas where frescoes are missing (Abate et al. 2016).*

the wall dataset was particularly time-consuming, due to the presence of light spots that occurred during the photos shooting because of the uncontrolled light environment (Abate et al. 2016). The extracted dense point cloud consists of ~255 mil points, with an average spatial resolution of 0.6 mm, obtained by applying a high redundancy and image overlapping.

The frescoes fragments were digitized *in situ* at the museum and processed using the Agisoft Photoscan software. Each photo was pre-processed to according to a colour checkerboard in order to equalize its colours, and the background has been masked to facilitate and improve the quality of the alignment process. The extracted tie points were filtered out in order to limit their image re-projection errors below 0.5 pixel and to keep only well distributed and reliable points. A dense point cloud, a mesh 3D model and orthophotos with an average pixel dimension of 0.4 mm were created for each fresco fragment. Some fragments were still covered by tissues for conservation purposes; their digital images were pre-processed with a photo editing software in order to improve their colour information (i.e. white balance, colours enhancing, etc.). All orthophotos were imported into AutoCAD for a correct alignment within a unique reference system. After the photogrammetric process all images were properly scaled and no further adjustment was necessary.

Before the final alignment of all fragments into a single 3D reference system, the current condition of both walls, originally fully covered by frescoes, was assessed. The dense point clouds of the two walls were analysed using the CloudCompare open source software (Cloud to Mesh distance tool). For each point cloud, a best fitting plane was first extracted and used as reference, resulting in a mean plane fitting RMS of ~ 0.015 m. After the calculation of the distances between each point cloud and its best-fitted plane, the resulted scalar field visualization tool highlighted the parts of the wall where frescoes survived (red areas) and the damaged surface of the wall from where frescoes were ripped off (green areas) (Fig. 3.7).

Starting from the best fitting plane results, a quantitative analysis of the walls area, calculated in square metres, was performed in AutoCAD. The assessment was made on orthophotos with and without the fragments' virtual re-location. The Tree of Jesse wall extends over ~15.7 sq. m. The looted area is *c*. ~7.20 sq. m, or *c*. 45 per cent of the original wall. The recovered fragments represent an average surface of 3.65 sq. m, thus reducing the missing frescoes to 23 per cent. The Last Judgment scene extends over an area of ~17 sq. m. This area showed a percentage of missing frescoes close to 75 per cent (12.8 sq. m). After the repositioning of the 36 fragments, the missing surface decreased to *c*. 28 per cent, equivalent of 4.75 sq. m. Some *c*. 3–5 per cent of the frescoes on each wall were totally destroyed during their looting.

***Principle 5. Sustainability**. Strategies should be planned and implemented to ensure the long-term sustainability of cultural heritage-related computer-based visualization outcomes and documentation, in order to avoid loss of this growing part of human intellectual, social, economic and cultural heritage.*

All data produced is on standard formats, readable with a wide range of software. 3D models and digital images used are stored in an online accessible repository, together with their descriptive metadata (Ronzino, et al. 2012), which contains both machine-generated information (technical details on how data was obtained) as well as what in the relevant literature is called 'paradata' (how data was obtained) (Baker 2012).

***Principle 6. Accessibility**. The creation and dissemination of computer-based visualization should be planned in such a way as to ensure that maximum possible benefits are achieved for the study, understanding, interpretation, preservation and management of cultural heritage.*

The entire data generated by the project is made available in its raw and processed formats, along with related metadata and paradata (see above).

Summary and conclusions

'Authenticity' is not a term employed or directly addressed by The London Charter, possibly because the term 'authentic' is in fact a bit misleading. It may sound as defining an object as the real, and only one, undisputed thing, opposed to a fake, a copy or a counterfeited substitute. Indeed, many digital replicas are so: they do no represent faithfully the original. Compliance with The London Charter guarantees instead that they are 'authentic' copies, i.e. they are accurate and reliable, based on facts, and such facts are reported to guarantee the intellectual accountability of the scientific research that led to produce the digital artefact, and data transparency. The London Charter principles were defined precisely in order to assure that these two components are addressed whenever computer-based visualization is applied in cultural heritage research. As such, the quality of a visualization outcome can be measured quantitatively, (number of pixels, density of point clouds, number of scans taken, environmental conditions, etc.) where the

threshold between authentic or not can be decided by each researcher according to its own acceptance level. Actually, such precision does not influence 'authenticity' as long as it is clearly reported and documented: what is 'authentic' for communication purposes may not be such when scientific analysis is involved. A description of how the creation process of a 3D model can be fully documented with CIDOC CRM can be found in (Amico et al. 2013).

Complying with The London Charter provides the information necessary to any future researcher to assess if the involved digital object is 'authentic enough' for its intended re-use. This aspect is even more important when the digital object does not correspond to any real object, but just depicts the supposed shape and appearance a real object had in the past. This is the case, for example, of virtual restoration, where fragments are recombined to digitally reconstruct the broken original. If often pieces recombine easily to fit well with each other, for other parts the assembly is based on computations or is inferred basing on other criteria, which need to be precisely stated (Hermon et al. 2011, Iannone et al. 2011).

Even more difficult is the documentation of the virtual reconstruction of buildings, monuments and sites. To avoid that the reconstruction is a mere result of imagination, there are many implicit decisions that need to be made explicit and accurately documented, in the same way as the meaning of a corrupt text is patiently reconstructed through a philological approach (Frischer et al. 2002). In both cases, the result will not 'authentic' in a strict sense – and it could not be: the original does not exist – but will be so at the best of one's knowledge.

The London Charter concerns the shape and appearance of objects, which do not exhaust the features of objects. There are many others, either directly perceivable (the touch and feel, for example) or hidden ones (the chemical composition), which probably will need to be addressed with the same approach. For most of the archaeological science analyses, for example, there are so far no similar guidelines, and the 'authenticity' of the result relies only on generic research good practices. Thus, as far as authenticity is concerned, there is a risk that scientific analyses are no less deceptive than a pretty, but undocumented, visualization.

References

Abate, D., Hermon, S. & I. Eliades, 2016. Virtual and physical re-composition of fragmented ecclesiastical frescoes using a photogrammetric approach. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLI-B5, 153–60.

Amico, N., Ronzino, P., Felicetti, A. & F. Niccolucci, 2013. Quality management of 3D cultural heritage replicas with CIDOC-CRM, in *Practical Experiences with CIDOC CRM and its Extensions (CRMEX 2013), Workshop at 17th International Conference on Theory and Practice of Digital Libraries (TPDL 2013)*, eds V. Alexiev, V. Ivanov & M. Grinberg. CEUR Workshop Proceedings vol. 1117, 61–9.

Athanasiou, E., Faka, M., Hermon, S., Vassallo, V. & K. Yakoupi, 2013. 3D documentation pipeline of Cultural Heritage artifacts: a cross-disciplinary implementation, in *Digital Heritage International Congress*, eds A. Addison, G. Guidi, L. De Luca & S. Pescarin. Marseille: IEEE, Vol. I, 145–52.

Baker, D., 2012. Defining paradata in heritage visualization, in *Paradata and Transparency in Virtual Heritage*, eds A. Bentkowska-Kafel, D. Baker & H. Denard. London: Ashgate, 163–75.

Bakker, G., Meulenberg, F. & J.D. Rode, 2003. Truth and credibility as a double ambition: Reconstruction of the built past, experiences and dilemmas. *The Journal of Visualization and Computer Animation* 14(3), 159–67.

Barceló, J.A., Forte, M. & D.H. Sanders, 2000. *Virtual Reality in Archaeology*. BAR International Series 843, Oxford: Archaeopress.

Beacham, R., Denard, H. & F. Niccolucci, 2006. An Introduction to The London Charter, in *The e-volution of Information Communication and Technology in Cultural Heritage, Proceedings of VAST 2006*, eds M. Ioannides, D. Arnold, F. Niccolucci & K. Mania. Budapest: Archaeolingua, 263–9.

Bentkowska-Kafel, A., Baker, D. & H. Denard (eds.), 2012. *Paradata and Transparency in Virtual Heritage*, London: Ashgate.

Berggren, Å., Dell'Unto, N., Forte, M., Haddow, S., Hodder, I., Issavi, J., Lercari, N., Mazzucato, C., Mickel, A. & J.S. Taylor, 2015. Revisiting reflexive archaeology at Çatalhöyük: integrating digital and 3D technologies at the trowel's edge. *Antiquity*, 89(344), 433–48.

Bruno, F., Bruno, S., De Sensi, G., Luchi, M. L., Mancuso, S. & M. Muzzupappa, 2010. From 3D reconstruction to virtual reality: A complete methodology for digital archaeological exhibition. *Journal of Cultural Heritage*, 11(1), 42–9.

Chalmers, A., Stoddart, S., Tidmus, J. & R. Miles, 1995. INSITE: an interactive visualization for archaeological sites, in *Computer Applications and Quantitative Methods in Archaeology*, eds J. Huggett & N. Ryan. Oxford: Hadrian Books, 225–8.

D'Andrea, A. & K. Fernie, 2013. CARARE 2.0: a metadata schema for 3D Cultural Objects, in *Digital Heritage International Congress*, eds A. Addison, G. Guidi, L. De Luca & S. Pescarin. Marseille: IEEE, Vol. 2, 137–43.

Damnjanovic, U., Hermon S., Iannone, G. (2013). Documentation of decision-making process in the analysis of digital heritage objects, in A. Addison, G. Guidi, L. De Luca, S. Pescarin (eds.) *Digital Heritage International Congress*, Marseille: IEEE, Vol. I, 743–6.

De Reu, J., De Smedt, P., Herremans, D., Van Meirvenne, M., Laloo, P. & W. De Clercq, 2014. On introducing an

image-based 3D reconstruction method in archaeological excavation practice. *Journal of Archaeological Science* 41, 251–62.

Denard, H., 2012. A new introduction to the London Charter, in *Paradata and Transparency in Virtual Heritage*, eds A. Bentkowska-Kafel, D. Baker & H. Denard. London: Ashgate, 57–71.

Denard, H., 2013. Implementing Best Practice in Cultural Heritage Visualisation: The London Charter, in *Good Practice in Archaeological Diagnostics*, eds. C. Corsi, B. Slapšak & F. Vermeulen. Chicago: Springer International Publishing, 255–68.

Doërr, M., 2003. The CIDOC conceptual reference module: an ontological approach to semantic interoperability of metadata. *AI Magazine*, 24(3), 75–91.

Forte, M. (ed.), 2010. *Cyber-Archaeology*. BAR International Series 2177. Oxford: Archaeopress.

Forte, M. & A. Siliotti (eds.), 1997. *Virtual Archaeology – Great Discoveries Brought to Life Through Virtual Reality*. London: Thames & Hudson.

Frischer B., Niccolucci F., Ryan N. S. & J. A. Barceló, 2002. From CVR to CVRO: the Past, Present and Future of Cultural Virtual Reality, in *Virtual Archaeology,* ed. F. Niccolucci. BAR International Series 1075, Oxford: Archaeopress, 7–18.

Gaugne, R., Gouranton, V., Dumont, G., Chauffaut, A. & B. Arnaldi, 2014. Immersia, an open immersive infrastructure: doing archaeology in virtual reality. *Archeologia e Calcolatori* 5, 1–10.

Gea, J. M. C., Toval, A., Alemán, J. L. F., Nicolás, J. & M. Flores, 2013. The London Charter and the Seville Principles as sources of requirements for e-archaeology systems development purposes. *Virtual Archaeology Review*, 4(9), 205–11.

Goodrick G. & M. Gillings, 2000. Constructs, simulations and hyperreal worlds: the role of Virtual reality (VR) in archaeological research, in *On the theory and practice of archaeological computing*, eds. G. Lock & K. Brown. Oxford: Oxford University Committee for Archaeology, 41–58.

Georgiou, R. & S. Hermon, 2011. A London Charter's visualization: the ancient Hellenistic-Roman theatre in Paphos, in *The 12th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST*, eds M. Dellepiane, F. Niccolucci, S. Pena Serna, H. Rushmeier & L. Van Gool. The Eurographics Association, 53–6.

Hermon, S., 2008. Reasoning in 3D: a Critical Appraisal of the Role of 3D Modelling and Virtual Reconstructions in Archaeology, in *Beyond Illustration: 2D and 3D Technologies as Tools for Discovery in Archaeology*, eds B. Frischer & A. Dakouri-Hild. BAR International Series 1805, Oxford: Archaeopress, 36–45.

Hermon, S. & P. Fabian, 2002. Virtual reconstruction of archaeological sites – some archaeological scientific considerations, in *Virtual Archaeology VAST2001*, ed. F. Niccolucci. BAR International Series, S1075, Oxford: Archaeopress, 103–8.

Hermon, S. & S. Hazan, 2013. The Responsive Museum, in *Beyond Control – The Collaborative Museum and its Challenges. International Conference on Design and Digital Heritage, NODEM2013*, ed. H. Gottlieb. Stockholm: Interactive Institute Swedish ICT, 183–93.

Hermon, S., Iannone, G., Gheorgiou, R. & N. Amico, 2011. A Virtual Restoration of a Broken Pottery Vessel, in *On Cooking Pots, Drinking Cups, Loom weights and Ethnicity in Bronze Age Cyprus and Neighbouring Regions*, eds V. Karagheorghis & O. Kouka. Nicosia: The A.G. Leventis Foundation, 97–100.

Hermon, S., Iannone, G. & N. Amico, 2014. Three-Dimensional Approach to the Documentation and Analysis of Heritage Sites – a Case Study from the Cypriot Cultural Heritage Landscape, in *Proceedings of the 1st International Conference on Best Practices in World Heritage: Archaeology*, Menorca, Spain, 27–37.

Hermon, S., Niccolucci, F. (2015). 3D Archaeology: research methodology and applicability aspects – some preliminary thoughts, in *Virtual Archaeology, Proceedings of the Second International Conference, Saint Petersburg*, ed. D. Y. Hook. The State Hermitage Museum, 25–37.

Hermon, S., Niccolucci, F. & D'Andrea, 2005. Some evaluations on the potential impact of virtual reality on the archaeological scientific research, in *Proceedings of the 11th International Conference on Virtual Systems and Multimedia*, Budapest: Archaeolingua, 105–14.

Hermon, S., Nikodem, J. & C. Perlingieri, 2006. Deconstructing the VR – Data Transparency, Quantified Uncertainty and Reliability of 3DModels, in *The e-volution of Information Communication and Technology in Cultural Heritage, Proceedings of VAST 2006*, eds. M. Ioannides, D. Arnold, F. Niccolucci & K. Mania. Budapest: Archaeolingua, 123–30.

Hermon, S., Sugimoto, G. & H. Mara, 2007. The London Charter and Applicability, in *Future Technologies to Empower Heritage Professionals, VAST 2007*, eds D. Arnold, S. Chalmers, & F. Niccolucci. Budapest: Archaeolingua, 11–14.

Iannone, G., Georgiou, R., Amico, N., Ronzino, R., Hermon, S., Karageorghis, V. & D. Pilides, 2011. Ancient vase 3D reconstruction and visualization, in *Revive the Past, Proceedings of the 39th Conference on Applications and Quantitative Methods in Archaeology* (CAA), eds M. Zhou, I. Romanowska, Z. Wu, P. Xu & P. Verhagen, Beijing, China, 59–64.

Karp, C., 2005. Digital heritage in digital museums, *Museums International* 56(1–2), 45–51.

Kolosova, A. & S. Hermon, 2013. Metadata Enhanced 3D Content Search for Real-Time Visualization of 3D Digital Assets, in *Digital Heritage International Congress*, eds A. Addison, G. Guidi, L. De Luca & S. Pescarin. Marseille: IEEE, Vol. II, 173–6.

Knabb, K. A., Schulze, J. P., Kuester, F., DeFanti, T. A. & T. E. Levy, 2014. Scientific Visualization, 3D Immersive Virtual Reality Environments, and Archaeology in Jordan and the Near East. *Near Eastern Archaeology (NEA)*, 77(3), 228–32.

Lackovic, N., Crook, C., Cobb, S., Shalloe, S. & M. D'Cruz, 2015. Imagining technology-enhanced learning with heritage artefacts: teacher-perceived potential of 2D and 3D heritage site visualisations. *Educational Research*, 57(3), 331–51.

Lake, M., 2012. Open archaeology. *World Archaeology*, 44(4), 471–8.

Murteira, H. & P. S. Rodrigues, 2016. Lost Cities in the Digital Era: The Case of Pre-Earthquake Lisbon, in *Space and Time Visualisation*, eds M. Boştenaru Dan & C. Crăciun. Springer International Publishing, 151–71.

Niccolucci, F., Beacham, R., Hermon, S. & H. Denard, 2010. Five Years After: The London Charter Revisited, in *VAST 2010 The 11th International Symposium on Virtual Reality, Archaeology, and Cultural Heritage*, eds A., Artusi, M. Joly, G. Lucet, D. Pitzalis & A., Ribes. Eurographics Association, 101–4.

Niccolucci, F. & S. Hermon, S. (in press). Expressing Reliability with CIDOC CRM. *International Journal on Digital Libraries, Special Issue on Networked Knowledge Organization Systems*.

Niccolucci, F. & S. Hermon, 2013. 3D in archaeology: 15 years of research-the role of EU projects, in *Electronic Imaging & the Visual Arts. EVA 2013*, ed. V. Cappellini. Firenze University Press, 48–52.

Niccolucci, F., Hermon, S. & M. Doërr, 2015. The Formal Logical Foundations of Archaeological Ontologies, in *Mathematics and Archaeology*, eds J. A. Barceló & I. Bogdanovic. Science Publishers, 86–99.

Niccolucci, F. & S. Hermon, 2010. A Fuzzy Logic Approach to Reliability in Archaeological Virtual Reconstruction, in *Beyond the Artifact – Digital Interpretation of the Past, CAA2004*, eds F. Niccolucci, & S. Hermon. Archaeolingua, Budapest, 26–33.

Olson, B. R., Placchetti, R. A., Quartermaine, J. & A. E. Killebrew, 2013. The Tel Akko Total Archaeology Project (Akko, Israel): Assessing the suitability of multi-scale 3D field recording in archaeology. *Journal of Field Archaeology* 38(3), 244–62.

Pitzalis, D., Niccolucci, F., Theodoriou, M. & M. Doërr, 2010. LIDO and CRM dig from a 3D cultural heritage documentation perspective, in *VAST 2010 The 11th International Symposium on Virtual Reality, Archaeology, and Cultural Heritage*, eds A., M., Artusi G. Joly, D. Lucet, D. Pitzalis & A. Ribes. Aire-la-Ville: Eurographics Association, 87–95.

Remondino, F. & S. Campana, S. (eds.), 2014. *3D Recording and Modelling in Archaeology and Cultural Heritage: Theory and best practices*. Oxford: Archaeopress.

Reilly, P., 1992. Three-Dimensional modelling and primary archaeological data, in *Archaeology and the Information Age*, eds P. Reilly & S. Rahtz. London: Routledge, 147–73

Ronzino, P., Niccolucci, F. & S. Hermon, 2012. A Metadata Schema for Cultural Heritage Documentation, in *Electronic Imaging & the Visual Arts: EVA 2012*, ed. V., Capellini. Firenze University Press, 36–41.

Sanders, D. H., 1999. Virtual Worlds for Archaeological Research and Education, in *Archaeology in the age of the Internet CAA 1997*, eds L. Dingwall, S. Exon, V. Gaffney, S. Laflin & M. Van Leusen. Oxford: BAR International Series 750. Pp. 265 and CD_ROM.

Sanders, D. H., 2014. Virtual Heritage: Researching and Visualizing the Past in 3D. *Journal of Eastern Mediterranean Archaeology & Heritage Studies* 2(1), 30–47.

Silberman, N. A., 2004. Beyond Theme Parks and Digitized Data: What Can Cultural Heritage Technologies Contribute to the Public Understanding of the Past?, in *Interdisciplinarity or The Best of Both Worlds The Grand Challenge for Cultural Heritage Informatics in the 21st Century, VAST2004*, eds K. Cain, Y. Chrysanthou, F. Niccolucci, D. Pletinckx & N. Silberman. Budapest: Archaeolingua, 9–12.

Smith, N.G., Knabb, K., DeFanti, C., Weber, P., Schulze, J., Prudhomme, A., Kuester, F., Levy, T.E. & T.A. DeFanti, 2013. ArtifactVis2: Managing real-time archaeological data in immersive 3D environments, in *Digital Heritage International Congress*, eds A. Addison, G. Guidi, L. De Luca & S. Pescarin. Marseille: IEEE, Vol. 1, 363–70.

Taylor-Helms, L., Kvapil, L., Fillwalk, J. & B. Frischer, 2013. Investigating the Effectiveness of Problem-Based Learning in 3D Virtual Worlds. A Preliminary Report on the Hadrian's Villa Project. http://vwhl.soic.indiana.edu/villa/assets/_papers/Nelms%20Kvapil%20Fillwalk%20Frischer.pdf

Theodoridou, M., Tzitzikas, Y., Doërr, M., Marketakis, Y. & V. Melessanakis, 2010. Modeling and querying provenance by extending CIDOC CRM. *Distributed and Parallel Databases* 27(2), 169–210.

Chapter 4

Digital heritage objects, authorship, ownership and engagement

Stuart Jeffrey

In this chapter I will discuss how the shift from analogue representations of the past, be they of real or imagined, sites, objects or activities, to digital representations of the same, brings with it new challenges. I will focus particularly on where these representations are intended to engage broader, non-professional and non-academic audiences. The ways in which digital representations of the past are created and disseminated needs to be carefully considered if they are not to appear sanitized, unengaging and even potentially distancing. How we construct the past is intimately linked with the nature of the representations we use in the construction process, and the apparent immateriality of digital objects creates new forms of relationships between the representation and audience. This consequently leads to new relationships between the audience and the part of the past that the digital object is intended to engage with. An important debate around authenticity (with its multiple forms), particularly the auratic quality that an authentic object manifests, focuses on the migration of this quality from the original to records and representations and whether this process applies to digital as well as physical reproduction. Latour and Lowe (2011) building on Walter Benjamin's concept of 'aura' (1969 [1936]) suggests that physical replicas and reproductions can indeed acquire authenticity, but that this is dependent on factors such as intentionality, quality and the expenditure of resources. Other research suggests the network of relationships engaged in their creation also acts in the production of authenticity (Jones 2010; Jones & Yarrow 2013; Macdonald 2013). However, there are other inter-related factors that further complicate our conception of what is authentic, these include changing modes of ownership and authorship and the apparent transience of digital records. Such factors working together also have a bearing on the auratic quality of a digital object (or the absence of this) and in turn on its perceived authenticity. While similar issues have arisen in one form or another as new technologies for recording and representing the past have emerged as discussed in Benjamin's seminal essay on the aura in the age of mechanical reproduction (1969 [1936]), the shift from analogue to digital resurrects these issues and, due to the stark differences between mediums, accentuates them. For the purposes of this chapter it is digital heritage objects that are based on a three dimensional record, a digital reproduction, that best illustrate these issues and the focus remains on the sense of authenticity that relates to a person's emotional as well as intellectual engagement with the object, i.e. it is the form of authenticity that is not predicated entirely on a records apparent precision, objectivity and accuracy as suggested by some (Gartski 2016; Gillings 2005; Rabinowitz 2015). At the heart of these issues is how we feel about a particular representation and the impact this then has on our feelings about, and understanding of, the subject of the representation. In the following sections I will discuss the issues of authorship and ownership as well as the impact of technical issues affecting the longevity of digital objects and finally I will discuss what some of the implications are as the technology for recording and representing the heritage develops in the future. It should be noted that with each of the factors under discussion there are also practical, ethical and ideological drivers towards changes in practice, but in this chapter I will try and explore how they impact on our perception of the object, its aura and authenticity, irrespective of these other concerns.

Authorship and ownership

There are two closely related aspects of any digital object that, while apparently abstracted from its intrinsic value as a record or representation, do in fact

strongly act upon how these objects are received by their audiences. These are firstly, authorship, i.e. who created the record or representation, and secondly, ownership, or the question of who legally controls the object. Authorship was explored recently in a community co-production project called ACCORD. The ACCORD project, funded by the AHRC, ran from 2013–2015, was led by the Glasgow School of Art with partners from RCAHMS (now Historic Environment Scotland), Archaeology Scotland and the University of Manchester. Working with a number of community groups, this project specifically looked at the relationship between the intentionality and authorship of 3D record production and the perceived authenticity of the subsequent model. Through this research programme insights were gained on the value of the 3D recording as form of rapid ethnographic intervention and the way that the networks of relationships that manifest in the production process also impact the reception of the created digital object (Jones et al. 2017). The project methodology focussed on the use of co-design and co-production in order to explore these networks (Jeffrey et al. 2015). One of the key lessons of the ACCORD project with regard to co-production is not simply that the issues of who creates a record, and why, are important in its consumption, but that for this to have most effect, the identities of the producers have to be explicit. This means that the authorship of the record (or model, or reconstruction, or derived work) has to be fully acknowledged for the benefit of co-production to become apparent.

This highlights an interesting opposition to the majority practice in the production of digital heritage objects as it currently takes place. Due to the presumed importance of stamping a record with academic or institutional authority and the complication of multiple authorship (i.e. production by teams), direct naming of the actual individual authors is often deprecated in favour of an institutional marque. In this way digital objects are essentially branded as being the products of organizations and institutions and the names of the individuals responsible are relegated to contextual information or metadata, or are entirely absent. This is a significant statement on both the power relationships between the actual data creators and their host organizations and, perhaps more importantly, the way in which the digital objects themselves are conceived by those organizations. It has long been noted that the digital medium retains powerful overtones of science and technology (e.g. Huggett 2004) and that the processes of digital recording and computer modelling first grew out of technologically focussed practices such as survey, design and construction. However, it has also been noted that the creation of digital representations of real world sites and objects and, in particular, reconstructions of imagined past sites and objects actually requires a series of decisions to be made that are ultimately more or less subjective or interpretative (Cameron 2007, Jeffrey 2015). In essence the production of a digital record can be seen to be as much as creative process as it is a technological or mechanical process. Artefacts conceived as creative outputs, i.e. works of art, most often explicitly reference an author and this in turn allows their audience to situate the work in the context of an author's other works, perhaps helping them to understand nuances, but also allowing them to attach notions of authenticity to the work irrespective of whether it is a copy or not. While literary critics have argued that a focus on authorship is a lazy and restrictive way to interpret a creative work (Barthes 1977 [1967]), it is still an important feature of how most people consume creative outputs and effects their conception of what is an authentic work. For example, a digital copy of a film by a particular director e.g. Michael Powell, is still an authentic Powell film irrespective of whether you are viewing an analogue master copy on celluloid or a digitally re-mastered version (there is of course a separate argument regarding the authentic cinematic experience intended by the director versus the individual or small group TV viewing most likely today). Forms of authenticity then reside both in the media and in authorship. The act of assigning an author to a work is also an important statement of the level of human intervention in its production. It counters the somewhat spurious idea that a digital record is the result of an entirely objective and/or automated process in which the creator is essentially a machine operator rather than an active participant. Where a discipline, for example archaeology or heritage conservation, already has a mixed, and sometimes conflicted, status somewhere between the arts, humanities and the hard sciences, it becomes a charged decision whether or not to embed an assignation of authorship within the object in question. On the one hand it could be argued that assigning authorship, and admitting the creative nature of the record diminishes the objects status as an 'authentic record' in terms of machine generated precision, on the other it could be argued that authorship enhances the authenticity of the digital object by connecting its audience with its creators while simultaneously acknowledging the creative nature of the production process.

There is a further and perhaps more important consequence of making the authored nature of digital objects prominent and this relates to the apparently sanitized nature of this class of object. In the analogue world there is a desire to be close to an important site

or object, physical proximity enhances the experience of aura, this was commented on in Benjamin's seminal work where photography is discussed in terms of a desire to bring the subject of the image closer to the viewer (Benjamin (1969 [1936]). Similarly for physical replicas of real world objects there is always a chain of physical connections that, at least conceptually, leads one closer to the original. For example, in the case of plaster casts this chain leads back to the moment of physical contact with the original object. Each further generation of cast (i.e. a copy of a copy) can be said to extend that chain of proximity, but also to attenuate the sense of connection back to the original. In this way a third- or fourth-generation copy might be considered less authentic than a first, both in terms of a technical authenticity (inaccuracy emerging in the copying process) and in terms of the sense of proximity to the original that a first-generation copy might engender. Despite this, depending on their biographical trajectory even later generation replicas can themselves acquire a form authenticity (Foster & Curtis 2015). This also applies to replication processes where the technical attenuation is minimal, such as analogue photographic prints from an original negative, early prints in a numbered sequence somehow remain more highly valued that later ones. Strangely perhaps, this valuing of early links in the chain continues with digital print runs. However, I have argued that in the domain of digital heritage objects the chain of proximity between the original and the digital appears to break, with an isolating and sanitizing effect (Jeffrey 2015, 145). The non-contact nature of many digital recording technologies such as laser scanning, structured light scanning and photogrammetry is a real virtue for the conservation professional. However, this feature in combination with the immateriality and essential weirdness of the resulting digital object (Jeffrey 2015, 146) conspire to obscure any sense of a physical chain of connections back to the original. For broad audiences it becomes difficult to conceive of the physical connections that take the audience back to some moment of human presence associated with the original object.

Adding to this sense of disconnection from the original are the limited modes of embodied engagement with a digital object. Whereas an analogue photographic print might arguably operate to bring the subject of the image closer, interactive digital objects are only ever presented behind glass, through a screen, effectively an impassable barrier between us and the object. Immersive Virtual Reality (VR), although obviously still presented via glass screens (albeit mounted near the eye and harder to perceive), does seem to offer an alternative to the sense of trying to reach through the glass. Where it is well executed and a 'suspension of disbelief' is achieved and immersion is effective, there is definitely a sense that one is in the same shared space as the digital object (at least giving the digital object an apparent location, something it lacks whilst dormant (Jeffrey 2015, 146). It could be argued though that rather than the digital object somehow entering the real world by breaking through the glass barrier, the audience has in fact themselves gone through the glass in the other direction. Immersive VR as a form of engagement clearly has a lot to offer especially when combined with spatially encoded sound and as a shared rather than solitary experience (cp. Augmented Reality). However it still does not overcome the lingering issues of immateriality and sanitization. Even the most advanced haptic experiences, designed to engage the digital 3D object through the sense of touch, still leave us feeling that we are engaging with the digital object as if via a bio-medical or nuclear containment glove box. Not only do they provide the user with a disconcertingly unfamiliar sense of physical contact due to current hardware limitations, but the dirt, bacteria, oil and various other substances that are the markers of contact, which leave physical traces both on an object (patina) and on ourselves, are absent. This further re-enforces the sanitized nature of the digital and further deprives it of the sense of pastness as described by Holtorf (2013). It should be noted that for some records there are ways in which the digital can break back into the material world through technologies such as 3D printing, these in themselves are not unproblematic in relation to questions of both authorship and authenticity, but are beyond the scope of this chapter (for a discussion see Reilly 2015).

In what way can authorship mitigate the sense of distance and sanitization? It has been argued that the root of people's desire to be close to an object from the past (or site or building) is not actually about the object itself, it is about a desire to move somehow closer in time to the people that are associated with that object, those who created it, used it, visited it or interacted with it in some way throughout its existence (Jones 2010, Macdonald 1997). Breaking the chain of proximity, as described above, is not about proximity to an object, building or site in itself, but rather about a sense of proximity to the people associated with them. The perceived break in the chain effectively dehumanizes the digital object, so that it cannot bring us closer too, if not actually distancing us further from, the network of people associated with the object in the past. For that digital object to subsequently be presented as essentially anonymous, acts to compound the process of dehumanization. It is possible that explicit, even celebrated, authorship can re-humanize the object, placing people back into the chain through the implied human

contact between the original object and the authors of its digital record. In this way it is possible for the digital record or representation to once again become part of the biography of the original and represent, if in no other meaning of the word, an authentic response by a creative individual or group, to the original.

The absence of authorship is also perhaps somewhat ironic in that there is a pre-existing critique of digital reconstructions that points out the disconcerting, even alienating, emptiness of representations of past cities, buildings or artefacts that are completely devoid of any representations of humanity (see Pujol-Tost 2016). Historically there are number of reason for this, but is primarily due to the expense of populating a scene with avatars, the ethics (or simple unwillingness) of doing so when dress, social stratification, behaviour etc. are so little known, and the arguments over whether or not the infamous 'uncanny valley' actually exists (Murgatroyd 2008). The irony lies in that the dehumanization of the represented scene in the past is mirrored, for very different reasons, by a dehumanization of the object in the present through deliberate or unconscious anonymization.

Just as authorship and intentionality can be made to work together to encourage an audience to engage with a digital object in a way beyond simple intellectual curiosity, the question of ownership has the power to do the opposite. It is important to draw a distinction here between ownership and copyright. For both real world objects and digital objects it is perfectly possible to own them, or an individual copy of them, without owning copyright, i.e. the right to further copy or distribute. This long standing legal position may be further complicated by attaching specific prohibitions to how items can be used via licensing of copyright material.

One of the simplest ways one can associate oneself with a cultural object or work of art, and thus feel closer to its creator, is to own a version of it. For example, a digitally encoded piece of music or a digitally encoded film. Until recent years this form of ownership has been manifest via possession of a physical object, perhaps a CD or a DVD, these objects existence and one's ability to own them, at least for personal consumption, is undoubted. As mentioned above, the ability to copy or distribute the content is an entirely a separate issue, but it is clear that the physical object that contains a digital representation of cultural artefact can be truly owned, it can be marked, it will age, it can be sold or given away and ultimately it can be destroyed. Its physicality provides a medium through which its biography can be read as it degrades over time or is moved from place to place, now on display, now hidden away in a cupboard, now sold and now destroyed. All the time the biography of the physical object, containing the cultural artefact, is entwined with the biography of its legal owner. Buying the object, creating ownership, is a powerful transaction that binds the object, conceptually as well as legally, to its owner and brings the owner closer to both the physical artefact and the content it contains through a shared life from the point of purchase. Even if the content is only consumed via broadcast or via download, the fact that the there exists a physical media that is owned binds the owner more strongly to the content. This may well be a particularly capitalist expression of the desire to be close to the original object, but it is not only the financial exchange that draws the owner closer, but the ability to handle and exercise control over a physical object that is, without the hardware to access it, simply emblematic of the content itself.

This situation is changing, globally and in a rapidly growing number of domains, our concept of ownership or even of possession, is transforming as modes of dissemination in the digital, and the physical world, become challenged by the demand for more and more control of what we consume and how we consume it. It is becoming the norm that digital content in particular is only ever accessed under licence for a particular moment of consumption. This is exemplified by streaming audio and video content, but actually extends into download content such as books on an eBook reader, which we might think we own, but in fact do not (see the case of George Orwell's *1984* as reported in the *New York Times* (Stone 2009)). This new mode of non-ownership even extends to physical objects, objects that contain Digital Rights Management that is intended to, for example, protect the copyright of software embedded within it. From 'phones to motor cars, you may think you own it, but in multiple jurisdictions you will be breaking the law if you change or even try to access certain elements of it (McSherry 2015), somewhat altering what the concept of ownership actually means. The result is that we are beginning to struggle to actually own things in the way we once understood. This is not a manifestation of a utopia which renders ownership redundant for the benefit of society, rather, it is a process of concentrating the full rights of ownership in a smaller group of hands. Ownership has become even more entangled with and deeply entrenched with those who own the means of production. This is clearly an issue for society at large and one likely to be exacerbated by the so called 'Internet of Things' where copyrightable software will reside in many more physical objects than they do now, changing us further from owners to licensees (McSherry 2015). Specifically in the domain of digital heritage objects, the status of ownership is already linked to authenticity as this is often considered

as being constituted in part through regimes of value associated with authorizing institutions (Cameron 2007, Deger 2016, Fyfe 2004, Lindholm 2008). Here the consideration is not about that authority that the original owner imparts to the object, but the ability of the act of possession itself to act on our perceptions of an object. For digital objects representing the past, one sense in which it was possible to use physical versions of digital artefacts to experience closeness, however attenuated, is through possession of a copy, even when that copy has no financial value, i.e. freely available for download. This represents a challenge for organizations that hope to generate income from, or to maintain institutional authority over their digital heritage objects through the control of each instance. Individual ownership is being eroded by confusing, even contradictory, claims to copyright and restrictive licensing that call in to question any sense of ownership one previously might have had. Ownership is being transmuted into a temporary right of access and re-use for specific purposes and with it the sense of closeness to the content that ownership engendered is being transmuted into a sense of anxiety that by some small action you may be breaking the rules and one's right of access may at any time be rescinded by the objects true owners. This can be a disempowering rather than empowering experience, it calls in to question one's ability to experience a closeness to the original by meaningful act of ownership. The debate between open access, and open licensing regimes versus restrictive licensing and intrusive Digital Rights Management, can very easily be characterized as ideological, in reality it extends beyond the ideological by acting on the nature of our perception of the objects in question, including digital cultural heritage objects. If there is overly tight control of access and the types of use and reuse of these objects, the closeness implied by ownership becomes impossible and they become, in a sense, unobtainable.

Transience

There is a well understood range of technical issues that can be seen to apply to the longevity of digital objects. The spectre of a 'digital dark age' arises (Kuny 1997), is somewhat addressed and then later arises again in a new form (Jeffrey 2012). An important truth to acknowledge with regards all digital data is that despite their apparent imperviousness to decay and the apparent ease in with which digital originals and a potentially infinite number of perfect copies can be easily stored and accessed, in practice they are in fact fragile, costly and labour intensive to curate over long periods of time. The technical reasons for this, and indeed the technical solutions to these problems, including data integrity (e.g. error detection and correction), are discussed elsewhere (Niven 2013, Niven et al. 2012). However, it is not being overly pessimistic to say that this remains a serious issue in the field of digital heritage and digital archaeology. It still often remains the case that more attention is paid to data capture and data creation than is routinely paid to how that data will be maintained in the long term, and where and how stable points of access to the data will be. At its most basic this problem is exemplified by the plethora of dead hyperlinks that litter the World Wide Web. Unfortunately it is still a common experience to follow a hyperlink to a '404' message and it is a particularly unfortunate if that link used to go to a well-used and valuable resource, that has apparently simply disappeared. This is made even more pertinent if you have no rights of ownership over that resource and have been forbidden from owning a copy (see above). To a large extent this problem has been mitigated by the implementation of permanent addressing systems such as Digital Object Identifiers (DOIs, https://www.doi.org/), which rely on an authorizing body and in which commitment to long term maintenance of the digital object is an explicit feature. At the other end of the spectrum from a broken hyperlink, the same issue is exemplified by large scale datasets, scans, models and analysis that have been 'backed-up' but never actually archived. The original creators, over time, change organizations, the organizations themselves, merge or disappear and the responsibility or interest in maintaining the datasets dissipates and if no suitable host can be found, or if there is not enough metadata for meaningful archiving, or there are simply no funds available, the data languishes until its ultimate loss through hardware failure or deletion from the cloud. As mentioned above the means of addressing these issues are well understood, perhaps less well understood, or at least less frequently considered, is the effect ownership anxiety and disappearing objects have together on the way digital objects are considered by the user. All the weirdness of the digital object, its immateriality and its physical unlocatability are further accentuated by its apparent transience, or at least the suspicion that it might be transient.

A key feature of physical heritage objects is the fact of their survival over long periods of time. This longevity and the richness of human associations that it implies is a defining feature of its auratic quality. Latour and Lowe and others have discussed how, in practice the auratic quality of the original can migrate to its copy (2011), including digital copies/records (Cameron 2007, Jeffrey 2015), and indeed new forms of authenticity relating to the networks of relationships

around a digital object can be created. However, unless a digital object is specifically intended to be temporary, all of the arguments regarding their aura and authenticity are entirely undermined if the digital object being created is either perceived to be, or is in reality, an unreliable object. The long term existence of a digital object and the permanence of points of access to it speak powerfully of the value ascribed to it by its creators.

Future recording

Looking just a short way into the future there are two areas in which conceptions of authenticity and the directly linked conception of the auratic quality of an original will be further challenged. The first change will be the continuing drive towards the automation of the digital recording process. While I have discussed above that currently digital recording of cultural objects in three dimensions remains both skilled and highly interpretative, the trend is towards both automated processes and integrated workflows. With Structure from Motion (SFM) the inevitability of 'robotic' capture (e.g. with drones or swarms of drones) and real-time processing of the imagery they generate mean that the greatest operator challenge will be specifying the building or object to be recorded. Autonomous or semi-autonomous hardware and integrated software workflow will then deliver a 3D model of the target fully formed with minimal user intervention. Similarly the deployment of time of flight laser devices or structured light devices using visible and non-visible parts of the spectrum will be married with mobile robotic platforms that require targeting, and little else, before delivering surface models with integrated textures for their operators. While it might be argued that the likely cost associated with new devices and systems will keep them firmly in the domain of experts, this will not necessarily be the case. SFM can in many instances produce a similar quality model to a laser scan at a fraction of the price. It is also true that the quality of 3D record that will be generated from consumer grade hand held devices in future might well match or surpass the quality of today's most exclusive technology, at least in terms of accuracy. What will remain, what is unavoidable, is what we fail to value highly enough today, namely the sequence of creative decisions we make on how to use a 3D record to create a meaningful representation of the past. The knowledge, experience and skills required to do this become apparent when we consider the impossibility of this stage of the visualization process being automated. While there is an undeniable level of technical skill required to create 3D models of complex real world objects, there is also a large degree of creativity, interpretation and even artistry. In future it will become harder and harder to deny this in favour of a self-defined formulation of the recorder as a technician.

As well as further automation of data capture there is likely to be an increasing drive towards data rich models, these are representations of the past that are not simply visual, or even sensual, but are specifically designed to act as points of integration for other, spatial and non-spatial, datasets. This concept is emerging from, among other sources, the field of Building Information Modelling (BIM) and 'Heritage BIM' where complex datasets are associated with 3D models of historic buildings (Fai et al. 2011). Currently the focus on of this kind of model is the integration of technical datasets, but there is no reason to discriminate against the wide range of heterogeneous datasets that might be of interest to various audiences, from archival texts and images to expressions of contemporary social value. Indeed this holds out the further likelihood that 3D visualizations of heritage objects will no longer be isolated, free floating entities disconnected from other forms of data, but become integrated within a broader cultural heritage data ecosystem. This integration process in itself could well create a new series of challenges to our conception of the aura and authenticity of the digital object as it transforms from static representation linked only to its real world original to a dynamic exploratory tool linked to multiple other datasets.

Conclusion

It has been argued that we are at a moment of crisis, even a permanent crisis, with regards to the authenticity and aura of digital objects (Bolter et al. 2006). Authorship, ownership and transience all act as additional complicating factors on our understanding of the impact of mechanical and digital reproduction on aura. I would argue that we are still at the early stages of understanding our relationship with the digital world in general, and that understanding will emerge from practice. We clearly value a sense of the authentic and actively seek out objects with an auratic quality. Because both aura and authenticity are part of the way we understand and engage with the world around us, it is hard to conceive that our experience in the future will be one where these qualities are entirely absent. It has been argued that new forms of aura and authenticity can arise in replicas and representations not only through attention to intentionality, value, quality and relations, but also through consideration of authorship, ownership and transience. Each of these represent opportunities as well as challenges. We can think of narrowly focused,

anonymous, restrictively licensed and ultimately inaccessible digital objects as being inappropriate for broader audiences. Not just for technical reasons, but because of how they might discourage this audience from engaging with them at any level beyond passive consumption. An emerging alternative approach would see a digital heritage object that is produced for a specific audience (or better, co-produced with them), free to use and re-use for any purpose, clearly creative, explicitly authored, and reliably and permanently accessible. Such digital objects leverage the networks of relations involved in their production, they allow them to be valued through unfettered possession, they re-humanize them and render them reliable objects in the world. It is fair to say that the process of creating objects with these qualities may still encounter a number of practical problems. However, by paying attention to these qualities, digital heritage objects created and delivered in this way have a far higher likelihood of not only mitigating the issues arising from perceived inauthenticity or absence of aura, but facilitating the creation of these in new forms associated with both the representation and the original.

References

Barthes, R., 1977 [1967]. *The Death of the Author*. Image / Music / Text. Trans. Stephen Heath. New York: Hill and Wang, 142–7.

Benjamin, W., 1969 [1936]. The Work of Art in the Age of Mechanical Reproduction, in *Illuminations*, ed. H. Arendt, trans. H. Zohn. New York: Schocken Books, 217–51.

Bolter, J.D., MacIntyre, B., M. Gandy & P. Schweitzer, 2006. New Media and the Permanent Crisis of Aura. *Convergence* 12(1), 21–39.

Cameron, F., 2007. Beyond the Cult of the Replicant: Museums and Historical Digital Objects – Traditional Concerns, New Discourses, in *Theorizing Digital Heritage: A Critical Discourse*, eds. F. Cameron & S. Kenderdine. Cambrideg, Mass.: MIT Press, 49–76.

Deger, J., 2016. Thick Photography. *Journal of Material Culture* 21(1), 111–32.

Fai, S., Graham, K., Duckworth, T., Wood, N. & R. Attar, 2011. Building Information Modeling and Heritage Documentation, in *CIPA 2011 Conference proceedings: XXIIIrd International CIPA Symposium*. Accessed 15 May 2017: http://www.cipa2011.cz/proceedings/index.htm

Foster, S.M. & N.G.W. Curtis, 2015. The Thing about Replicas – Why Historic Replicas Matter. *European Journal of Archaeology*, Online First, 1–27.

Fyfe, G., 2004. Reproduction, Cultural Capital and Museums: Aspects of the Culture of Copies. *Museum and Society* 2(1), 47–67.

Garstki, K., 2016. Virtual Representation: the Production of 3D Digital Artefacts. *Journal of Archaeological Theory and Method*, Online First (07/04/16), 1–15.

Gillings, M., 2005. The Real, the Virtually Real, and the Hyperreal: The Role of VR in Archaeology, in *Envisioning the Past: Archaeology and the Image*, eds S. Smiles & S. Moser. Blackwell Publishing Ltd, Oxford, UK, 223–39.

Holtorf, C., 2013. On Pastness: a Reconsideration of Materiality in Archaeological Object Authenticity. *Anthropological Quarterly* 86(2), 427–43.

Huggett, J., 2004. Archaeology and the New Technological Fetishism. *Archeologia e Calcolatori* 15, 81–92.

Jeffrey, S., 2015. Challenging Heritage Visualisation: Beauty, Aura and Democratisation. *Open Archaeology* 1, 144–52.

Jeffrey, S., Hale, A., Jones, C., Jones, S. & M. Maxwell, 2015. The ACCORD project: Archaeological Community Co-Production of Research Resources, in *Proceedings of the 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology, CAA 2014*, eds F. Giligny, F. Djindjian, L. Costa, P. Moscati & S. Robert. Paris: CAA, 1–7.

Jeffrey, S, 2012. A new Digital Dark Age? Collaborative web tools, social media and long-term preservation. *World Archaeology* 44 (4), 553–70,

Jones, S., Jeffrey, S, Maxwell, M., Hale, A. & C. Jones, 2017. 3D heritage visualisation and the negotiation of authenticity: the ACCORD project. *International Journal of Heritage Studies* 24(4), 333–53.

Jones, S., 2010. Negotiating Authentic Objects and Authentic Selves: Beyond the Deconstruction of Authenticity. *Journal of Material Culture* 15(2), 181–203.

Jones, S. & T. G. Yarrow, 2013. Crafting Authenticity: an Ethnography of Conservation Practice. *Journal of Material Culture* 18(1), 3–26.

Kuny, T., 1997. A Digital Dark Ages? Challenges in the Preservation of Electronic Information, in *63RD IFLA (International Federation of Library Associations and Institutions) Council and General Conference*. Accessed 27 September 2016: http://archive.ifla.org/IV/ifla63/63kuny1.pdf

Latour, B. & A. Lowe, 2011. The Migration of the Aura, or How to Explore the Original through its Facsimiles, in *Switching Codes: Thinking Through Digital Technology In The Humanities And The Arts*, eds. T. Bartscherer & R. Coover, 275–98. Chicago: University of Chicago Press.

Lindholm, C., 2008. *Culture and Authenticity*. Oxford: Blackwell.

Macdonald, S., 1997. A People's Story: Heritage, Identity and Authenticity, in *Touring Cultures: Transformations of Travel and Theory*, eds. C. Rojek & J. Urry, 155–75. London: Routledge.

Macdonald, S. 2013. *Memorylands: Heritage and Identity in Europe Today*. London: Routledge.

McSherry, C., 2015 Who Will Own the Internet of Things? (Hint: Not the Users), *Deeplinks Blog*, 20 January 2015, The Electronic Frontier Foundation (EFF). Accessed 27 September 2016: https://www.eff.org/deeplinks/2015/01/who-will-own-internet-things-hint-not-users

Murgatroyd, P.S. 2008 'Appropriate Levels of Detail in 3-D Visualisation: the House of the Surgeon, Pompeii', Internet Archaeology 23.

Niven, K. (ed.), 2013. *Caring for Digital Data in Archaeology*. ADS/ Digital Antiquity Guides to Good Practice, Oxbow Books

Niven, K., Jeffrey, S. & J. Richards, 2012. Archiving Three-Dimensional Archaeology: New Technologies, New Solutions?, in *Archaeology in the Digital Era Volume II, e-Papers from the 40th Conference on Computer Applications and Quantitative Methods in Archaeology*, eds G. Earl, T. Sly, A. Chrysanthi, P. Murrieta-Flores, C. Papadopoulos, I. Romanowska & D. Wheatley.

Pujol-Tost, L., 2016 Pixel vs Pigment. The goal of Virtual Reality in Archaeology in *Savage Minds* (blog). Accessed 27 September 2016: http://savageminds.org/2016/01/11/pixel-vs-pigment-the-goal-of-virtual-reality-in-archaeology/

Rabinowitz, A., 2015. The Work of Archaeology in the Age of Digital Surrogacy, in *Visions of Substance: 3D Imaging in Mediterranean Archaeology*, eds. B.R. Olson & W.R. Caraher. Grand Forks, ND: The Digital Press at the University of North Dakota, 27–42.

Reilly, P., 2015 Additive Archaeology: An Alternative Framework for Recontextualising Archaeological Entities. *Open Archaeology* 1(1).

Stone, B., 2009. Amazon Erases Orwell Books From Kindle, *New York Times,* 17 July 2009. Accessed 27 September 2016: http://www.nytimes.com/2009/07/18/technology/companies/18amazon.html?_r=0

Part 3
Practices

Chapter 5

Evaluating authenticity: the authenticity of 3D models in archaeological field documentation

Peter Jensen

The use of photorealistic and photogrammetric techniques to create 3D models of excavations is increasingly becoming an accepted approach to documentation practice in field archaeology. Whilst archaeologist seem happy to embrace new technologies for field documentation they tend to use them, either for traditional recording purposes (such as computer-aided drawing), or by letting technology dictate the documentation outcomes, for example, by creating interactive 3D models, which are incompatible with traditional means of documentation. Paradoxically, the use of 3D visualization in archaeology is neither a relatively recent or sudden phenomenon (Reilly 1992; 1988). The advent of 3D representations as archaeological documentation characterizes a departure from the conventional spatial abstraction of a 3-dimensional world to a 2-dimensional piece of paper. As a consequence, the basic epistemological foundations for archaeological recording are affected, calling for a revision of not only the general workflow of excavations, but a re-evaluation of those dichotomies inherent to field archaeology, such as that between observation and interpretation. With 3D documentation, we are increasingly dealing with photorealistic representations of archaeological excavations, and the time, place and basis for archaeological interpretation is changing. The far-reaching consequences touch upon core dichotomies of archaeological science, where particularly the polarization of objectivity and subjectivity has affected archaeological thinking for the better half of a century (Kristiansen & Rowlands 2005, Shanks & Tilley 1987). However, as stated by Shanks and Tilley (1987, 243): '*Archaeological theory and practice as labour in the present completely transcend this artificial division, labour which draws past and present into a fresh perspective, a perspective which serves to rearticulate their relationship.*' In this regard, accepting 3-dimensional photorealistic documentation also means accepting that it is not free of bias. To an extent, the ideal of objective truth through empirical falsification (Popper 1959), reproducibility, and testability set forth by the scientific method is hindered by the destructive nature of the archaeological excavation and the derivative nature of the archaeological documentation.

In this chapter, the term reality-proximate is used to describe the creation of photorealistic representations of the observation event, taking into account the limitations of detail, and distancing the visual replication from a notion of objective recording. Rather than focusing on objectivity and subjectivity, this chapter will discuss the dichotomy between observation and interpretation in archaeology in the light of the new paradigm of 3D photogrammetric documentation, and it proposes a way of managing 3D observation data alongside reconstructions and visualizations. The excavation of three archaeological sites in Denmark; Skelhøj, Jelling and Alken Enge, reflects the impact of technological developments on the archaeological workflow during the last 15 years, and show how a conceptualization of authenticity may be applied to address the evaluation of documentation quality.

It is proposed that the use of 3D documentation encourages us to adopt a new workflow with more 3-dimensional reasoning, allowing the utilization of 3D recording as a tool for the continuous monitoring of progress and evaluation of an excavation and its results. Just as in the general use of models to form hypotheses, it is possible to use 3D models as spatial hypotheses within an ongoing excavation. This allows us to visually realize or spatially conceptualize our hypothesis as a virtual reconstruction and to combine it with our observational data.Usually our interpretation is characterized by the delineation and characterization of features and finds, be it line drawing on paper or vectorizations in GIS or CAD, but in a 3D representation, this makes much less sense. We are actually able

to interpret and visualize through 3D modelling of a spatial hypothesis, rather than working with lines and sketches. This in turn requires strict guidelines, and regard for the separation of observation and spatial hypothesis, and assurance that the one is not mistaken for the other.

Finally, this chapter presents experiences gained from combining *reality data* with *model data* in the case of the Jelling excavations. The field-recording principles applied accentuate the necessity of continuous evaluation of the integrity and validity of empirical data, and illustrate how the concept of authenticity becomes paramount to assessing excavation documentation. This is particularly the case when documentation is combined with 3D models and reconstructions at the boundary between research and dissemination.

Observation and interpretation in archaeology

If there is one characteristic, more than any other, that permeates the discipline of field archaeology, it is dichotomy. As Carver (1990, 45) puts it: '*Archaeologists who work in the field suffer from split personality*.' Carver obviously refers to the conflicting traditions of field work, which diverged in the early youth of the discipline, in the nineteenth century. Briefly put, British archaeologists Pitt-Rivers (1887) and later Barker (1977) were among the most prominent proponents of the empiricist approach, based on an idea that every minute detail matters and should be recorded in the field, and that an archaeological site should be treated as a system of deposits and formations processes. This is related to the processualist approaches of New Archaeology (Binford & Binford 1968, Trigger 1989). On the opposing branch, Petrie (1904) and Wheeler (1954) saw that attempting to record every fact about everything was futile and useless without an overall goal or research motivation, which is what inspired the structuralist and contextualist approaches, focusing on the site as text to be read, rather than deposits to be described. These dichotomies exist to this day, albeit they are converging, perhaps not least due to developments in technology. Lucas (2001, 10) points to the fact that field archaeology by the 1870s was characterized by '*experience, presence in the field, as a critical guarantor of scientific validity*.' Incidentally, the advent of contract archaeology and the factor of competitive tendering based on price, favouring preservation by record, saw the growth of archaeologists specializing in fieldwork, meaning that fieldwork became more separated from the broader interpretative process. The archaeologist now took the role as a technician, whose job it is to retrieve data from the field, resulting from '*an ideology founded on the assumption that data collection is independent of interpretation*' (Lucas 2001, 12). In contract archaeology, the dichotomy stems from a matter of politics which separates fieldwork from interpretation, and where the empiricist seek to record as much as possible, while researchers and universities state that actual meaning is determined by posing relevant research questions – making data a research asset. The challenge or 'Archaeological Value' lies in combining the two (Carver 2009; 2003).

When dealing with archaeological excavation recording and documentation, using a seemingly arbitrary concept like authenticity may appear to make very little sense, especially if we claim to aim for 'objective' documentation. Nonetheless, one might argue that the dichotomy of the objective (Malmer 1980) vs. subjective (Shanks & Tilley 1987) lies at the heart of evaluating the authentic, but it tends towards an unproductive opposition between realism and constructivism (Madsen 2003, Madsen 1995). The processual or 'new' archaeology of the 1960s never questioned if we are able to describe anything objectively, but rather than the positivistic realism of measurements and observations, asserted that archaeological interpretation could come to objective conclusions via the ability to pose questions and formulate what we want to investigate (Binford 1964, 426). In particular, the ability to uncover the regularities of human cultural behaviour was in question. The post-processual archaeology of the 1980s, however, saw that every description requires interpretation and reflects the subjectivity and viewpoint of the archaeologist. By this notion, authenticity, which usually relates to a seemingly arbitrary level of 'trustworthiness' or 'related to fact', reflects the views, bias and possibly the social/political circumstances of archaeology and the archaeologist. The influence of society '*appears to remain one of archaeology's permanent features*' (Trigger 1989, 380), which is why it is necessary to account for context when evaluating authenticity in archaeological documentation. This in turn forces the archaeologist to explain, if not theory and method, at least the choices made during the excavation process, as well as the rationale behind them. It is considered a serious problem if an archaeologist is unable to '*look out beyond the individual context or unit they are excavating, [as they] will not be able to deal with interpretative issues that involve other contexts and other sets of data*' (Hodder 2003, 59). In particular, the interpretative and reflexive element is of interest to Hodder who pointed to the 'momentary, fluid and flexible' existence of excavation methodology by the late 1990s (Hodder 1997).

Advances in archaeological field documentation in the new millennium are a continuation of the development of computer applications in archaeology throughout the 1980s and 1990s focusing on the use

of quantitative methods in archaeology. In particular, photorealistic and photogrammetric techniques for creating 3D models of excavation situations are fast becoming a common approach to documentation practice, and call for a re-evaluation of the inherent dichotomy of interpretation and observation in archaeology (Berggren et al. 2015, Forte et al. 2015, De Reu et al. 2013, Forte 2014, Powlesland 2014). Compared to previous paradigm shifts, which were characterized by confronting ideas and ideals of how to do archaeology, the significant technological advances have only just recently become identified as a prelude to a paradigm shift in a scientific revolution (Kristiansen 2014, Huggett 2004). This inevitably raises questions and concerns whether archaeology is at risk of abandoning the interpretative and reflexive incentive, for the sake of a form of documentation that appears to correspond more closely to the observed 'truth'. Drawing in particular, is often seen as essential to archaeology and '*part of a hermeneutic system that acts to both initiate and reinforce the knowledge-creation structures of the discipline*' (Bateman 2006, 74), but it may also be considered a remnant of analogue documentation traditions, which becomes challenged by the need for the ability to handle and integrate digital representations of both reality and interpretation. Evidently, Hodder's fluid archaeology is becoming even more pronounced, as the clear distinction between observation and interpretation turns increasingly fluid and traditional concepts become entangled. By direct consequence, evaluation of authenticity gains new relevance as the documentation itself, rather than the object or artefact, attains authenticity. Generally speaking, archaeologists who share a goal of measuring the past as accurately as possible are also the ones who are most interested in pursuing authentic archaeology.

Photogrammetric documentation

One technological advancement stands out more than any other as '*a tool that underpins our notion of the objectivity of the recording process*' (Bateman 2005, 192). In the last decade, archaeologists have overwhelmingly adopted digital photography (Morgan 2014, Morgan & Wright 2018). At the same time, digital photos have increasingly become one of the primary sources of archaeological documentation, in addition to – or as basis for – digital delineation of the interpreted features and contexts. Digital photos have become an easy, quick and affordable way of documenting an excavation. The documentation process at the excavation of the Bronze Age barrow Skelhøj (2002–2004) in Southern Denmark exemplifies one such early application of digital photography in excavation documentation (Holst & Rasmussen 2013). It also illustrates how the archaeological community, fairly early on, realized that digital photography had to be treated differently, as it is not directly equivalent to analogue hand drawing. First of all, digital photos must be manipulated to become usable for documentation: rectified (Scollar 1998, Johansen 2003) and embedded with geographic information. This clearly leads to some concerns as to the validity and derivative nature of what would otherwise be considered very objective documentation. On the other hand, it evidently offers new possibilities of a different level of detail, quality and authenticity. In the case of Skelhøj, documentation workflows were deliberately adapted to combat the risk that photos could potentially shift the archaeological focus away from interpretation, towards the mere descriptive, and basically undermine the value of documentation. To accommodate concerns of losing the interpretative incentive and whenever possible, parallel series of photos were taken – an observation series with the prepared archaeological features, and an interpretation series where an archaeologist's interpretation would be scratched or sketched into to soil (Fig. 5.1). This of course only works for soil-archaeology, as opposed to building recording, but was based on a notion that the observational photos are somehow a more objective form of documentation that would allow us to revisit or re-examine our archaeological data, and therefore represent a set of data, which was less 'disturbed' by interpretational bias.

As claimed regarding the reflexive archaeology at Çatalhöyük: '*The goal is to make the excavation process virtually reversible in a simulated environment at levels ranging from laptop computers to virtual immersive systems*' (Berggren et al. 2015, 437). Being well aware that the collected data – the photos – are never more objective than the archaeological process as a whole (Bateman 2005), the archaeologist still has to choose and prepare the different surfaces and objects for documentation. It is an encounter, not just observation, albeit active or interpretive observation (Lucas 2001). On many levels, digital photos represent different resolutions of evidence, and 3D photogrammetric techniques such as Structure from Motion represents a further extension of the inherent properties of digital photos. This is due to their ability to provide visualizations and representations, which appear as photorealistic and geometrically authentic representations of real-world objects and scenes, which consequently is evolving to become an ideal of documentation. The key point here is that 3D photogrammetric techniques *represent* rather than accurately *reproduce* some aspect of reality. The documentation is still as subjective as ever but, perhaps worryingly, disguised as unbiased by its photorealistic appearance.

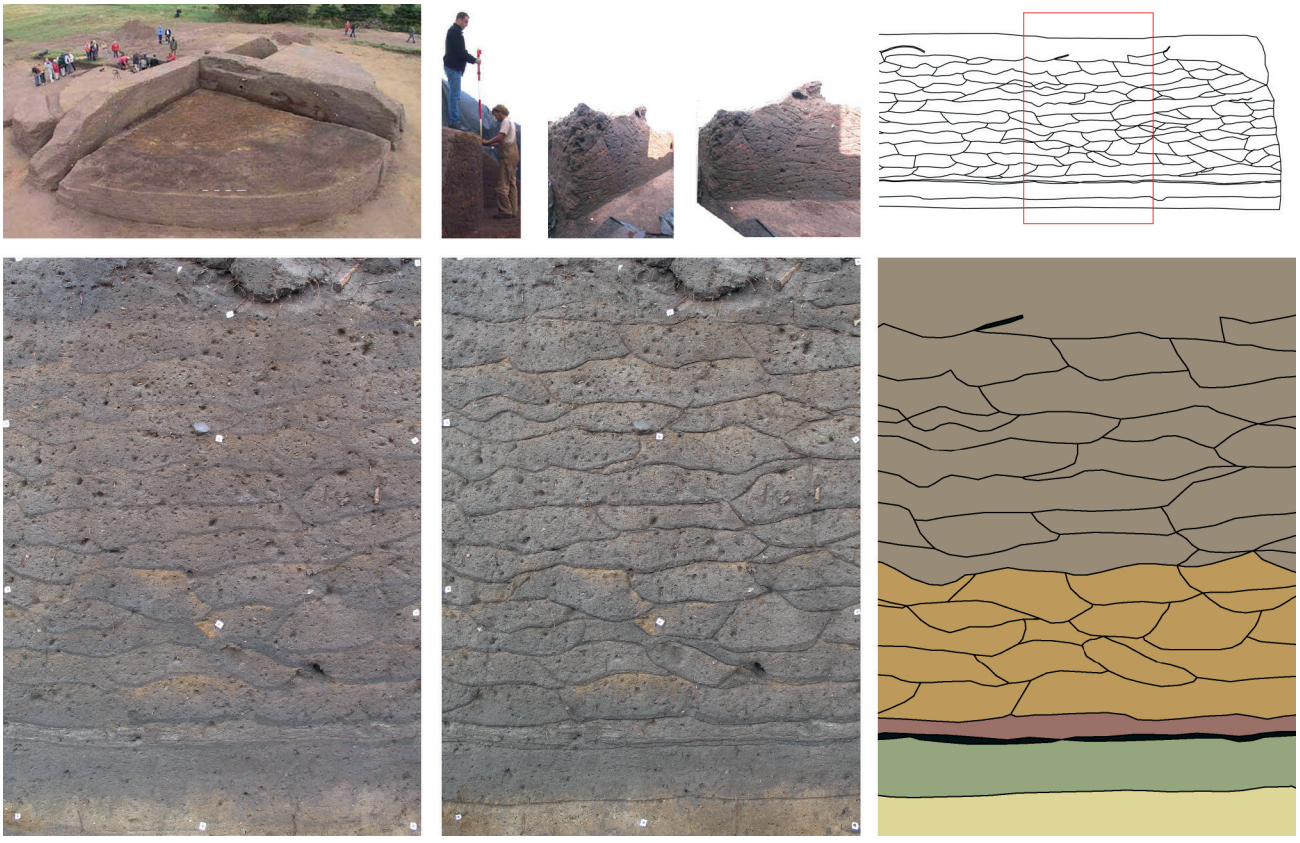


Figure 5.1. *Skelhøj. Documentation of turf structures in a Bronze Age barrow, using observation photos and interpretation photos as basis for rectification, mosaicking and vectorization. Photo: Peter Jensen.*

If, for the sake of argument, we state that the level of authenticity is in direct correlation with the amount of interpretation and assumption in its representation of reality, photographic evidence must clearly be more authentic than a delineated interpretation. But more authentic in this case does not necessarily mean that it makes the greatest contribution to knowledge. One would think that a 3D model or a photo is easily understood and requires fewer preconditions, but rather it lacks explanation and interpretation to fully extract the embedded information. What a 3D model does provide, however, is an immediate representation of reality. Instead of knowledge and skills of abstracting from the 2-dimensional drawing or photo, we see a malleable canvas, which we can interactively explore in a non-predetermined way.

Maybe the biggest Achilles heel of post-processual archaeology is our inability to agree on even the most trivial factors, such as classifications or the description of fill and colour of a context or layer in a section. As Madsen (2003, 14–15) illustrates, the descriptions are so dependent on prior experience and knowledge, that two people with the same basic understanding, but different experience, will rarely reach the same conclusions. The work of the less experienced archaeologist may appear as the most authentic, as the lack of prior knowledge prevents differentiation between the important and the less significant; they tend to describe 'what they see'. It is, however, difficult to integrate as common fact into our documentation, and emphasizes the dichotomy between rationalism and pragmatism – if knowledge comes before experience or if experience precedes knowledge. Even implementing something as objective as colour-codes is still limited by various factors, ranging from different lighting condition to the individuals' perception of colour. Post-processual archaeology inherently necessitates an evaluation of the authenticity of the classification and description according to the 'human factor'. One of the postmodern traits of post-processual archaeology is the disappearance of the limits between disciplines, and the disappearance of faith in knowing the one truth (Johnson 1999, 166), leading archaeologists to accept all understandings of the past as equally valid and equally authentic, but not necessarily equally objective.

'New-objectivity'

In 2003 Madsen pointed to the discrepancies between the geologist's and the archaeologist's approach to the interpretation of a soil section, and how different professional backgrounds and perspectives shape the documentation outcome. Naturally, an archaeologist will focus on traces of human activity, while the geologist is looking for geological processes. In either case, the issue is not how to draw or describe, but the act of identifying the abstract notion of something, which is not a physical entity like an object or artefact, but a context of some previous human or natural action. 10 years later, in addition to the philosophical implications of a new paradigm of 3D photorealistic documentation, this 'new-objectivity' has arguably a profound methodological impact on several aspects of field recording. It offers a new conceptual interface or structure of visual representation, which forces us to construe how an object in a 3D representation relates to a feature in the reality of the past. The new tools affect the interpretation flow and how we perceive and identify the relation between objects, and redefine the interdisciplinary preconditions of archaeology such as collaboration with geologists.

The archaeological investigations in the wetlands of Alken Enge between 2012 and 2014 revealed thousands of scattered human bones, dated to the Early Iron Age, lying beneath approximately 2 m of peat on an old lake bed (Hertz & Holst 2015; Holst et al. in press). This set the stage for an interdisciplinary collaboration involving, amongst others, the Department of Geoscience at Aarhus University (Søe et al. 2017).

The excavation conditions were challenging; excavating a bog 2 m below the water table of the neighbouring Lake Mossø. From the onset, a workflow and documentation pipeline was set up, consistently based on photogrammetry and Structure from Motion using VisualSFM and Agisoft Photoscan (Wu 2011, Agisoft 2016). This way, every documentation unit, context, and arbitrary plan or section was photo documented, 3D modelled, ortho-rectified, printed, drawn, classified and vectorized. Beyond the collaboration with osteoarchaeologists and anthropologists, the presence of geologists and their very different approach to the research questions came to be of great value in explaining the prehistoric events (Fig. 5.2).

Furthermore, the challenge of combining the archaeological and the geological interpretation of

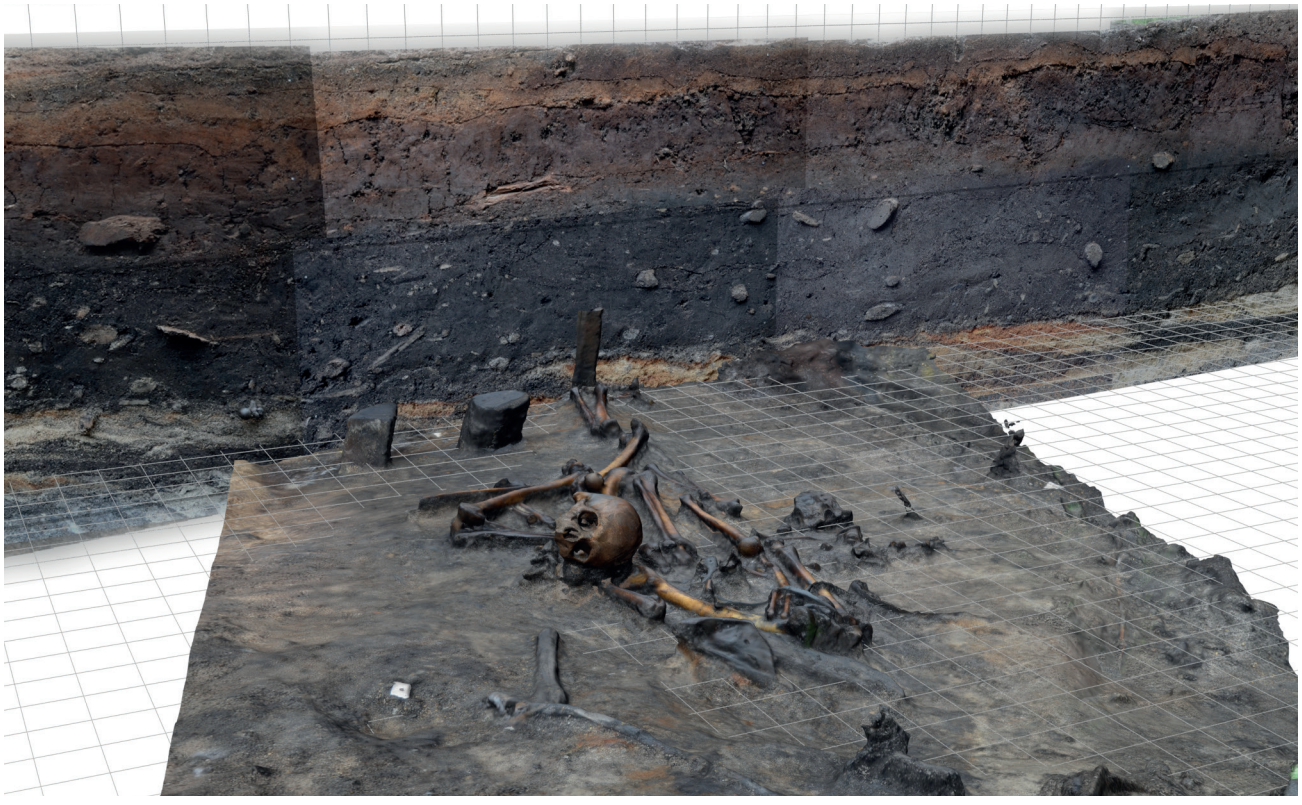


Figure 5.2. *Composite of 3D Structure from Motion documentation of human bones, alongside geological section in Alken Enge. Photo: Peter Jensen.*

the same reality demonstrated, how 3D models and photorealistic documentation may act as a common language in this discourse. The excavation saw the development of a common language, exchange of terms across disciplines and illustrated how interpretations were not necessarily linked to one profession alone. The boundary between geology and archaeology became fluid, and at a general level a method development took place where datamining and comparison of data became key to understanding the facts. Most importantly, this cross-discipline exchange of knowledge was not limited to or hindered by different interpretations of the same reality, because the issue was no longer a disagreement of classifications, as Madsen (2003) implied. The premise for the 'new-objectivity' of 3D photogrammetric documentation is not one of classification, but accounting for the level of authenticity and validity. How open to interpretation are our observations and what is the quality of our documentation?

Derivative and generalized: para- and meta-data

One of the keys to integrating 3D photogrammetric documentation in archaeology lies with the realization that 3D models are part of a process, much like the formation processes which create the archaeological record in the first place. The premise for this type of documentation is that our so-called primary data is derivative in nature, and its validity depends entirely on our ability to account for how data was created and evolves over time. We all work from assumptions that are rarely well described or even questioned. The formation process of our 3D documentation, or rather the para- and meta-data does exactly this. By estimating and evaluating claims of certainty or documentation quality, it may be possible to augment the scientific quality of data – and use authenticity both as a concept and as a tool in the archaeological documentation workflow. In this way, we are in fact equalizing evidential value and testing hypotheses – rather than engaging in a truth-seeking quest.

The most enticing promise of archaeological 3D documentation is that, in theory, we should be able to create a reality-proximate visual representation of reality. And in fact, we should be able to 're-excavate' on the computer at a later point in time, and potentially engage other colleagues in the interpretation process. This breaks with the traditional premise or paradox of archaeological excavations – that it is a destructive discipline that cannot be redone and which destroys the original source material. The fact that this approach actually enables and encourages us to correct or revise both the observation and the interpretation data, facilitates a more dynamic approach to documentation, instead of delivering that one interpretation – the synthesized and condensed report of an excavation.

We know that all visual data is derived – a generalization of something more detailed to begin with, and must undergo some process to get from the real world into our digital representation. First of all, we must account for multiple parameters related to the excavation process; how was the excavation planned and executed, and what where the documentation events that make up our bulk raw data (Jensen 2012). Secondly, the data processing needed to get from photographs to 3D models must be documented. The increasingly complex calculations needed, perhaps even by proprietary closed-source software, poses an issue in this regard. It makes the documentation process much less transparent, and any inaccuracies and systematic errors may potentially sneak into our primary documentation when we trust a 'black box' and its invisible algorithms to process data.

Arguably, it is by conceptualizing levels of generalization and authenticity of these steps of the digital documentation that we are able to more coherently integrate new levels of documentation detail into our excavations. If we develop procedures for measuring the authenticity of 3D photogrammetric documentation through an evaluation process, we may break with the objective realist stance commonly applied to 3D models. This is, however, not to assume that the authentic is a utopianism to be achieved. The concept of *objective documentation* is far less important than *authentic documentation*, and in this regard, authenticity equals the quality and detail of representing the observed. To express it more explicitly; the level of authenticity may be expressed as an equation of approximation, which includes all available para- and metadata related to the documentation events. The level of generalization is in direct relation to the required resolution (level of detail) of the documentation, and the amount of interpretations and assumptions are in direct correlation with authenticity.

Conceptualized authenticity in archaeological documentation

In the case of the Skelhøj and Alken Enge excavations, the realization of authenticity as a concept and tool in the excavation practice happened gradually and as an iterative process, reflecting technological developments since the turn of the millennium.

First of all, an evaluative authenticity-concept was implemented at the lowest level of the documentation ladder; in fact, authenticity was printed on context and find sheets in order to allow for an assessment of the observation/interpretation dichotomy. This gave the

archaeologist the incentive to evaluate the documentation quality at a very early stage in the process, and impose the reflexive question: 'how certain am I?' and 'how well does this/my documentation reflect reality?'

Secondly, concepts of documentation units, documentation events and data collections were introduced to address the derivative nature of digital data, and record the historic dimension of the documentation process (Jensen 2012). This way, para and meta-data are explicitly contained within the documentation, and it is known how interpretations and representations evolve over time, as new data and new knowledge become available. Authenticity of the documentation has nothing to do with what is original, but simply how what we have now, the visual representation, relates to what was in the past; knowing that everything is derived. The combined parameters are what help ascertain the authenticity of the documentation, and becomes part of the hermeneutics of the documentation process, where the interpretation is not exclusively an end product of the documentation.

Thirdly, 3D models were increasingly used to visualize the spatial hypotheses of the ongoing excavation.

3D models and spatial hypotheses

Far from being limited to archaeology, it is easy to see how the 3D paradigm is currently trending in countless branches of computing. In particular, archaeology's most beloved tools: Geographic Information Systems (GIS) and Computer Aided Design (CAD) are merging and evolving into doing things which used to be limited to dedicated 3D software (Wheatley & Gillings 2002; Breunig & Zlatanova 2011). Consequently, this also means dealing with different levels of abstractions, ranging from the reality-proximate and photorealistic via the delineative and generalized to the artistic and stylized representation.

In addition, 3D representation supports the combination of the observed with interpretation, following a more 3-dimensional reasoning, where we may apply 3D documentation as a tool for continuous monitoring and evaluation of an excavation and its results. Just like the general use of models to form hypotheses, it is possible to use 3D models as spatial hypotheses of an ongoing excavation. This allows us to visually realize or spatially conceptualize our hypothesis as a virtual reconstruction and to combine it with our observational data. The inherent issues of using photorealistic and high quality hypothetical visualizations as part of the documentation, and discerning which is which and accounting for level of certainty, was already touched upon more than 20 years ago by Eiteljorg and others (Eiteljorg 1998; 2000; Eiteljorg & Limp 2008). One of the main concerns was that visualization tools are rarely capable of displaying uncertainty or fuzzy data, or levels of probability when it comes to reconstructions (Eiteljorg 2000; Miller & Richards 1995). '*As disseminators of information to a data-naïve public, we must find techniques for displaying areas of fudged data within our models, and attempt to educate people in the skills of visual data analysis: an awareness of scale, an understanding of the fact that lines on maps often represent fuzzy boundaries, and a perception of the limitations inherent in our data*' (Miller & Richards 1995, 21). One such way of displaying uncertainty is by the use of colour, texture or opacity (Fig. 5.3). This, however, trails back to the issues of relying on prior knowledge or an individual's intuitive ability to read and understand such visual information.

Additionally, there is a whole array of visual elements, which may not rely solely on archaeological

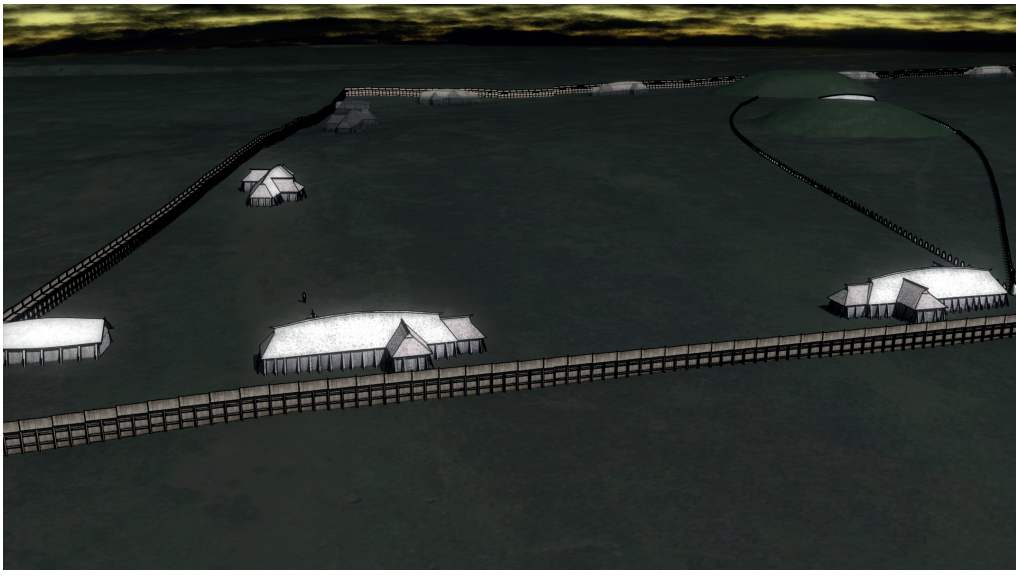


Figure 5.3. *The Jelling Complex visualized as 3D animation for the VIKING exhibition at the Danish National Museum. The style is non-photorealistic, and levels of uncertainty or hypothesis are indicated by varying transparency of elements.*

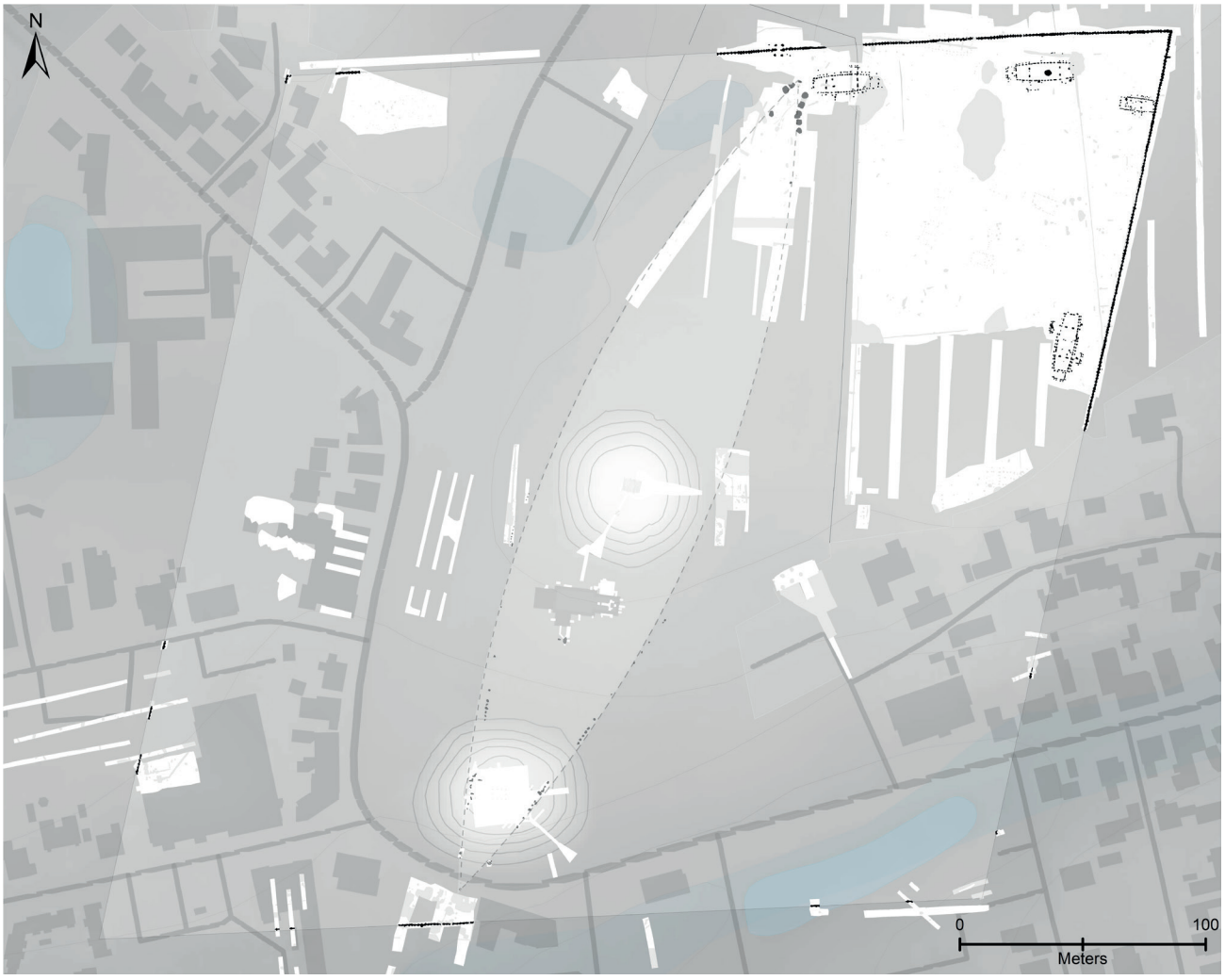


Figure 5.4. *The Jelling Complex: A central complex with a church and two burial mounds, rune stones and stone ship setting. A palisade surrounds the monuments and buildings are placed along the inside at fixed intervals and orientation. Excavated areas shown in white.*

evidence, and where the level of certainty is highly questionable. These may include, for example, written sources like *Beowulf*, which describes the appearance of the great hall building, ethnographic analogies, as well as the inherent assumptions governed by current trends and social/political circumstances. This is however part of a literary and societal discussion, rather than one of visual archaeological representation.

The concerns about scientific certainty in visualizations, among other, have led to the ratification of London Charter for the Computer-Based Visualisation of Cultural Heritage (Hermon et al. 2007; Denard 2012) – see Hermon & Niccolucci chapter 3. The London Charter highlights the major pitfalls of navigating the border zone between research hypotheses and public dissemination, but also hints at practices for combining *reality data* with *model data*. In this case, evaluating the level of authenticity, or uncertainty, is paramount to express the quality of excavation documentation, but as previously stated, authenticity may arguably also be integrated as a measurement tool that allows for evaluation of the empirical data and the excavation process.

The Viking Age royal complex in Jelling

As with Alken Enge, the excavations of the Viking Age royal monument complex in Jelling were to a very large extend based on digital photogrammetric documentation (Jessen et al. 2011; Holst et al. 2013). The 2010 campaign was targeted upon the large palisade structure, which encloses the mounds and the church, as well as the north-eastern quadrant (Fig. 5.4). The

excavations revealed postholes belonging to buildings, which in their pattern strongly resembled the architecture from known Viking Age houses, usually assigned to King Harald Bluetooth and the circular fortresses at Trelleborg, Fyrkat and Aggersborg (Holst et al. 2013; Jessen 2015; Roesdahl et al. 2014). In this case, it is of course important to note, that prehistoric architecture in Northern Europe is very seldom a matter of filling in missing pieces of a ruin of known design like Classical and Romanesque architecture (Miller & Richards 1995; Huggett & Guo-Yuan 2000). We are talking about the excavation of sub-surface ephemeral features associated with organic evidence of postholes with very little else evidence. This is a factor which should somehow accompany any visualization of such features.

Given that the houses at the circular fortresses tend to adhere to very strict geometric rules for placement, scale and orientation, meant that this was something which could be easily visualized and used to generate a working hypothesis of where to look for more houses, and estimate their architectural appearance – if indeed the similarities were substantiated. Key features of the Trelleborg-type houses are the unique entranceways and the double row of wall posts, presently interpreted as a combined wall and external supporting structure, following cruck construction. Neither the function of the external posts nor the entryways were initially identified by the early excavations of Trelleborg in the 1930s and 40s, but later excavations allowed archaeologists to reinterpret and physically reconstruct houses using these hypotheses (Schmidt 1981; Schmidt 1985; Olsen 1977) (Fig. 5.5). This is itself an excellent example of how reconstructions, as well as archaeology as a whole, are a product of time and society (Trigger 1989), as the first reconstruction shows Roman-derived traits, know from porticoes around Roman villas and Romano-Celtic temples, compared to the later, more Germanic reconstruction with cleaner lines.

By almost direct comparison, the excavations at Cowdery's Down (Millett & James 1983) also deal with the identification and interpretation of slanting posts, and quite interestingly present not just one, but several alternative reconstructions based on the same archaeological evidence.

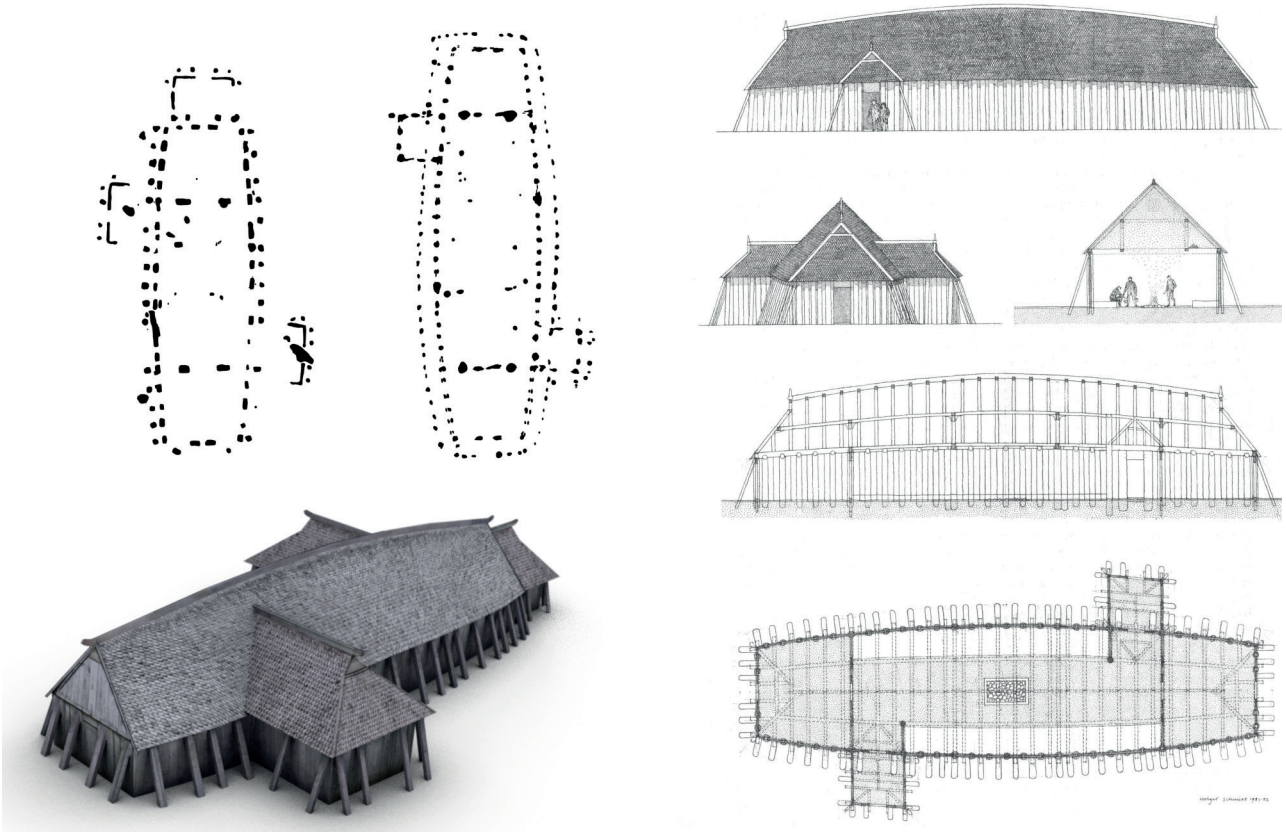


Figure 5.5. *Plan drawings of postholes show the architectural similarities between a Jelling House on the left and a Fyrkat House on the right (Olsen 1977). Holger Schmidt's architectural drawings for the Fyrkat reconstruction are on the far right (Schmidt 1985).*

The initial excavations in Jelling, revealed one house with an entranceway on one side. It was however known from the reconstructions of Trelleborg-type houses at Fyrkat that the entranceways are placed on both sides, and displaced to either end (Fig. 5.6). Combined with the observed systematic mirroring of the house orientation in the fortresses, this helped to guide the excavation into where to look for more entranceways, among the otherwise poorly preserved postholes. In addition, the Jelling houses turned out to have a very unique feature, as the gable ends would have an extension in either end. The Jelling-house, however, still adhered to the strict geometry and rules of mirroring and symmetry. The natural response was to try to 3D visualize this special structural feature on the basis of the architecture of the physical reconstruction at Fyrkat (Schmidt 1985) and apply it as a working spatial hypothesis for the excavation.

The visualizations were done in a combination of software: Agisoft Photoscan, ESRI ArcMap and ArcScene and 3D Studio Max. Acknowledging that archaeological interpretation is a dynamic and iterative process, different snapshots or documentation events account for the thought processes and expectations of the archaeological source material. This way, *when* these snapshots were made, by *whom* and based on *what* criteria, became the basis for evaluating the authenticity of the development of the spatial models, and the rationale for replacing one model with another revised model. The experiences gained in Jelling demonstrate how abstractions shape the basis for the archaeological process, and how 3D visualization functions as a tool of reflection – combining what we know with what we expect.

The excavations at Jelling, and not least the intensified use of 3D models as spatial hypotheses, exposed the need for a framework to manage the iteration of interpretations. By including an evaluation of authenticity at all levels of the documentation pipeline, the system should be able to fill in the void of meta- and para-data, left by the break-down of the clear distinction between observation and interpretation, itself caused by the introduction of photorealistic 3D representations.

The evaluative process of the empirical data collected would generally follow a predetermined chain of events:

Figure 5.6. *Photos of the reconstructed houses at Trelleborg (top) and Fyrkat (bottom). Photo: Anne Pedersen (top), Peter Jensen (bottom).*

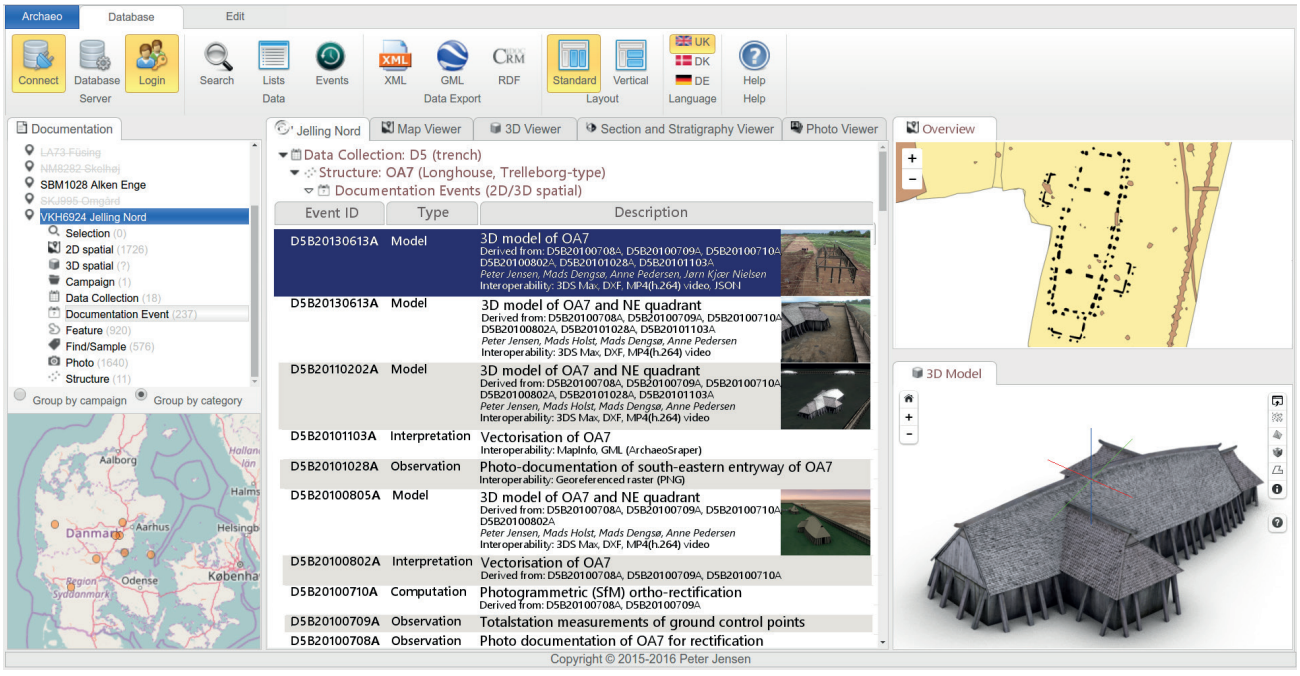


Figure 5.7. *Screenshot of the Archaeo online database, currently under development. Displaying the chain of Documentation Events and iterations of spatial hypotheses while excavating the house OA7 in Jelling.*

1. An opening strategy of excavation methodology and definition of Data Collections (Jensen 2012). The Data Collections were used as constructs, which served to collect all related primary data within well-defined physical boundaries. I.e. all descriptions, photos and measurements within a given area, which would tentatively be used to synthesize an illustration. In practice, each trench would act as a Data Collection.

2. Each consecutive Documentation Event would refer to a Data Collection in a one-to-many relationship, and provide primary data as well as derived data. Authenticity would be assessed through aggregated para- and meta-data.

3. Following a Documentation Event, results would be re-interpreted and synthesized into a separate Documentation Event containing a spatial hypothesis: GIS-plan or 3D model (see Fig. 5.7). In this case, authenticity was expressed as levels of certainty and evaluated through the use of colour-coded visual elements. Each element would refer to back to the Documentation Event from which the interpretation derived.

4. The excavation strategy is reassessed and retargeted according to the revised hypothesis defined by the last Documentation Event. New Data Collections are defined, or new Documentation Events take place within existing Data Collections, such as documentation at a deeper level.

Finally, we should consider whether we need to quantify levels of authenticity, to tie our documentation to standards of processual archaeology, or if we should focus more on the separation of research vs. dissemination or hypothesis vs. fact in 3D visualization to accommodate a different type of audience.

Unintended consequences; Research tool or public dissemination?

Visual models have a tendency to cement an interpretation as fact, rather than fiction or hypothesis, and even with proper precautions and disclaimers they easily evolve into a 'truth', recognized as such by non-professionals. As already noted, this is also one of the main motivations behind the London Charter (Hermon et al. 2007; Denard 2012). This happens as archaeological research flows into public dissemination, where 3D graphics provide a marvellous tool to convey a story about the past. The use of models or reconstructions to convey a story, or even serve as experiments to test a hypothesis is nothing new, as already illustrated by the example of the physical reconstruction attempts of Viking Age Trelleborg houses in Denmark by Holger Schmidt (Schmidt 1981). These reconstructions have,

however, become representative of how the houses looked, even though we actually had two very different reconstruction attempts and therefore two conflicting architectural hypotheses. Paradoxically, this is the whole idea behind hypotheses or experiments; we learn from them and adapt our theories, which in this case, and in combination with subsequent research, has led to other or better interpretations of the architectural characteristics of the Trelleborg-type houses (Schmidt 1985; Jessen et al. 2011; Holst et al. 2013; Jessen 2013; Jessen et al. 2014; Jessen 2015). The challenge is how we convey this to the public in terms of authenticity. Compared to previous generations, what has changed is that 3D models and visualizations now reach the public much faster and through different media, and potentially without the necessary scientific discussion. Computer models tend to carry more authority than paper images and '*Large audiences are being exposed to visualizations in circumstances, where the pictures or animations are divorced from the academic discussion…*' (Miller & Richards 1995, 20).

When the excavations at Jelling encountered postholes of Viking Age buildings, which in their outline showed similar characteristics, the natural thing was to use the same architectural idea in 3D models, which helped the archaeologists get an impression of the site as it was excavated. Inadvertently, due to the high demand of something to show the public, these models were shared at a very early stage, and soon ended up in newspapers, information posters and even went into the new museum exhibitions. Fortunately, the Visitor and Experience Centre at Kongernes Jelling – Home of the Viking Kings, were very aware of the academic discussions and the reservations about visualizing ongoing research. They often brought in the archaeological team to re-evaluate the architectural basis for the interpretations in the light of the new excavations and archaeological evidence. It, however, still became a struggle between scientific integrity and the public demand for visualizations.

One key feature of the 'old' reconstructed houses were the hipped roofs which were part of Schmidt's

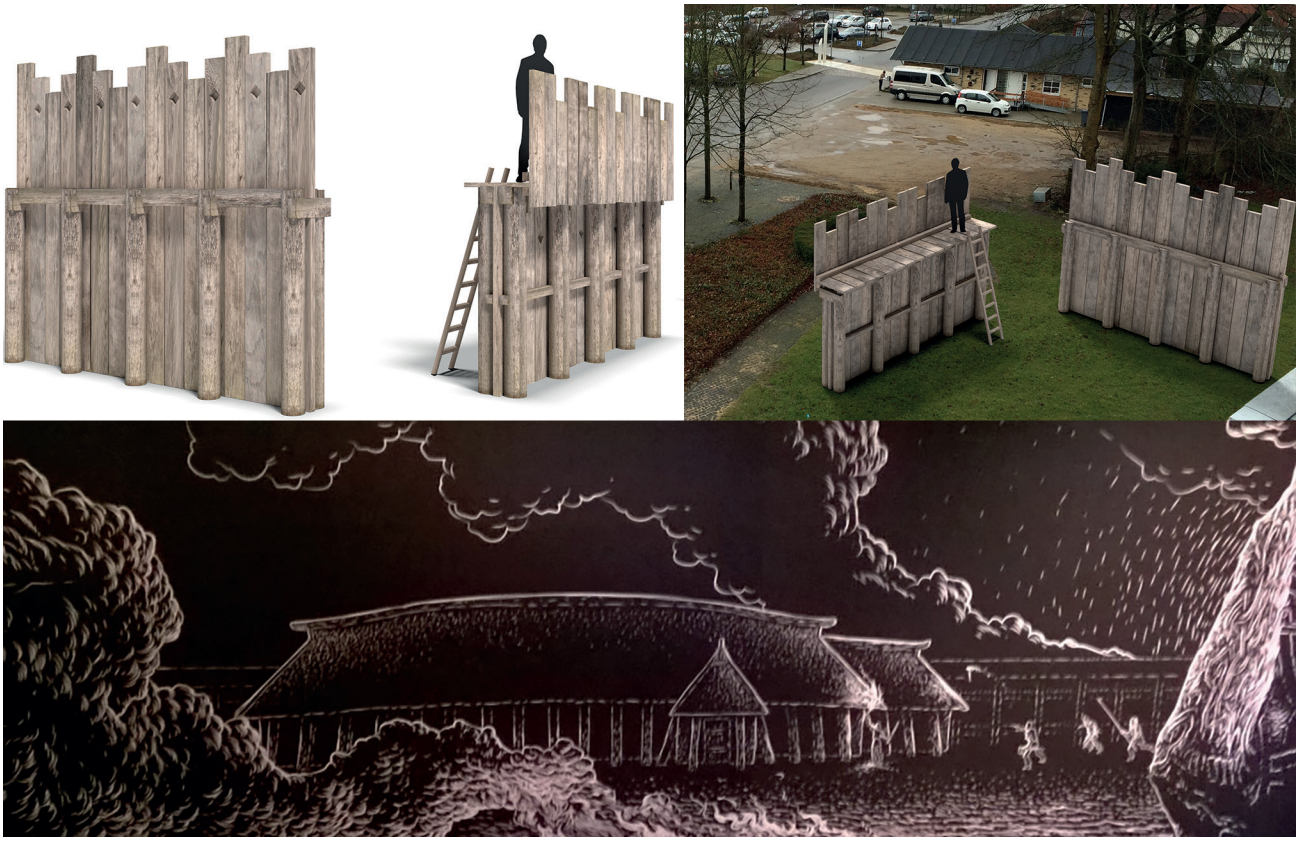


Figure 5.8. *3D model of the planned physical palisade reconstruction (top left and right). Photo: Peter Jensen. The exhibition wall backdrop at the Visitor and Experience Centre at Kongernes Jelling – Home of the Viking Kings, showing an artistic rendering of an outdated spatial hypothesis (bottom). Painting: Sebastian Bausdorph, photo: Adam Bak, Kongernes Jelling.*

original reconstruction at Fyrkat. The process meant that this feature was inherited by the visualizations of the Jelling houses, despite the fact that current interpretations of the postholes suggest gabled roofs were more likely. Stepping into a brand new exhibition and seeing visualizations based on a, now outdated, excavation hypothesis naturally causes concerns that an inauthentic or unsubstantiated account of the past is being conveyed to the public (fig. 8). The museum has addressed these challenges by actively introducing several interpretations of different architectural elements. An example of this is the Viking Age palisade, which went through several iterations in the archaeological spatial hypotheses. For 2017 a physical reconstruction of a section of the palisade is planned for the museum gardens, which will include several elements from the various interpretations regarding, height, paint, carvings and general architecture (Fig. 5.8).

Another example is the recent discovery of the Viking Age ring fortress Borgring, south of Copenhagen (Holm & Sindbæk 2014). Even though the preliminary excavations only revealed ramparts, gates and ditches, it was expected that it would be similar to the other Viking Age fortresses, in having 16 buildings inside (Fig. 5.9). Current excavations so far have however not found any evidence of buildings, which strongly conflicts with the 3D model, which was made to illustrate a hypothesis about what kind of feature had been discovered to the public (Persson 2016).

As the producer of these models, one realizes first-hand the importance of the London Charter (Denard 2012; Hermon et al. 2007) and the challenges of navigating the grey zone between archaeological documentation, hypotheses and public dissemination.

Despite all possible disclaimers, there is a demand from the public and exhibitions to visualize archaeology, not just as postholes, but to reveal *what the archaeologists are thinking* and to offer an informed opinion of what features might have looked like. One instrument to accommodate both is to refrain from photorealistic models altogether (Fig. 5.3). Yet is it safe to assume that the audience most likely already realize it is a model, but trust the authority when we present a model or claim? We should not underestimate the capacity of the audience to deal with uncertainty. What really matters is the ability to account for or justify the visualization, and in doing so, facilitate access to raw data as well.

The London Charter clearly states: '*Sufficient information should be documented and disseminated to allow computer-based visualisation methods and outcomes to be understood and evaluated in relation to the contexts and purposes for which they are deployed'* and *'Documentation of the evaluative, analytical, deductive, interpretative and creative decisions made in the course of computer-based visualisation should be disseminated in such a way that the relationship between research sources, implicit knowledge, explicit reasoning, and visualisation-based outcomes can be understood'* (Denard 2012, 8). This is not an easy task to accomplish, but evidently transparency of what the model is based on is what defines its authenticity. As Eiteljorg (1998, 3) put it: '*If we only present a simplified and sanitized view of the past, especially one that seems real and is visually compelling, we will have failed those who want truly to understand, both as scholars and as users of the technology*'.

Figure 5.9. *DR News online (www.dr.dk) depicting the Borgring visualization next to queen Margrethe II at the day she inaugurated the new excavations.*

On the other hand, the chances are that we are overly concerned with muddling the border between reality and model. Arguably many post-processual archaeologists could be accused of being overly obsessed with measuring and recording the past in as detailed a fashion as possible – perhaps forgetting that '*not everyone even wants authentic archaeologies – whether scientific or not – and understand what this fact means for professionals who work in the public sphere*' (Lovata 2007, 21). While the use of 3D-'replica', -models or -visualizations in archaeology is susceptible to being criticized for overstepping the bounds of scientific ethics, other disciplines do not appear to have the same reservations. Take, for example, the visualizations which accompany space exploration by organizations like NASA and ESA which also have public dissemination as a top priority. The use of computer-generated imagery has grown substantially in this field during the last 20 years. In order to accommodate the audience, data from deep

space, which like archaeological 3D data is based on sensor-input and calculations, is often post-processed to an extent where it has very little to do with reality, and rarely do the authors bother to write 'an artist's impression', when it surely is. In these disciplines, public dissemination and 'raw' research data appear very disassociated, which is in striking contrast to how we currently pursue archaeology, where public engagement and immediate publication of research data tend to be vital. On the other hand, some would argue that archaeology is hardly 'rocket science'.

Conclusion

Does authenticity qualify as a conceptualization of documentation quality in a world of reality-proximate, photorealistic and geometrically accurate digital representations and visualizations? At first glance, it might appear somewhat ambiguous. In particular, because the most common use of authenticity in archaeology refers to individual objects and artefacts of the past, rather than the replication of an event of the (near) present, which the photogrammetric field documentation represents. On the other hand, what such conceptualization portrays is a very conventional notion of authenticity; as one that is achievable through its representation of reality. But why do we not just call it documentation quality? This all points back to the dichotomies of archaeological science, and mainly the dichotomy of *observational reproduction* and *interpretational reconstruction*. Whereas the first might very well be addressed through a quantitative evaluation of the derivative nature of data processing through the recording of para- and meta-data, it does not account for the interpretive and reflexive element of utilizing 3D models as representations, which are more or less reliant on the subjectivities of archaeologists. Furthermore, the concept of quality does not describe the spatial hypotheses which the latter represents, and the varying certainty of the reconstructed elements within.

Authenticity remains, in part, a subjective notion concerning the trustworthiness of a visual representation, but the experiences from the cases presented in this chapter also demonstrate how authenticity may be integrated as a concept and a tool in a spatial database. The immediate accessibility and transparency of data is a key issue, and the documentation events in the database reflect the iteration of spatial hypotheses, facilitating a less deterministic approach to archaeological visualizations in documentation as well as dissemination.

What remains are the unintended consequences of multiple versions of interpretations reaching the public audience. But as much as technology is to blame for rapid distribution of tentative reconstructions, it may also hold the key to solving the issue. As more and more museums apply digital and interactive elements to exhibitions, it is only natural to make use of less static exhibitions, which traditionally could be on display for years if not decades. An interactive 3D model in an exhibition is easily and inexpensively replaced with an updated hypothesis, while returning visitors increasingly expect exhibitions to reflect the latest research. In turn, the public may grow accustomed to this kind beta-exhibitions, which are always improving – and in the process become more aware of the iterative process and nature of archaeological interpretation.

References

Agisoft, 2016. PhotoScan. Accessed 15 January 2016: http://www.agisoft.com/

Barker, P., 1977. *Techniques of archaeological excavation*. London: Batsford.

Bateman, J., 2006. Pictures, Ideas and Things: The Production and Currency of Archaeological Images, in *Ethnographies of Archaeological Practice*, ed. M. Edgeworth. Lanham: AltaMira Press, 68–80.

Bateman, J., 2005. Wearing Juninho's Shirt: Record and Negotiation in Excavation Photographs, in *Envisioning the past: Archaeology and the image*, eds S. Smiles & S. Moser. Malden (MA): Blackwell, 192–203.

Berggren, Å, Dell'Unto, N., Forte, M., Haddow, S., Hodder, I., Issavi, J., Lercari, N., Mazzucato, C., Mickel, A. & J. S. Taylor, 2015. Revisiting reflexive archaeology at Çatalhöyük: integrating digital and 3D technologies at the trowel's edge. *Antiquity* 89, 433–48.

Binford, L. R., 1964. A Consideration of Archaeological Research Design. *American Antiquity* 29, 425–41.

Binford, S. R. & L. R. Binford, 1968. *New perspectives in archaeology*. Aldine Pub. Co.

Breunig, M. & S. Zlatanova, 2011. 3D geo-database research: Retrospective and future directions. *Computers and Geosciences* 37(7), 791–803.

Carver, M. O. H., 2009. *Archaeological investigation*. Boca Raton: Taylor & Francis.

Carver, M. O. H., 2003. *Archaeological value and evaluation*. Mantova: Societá Archeologica Padena.

Carver, M. O. H., 1990. Digging for data: archaeological approaches to data definition, acquisition and analysis, in *Lo scavo archaeologica: della diagnosi all'edizione*, eds R. Francovich & D. Manacorda. Firenze, Italy: Ediziono all'Insegna del Giglio, 45–120.

De Reu, J., Plets, G., Cheyle, W., Verhoeven, G., De Smedt, P., Bats, M., Cherretté, B., De Maeyer, W., Deconynck, J., Herremans, D., Laloo, P., Van Meirvienne, M. & W. De Clercq, 2013. Towards a Three-Dimensional Registration of the Archaeological Heritage of the Altai Mountains. *Journal of Archaeological Science* 40, 1108–21.

Denard, H., 2012. A New Introduction to the London Charter, in *Paradata and Transparency in Virtual Heritage*, eds. A. Bentkowska-Kafel, D. Baker & H. Denard. London:

Ashgate, 57–71. Accessed 16 August 2016: http://www.londoncharter.org/

Eiteljorg, H. I., 2000. The Compelling Computer Image – a double-edged sword. *Internet Archaeology* 8.

Eiteljorg, H. I., 1998. Photorealistic Visualizations May Be Too Good. *CSA Newsletter* XI(2, Fall).

Eiteljorg, H. I. & W. F. Limp, 2008. *Archaeological Computing*. 2nd edn. Bryn Mawr: PA Center for the Study of Architecture.

Forte, M., 2014. 3D Archaeology: New Perspectives and Challenges – The Example of Çatalhöyük. *Journal of Eastern Mediterranean Archaeology and Heritage Studies* 2(1), 1–29.

Forte, M., Dell'Unto, N., Jonsson, K. & N. Lercari, 2015. Interpretation Process at Çatalhöyük using 3D, in *Assembling Çatalhöyük*, eds. I. Hodder & A. Marciniak, 43–57.

Hermon, S., Sugimoto, G. & H. Mara, 2007. The London Charter and its Applicability, in *Future Technologies to Empower Heritage Professionals*, eds D. Arnold, F. Niccolucci & A. Chalmers. Geneva: Eurographics Association, 11–14.

Hertz, E. & M. Holst, 2015. Alken Enge – The mass grave at Lake Mossø. Accessed 16 August 2016: http://www.museumskanderborg.dk/Alken_Enge-English_version-1070.aspx

Hodder, I., 2003. Archaeological Reflexivity and the 'Local' Voice. *Anthropological Quarterly* 76(1), 55–69.

Hodder, I., 1997. Always momentary, fluid and flexible: Towards a reflexive excavation methodology. *Antiquity* 71, 691–700.

Holm, N. & S. Sindbæk, 2014. Enigmatic Viking Fortress discovered in Denmark. Accessed 16 August 2016: http://www.danmarksborgcenter.dk/sites/default/files/mediearkiv/pdf/pm_eng_csi_3_9_2014_hg.pdf

Holst, M. K., Heinemeier, J., Hertz, E., Jensen, P., Kristiansen, S. M., Mollerup, L. & N. E. Søe, In press. Direct evidence of a large North European Roman time martial event and post battle corpse manipulation. *Proceedings of the National Academy of Sciences*.

Holst, M.K. & M. Rasmussen (eds), 2013. *Skelhøj and the Bronze Age Barrows of Southern Scandinavia: The Bronze Age barrow tradition and the excavation of Skelhøj*. Højbjerg: Jysk Arkæologisk Selskab.

Holst, M. K., Jessen, M. D., Andersen, S. W. & A. Pedersen, 2013. The Late Viking-Age Royal Constructions at Jelling, Central Jutland, Denmark. Recent investigations and a suggestion for an interpretative revision. *Praehistorische Zeitschrift* 87(2), 474–504.

Huggett, J., 2004. Archaeology and the new technological fetishism. *Archeologia e Calcolatori* 15, 81–92.

Huggett, J. & C. Guo-Yuan, 2000. 3D Interpretative Modelling of Archaeological Sites. A Computer Reconstruction of a Medieval Timber and Earthwork Castle. *Internet Archaeology* 8.

Jensen, P., 2012. Event-based Archaeological Registration Principles, in *Revive the Past. Computer Applications and Quantitative Methods in Archaeology (CAA): Proceedings of the 39th International Conference, Beijing, April 12–16 2011*, eds. M. Zhou, I. Romanowska, Z. Wu, P. Xu & P. Verhagen. Amsterdam: Pallas Publications, 209–16.

Jessen, M. D., 2015. Stave, stolper og Skagerrak – spørgsmål om ressourcer og vikingetidens arkitektur under Harald Blåtand, in *Et fælles hav – Skagerrak og Kattegat i vikingetiden*, eds. S. Sindbæk & A. Pedersen, 188–209.

Jessen, M. D., 2013. Kongelig kaserne og royale rum – om trelleborghuse i Jelling, in *Vikingetid i Danmark*, eds. H. Lyngstrøm & L.G. Thomsen. København: Saxo-instituttet, 195–8.

Jessen, M. D., Andersen, S. W., Holst, M. K., Jensen, P. & A. Pedersen, 2011. Kongens gård i Jelling? – Et nyt anlæg fra Harald Blåtands tid. Nationalmuseets Arbejdsmark 2011. Nationalmuseets Arbejdsmark, 60–73.

Jessen, M. D., Holst, M. K., Lindblom, C., Bonde, N. & A. Pedersen, 2014. A Palisade fit for a King. Ideal architecture in King Harald Bluetooth's Jelling. *Norwegian Archaeological Review* 47(1), 42–64.

Johansen, K. L., 2003. Opretning af arkæologiske udgravningsfotos med AirPhoto Metoder og eksempler med udgangspunkt i Skelhøjprojektet.

Johnson, M., 1999. *Archaeological theory – an introduction*. Malden: Blackwell Publishing.

Kristiansen, K., 2014. Towards a new paradigm? – The Third Science Revolution and its Possible Consequences in Archaeology. *Current Swedish Archaeology* 22.

Kristiansen, K. & Rowlands, M., 2005. *Social Transformations in Archaeology: Global and Local Perspectives*. Routledge.

Lovata, T., 2007. *Inauthentic Archaeologies – Public Uses and Abuses of the Past*. Left Coast Press Inc.

Lucas, G. 2001, *Critical approaches to fieldwork: contemporary and historical archaeological practice*, Routledge, London.

Madsen, T., 2003. At gøre arkæologi. Refleksioner over udgravningen som videnskabelig praksis. *Arkæologisk Forum* (8), 12–20.

Madsen, T., 1995. Archaeology between facts and fiction. The need for an explicit methodology, in *Whither archaeology? Papers in Honour of Evzen Neustupny*, eds. M. Kuna & N. Venclová. Institute of Archaeology, Praha.

Malmer, M., 1980. Om arkaeologiens teori, metod och material. *Fornvännen* 75, 260–5.

Miller, P. & J. D. Richards, 1995. The Good, the Bad, and the Downright Misleading: Archaeological Adoption of Computer Visualisation, in *CAA94. Computer Applications and Quantitative Methods in Archaeology 1994*, eds. J. Huggett & N. Ryan. BAR International Series 600 edn. Oxford: Tempus Reparatum, 19–22.

Millett, M. & S. James, 1983. Excavations at Cowdery's Down Basingstoke, Hampshire, 1978–81. *Archaeological Journal* 140, 151–279.

Morgan, C., 2014. Archaeological Photography as Dangerous Supplement: History, Shifting Theory and Technology in Visual Representation. *Panel at the Royal Anthropology Institute Conference on Anthropology and Photography*. British Museum, 29–31 May 2014.

Morgan, C. & H. Wright, 2018. Pencils and Pixels: Drawing and Digital Media in Archaeological Field Recording. *Journal of Field Archaeology* 43(2), 136–51.

Olsen, O., 1977. *Fyrkat: en jysk vikingeborg*. Copenhagen: Det kgl. nordiske Oldskriftselskab.

Persson, C. P. 2016. Vikingeborg ved Køge mystificerer arkæologer. Accessed 16 August 2016: http://videnskab.dk/kultur-samfund/vikingeborg-ved-koege-mystificerer-arkaeologer

Petrie, S. F., 1904. *Methods and Aims in Archaeology*. London: Macmillan.

Pitt-Rivers A.L.F., 1887. *Excavations in Cranborne Chase*.

Popper, K. R., 1959. *The logic of scientific discovery*. Basic Books.

Powlesland, D. J., 2014. 3D imaging: enhancing the archaeological record. *British Archaeology* (Sep/Oct), 34–9.

Reilly, P., 1992. Three-Dimensional modelling and primary archaeological data, in *Archaeology and the Information Age: A global perspective*, eds. P. Reilly & S.P.Q. Rahtz. London: Routledge, 147–73.

Reilly, P., 1988. Data Visualization: recent advances in the application of graphic systems to archeology. *IBM UKSC report* 185(March).

Roesdahl, E., Sindbæk, S., Pedersen, A. & D. Wilson (eds), 2014. *Aggersborg – The Viking-Age settlement and fortress*. Højbjerg: Jysk Arkæologisk Selskab.

Schmidt, H., 1985. Om bygningen af et vikingetidshus på Fyrkat. Nationalmuseets Arbejdsmark, 48–59.

Schmidt, H., 1981. Trelleborghuset og Fyrkathuset. Nationalmuseets Arbejdsmark, 132–44.

Scollar, I., 1998. AirPhoto – A WinNT/Win95 program for the geometric processing of archaeological air photos. *AARGnews* 16, 36–8.

Shanks, M. & C. Tilley, 1987. *Re-Constructing Archaeology: Theory and Practice*. Cambridge: Cambridge University Press.

Søe, N. E., Odgaard, B. V., Hertz, E., Holst, M. K. & S.M. Kristiansen, 2017. Geological setting of a sacred landscape: Iron Age post battle depositions at Alken Enge, Denmark. *Geoarchaeology* 32(5), 521–33.

Trigger, B. G., 1989. *A History of Archaeological Thought*. Cambridge: Cambridge University Press.

Wheatley, D. W. & M. Gillings, 2002. *Spatial Technology and Archaeology: the archaeological applications of GIS*. London: Taylor & Francis.

Wheeler, R. E. M., 1954. *Archaeology from the Earth*. Oxford: Clarendon Press.

Wu, C., 2011. *VisualSFM: A Visual Structure from Motion System*.

Chapter 6

Virtual authority and the expanding role of 3D digital artefacts

Kevin Garstki

The technology used to create digital 3D models of archaeological material has proliferated in the discipline in recent years. There are now myriad types of technologies used to create digital artefact models that range in resolution, accuracy, and cost, depending on the type of research questions asked by the archaeologist. As these technologies expand in the discipline, the number of users of the final product (the digital model) is growing rapidly. Additionally, as the techniques and digital interfaces become easier to use, the number of producers is also growing. The benefits that these digital 3D artefact models present to research remain vast: access to otherwise remote collections, scalable models for comparative analysis, detailed morphometric analysis, and increased engagement with the public, are all potentials that these models bring to the discipline. However, as we keep these overwhelming benefits in mind, it is also necessary to consider the place that these new digital forms take in the discipline. The process of creating a digital model of an artefact requires significant input by the producer that includes choices about what technology to use, the capturing strategy, the lighting conditions and settings, the post-processing, and the software used to view or edit the model. Any number of these factors can, and do, influence the attributes of the final model. In turn, the way that we take into account or ignore these processes will impact how we use these digital models in archaeological research.

In this chapter I will begin by outlining the similar trajectories of photographic technology in archaeology in the nineteenth century and 3D scanning technology of the twenty-first century. This comparison will serve to establish the argument that 3D models of artefacts, just like artefact photographs, should be considered representations of the original object – establishing the terminology allows us to then acknowledge the biases inherent in the creation of a representation. I contend that the creation of any representation, be it photograph or 3D model, is accompanied by a perceived authority attributed to the producer. This implicit attribution of authority is in part based on the perception of a producer as a documentary witness to the original (Shanks 1997). In displaying a photograph or 3D model, the producer is saying 'I was there and this is what the artefact looks like.' This authority is also attributed to the producer as someone who knows how to use a 'black box' technology to create a representation. As the process by which data is manipulated in representations becomes more opaque, the authority attributed to the producer increases. I argue that this authority attributed to the producer of a 3D artefact model can be misappropriated in the argument for or against authenticity of a 3D model. The way in which authenticity can be defined, for digital models or otherwise, is extremely variable (Jones 2010; Jones & Yarrow 2013; Holtorf 2013; 2010; Garstki 2016). Yet I argue that any discourse surrounding the authenticity of a 3D digital representation of an artefact should include an understanding of the full production process – all of the choices, inputs, and data manipulation that affect the final model.

Photography and its similarities to 3D scanning

The discipline of archaeology has a long history of co-opting and subsuming outside technologies that are found to benefit the study of the human past. One of the earliest and most widespread examples of this is the development of photography in archaeology in the second half of the nineteenth century. I have argued elsewhere (Garstki 2016) that the development and use of photography in archaeology closely parallels the more recent development of 3D scanning and modelling techniques. One technology for capturing photographic images, the daguerreotype process,

was quickly adopted by archaeological expeditions following its development by Jacques-Louis-Mande Daguerre (Bohrer 2011; Dorrell 1994; Lyons 2005; Olsen et al. 2012). And while the daguerreotype was utilized to document monuments throughout the Mediterranean, the problem of reproducibility quickly came to the fore. The dissemination of visual archaeological data in publication is a key facet for the study of archaeology, yet the image produced by the daguerreotype process was not easily reproduced in print. This historical problem is paralleled by the techniques used in the early twenty-first century to produce 3D models of artefacts, and the hardware and software used to showcase them. If a 3D model can only 'live' on one computer or on a single server with limited access, then its utility to the discipline is also limited. It has only been with the increased capabilities of online digital repositories, 3D supplements in many major journals, or the capabilities to embed 3D representations into PDFs that the usefulness of 3D digital artefact models has been really felt. The reproducibility issue in the nineteenth century was also helped by an alternative photographic technology: Henry Fox Talbot's negative-positive procedure for capturing images, the calotype (Hamilakis & Ifantidis 2015). Although photography had been used in archaeology for a few decades, it was only with Conze's 1875 publication, *Archäologische Untersuchungen auf Samothrake*, that photographic documentation was used in a publication (Dorrell 1994).

By the later part of the nineteenth century, however, there were many techniques available to archaeologists to reproduce still images of excavations or artefacts – collotypes, chromolithography, autotypes, platinotypes, and heliogravures (Olsen et al. 2012, 53). This trajectory is once again mirrored by the development of 3D scanning techniques during this century. Archaeologists currently use a number of file types (OBJ, 3D pdf, PLY, STL, COLLADA, etc.) and digital interfaces (e.g. online journal supplements, embedded pdfs, Sketchfab,[1] Ariadne,[2] dedicated websites[3]) to reproduce and share digital 3D artefact models. Similarly, just as there were a number of technologies used to create photographic images in the early years, archaeologists are utilizing a number of types of surface capture technology to create digital 3D models of artefacts: laser scanning (e.g. McPherron et al. 2009; Pires et al. 2006), structured light scanners (e.g. Acka et al. 2006; Counts et al. 2016; Grosman et al. 2014), or photogrammetry (e.g. Kersten & Lindstaedt 2012; Heath 2015; Miles et al. 2014; Olson & Caraher 2015). Each type of technology utilizes different physical properties to capture the surface geometry (and visual appearance) of an object, just as the different types of photographic technologies differently captured the scene in front of the camera.

In addition to their historical development in the discipline, the way in which each image or 3D model seeks to present some visual and spatial data to the user is strikingly similar. The presentation of data to a user is partially based on the perception of source reliability and the authority to convey information from the original artefact to the user of the representation. The *perception* of photographic images is one of objective representation (Garstki 2016). There often exists a presumption of mechanical reproduction in the creation of an artefact photo – that there is little or nothing that influences the creation of the final representation. Photographs provide a static medium to interact with the original subject (i.e. artefact). In the nineteenth century, illustrations and later photographs were able to standardize experience and steer intellectual thought to a rigid framework by presenting standardized visual representations in scientific inquiry (Daston & Gailson 2007; 1992). This perception of objectivity is maintained in our modern interaction with photography (Bourdieu 1996, 77; Bohrer 2011, 28; Shanks 1997). Yet despite this perception of objectivity, Van Dyke (2006, 372) notes that '…there is always an eye behind the camera, and a hand on the development process, that directs what a viewer sees.' We cannot think of photography as a completely mechanical process, automated beyond human influence, or we remove any human determinism in the final product (Shanks 1997). The perception of photography as a 'camera automaton' is in danger of being mirrored in the use 3D scanning systems.

I would argue that despite its growth in the field, 3D scanning still maintains a *perception* of objective creation, resting on a mistaken assumption of mechanical reproduction (from original artefact to 3D model). As he traces the parallels between a conception of mechanical reproduction in plaster casts, squeezes, and digital 3D models, Adam Rabinowitz very correctly notes that 'the digital 3D model is not a true surrogate for the original, even when derived from photographs' (2015, 34). Rabinowitz (2015) identifies that there is a significant amount of input from the creator of any 3D model, which is not accounted for when the product is presented as being mechanically reproduced. In presuming a process of mechanical reproduction in the creation of a representation, the significant influence that the producer has over of the final product is ignored. By not addressing or understanding the producer's influence over the final product, a level of technological authority is attributed to them. This authority mistakenly assumes an objective translation of data, from the original artefact to the new 3D

model. As such, notions of an objective, mechanical technique are combined with a documentary aspect of photography. The user of a photograph attributes a level of authority to the producer of said photograph, which rests on a perception of the photographer as a documentary witness (Shanks 1997, 74). Shanks notes that 'a photograph may be used to provide authority based upon the notions of presence and seeing' (1997, 74). Authority rests with the producer of the digital 3D artefact model – as one who 'sees' the original artefact and is simply reproducing it in digital form through a mechanical process.

The argument made for authenticity of a representational object is tied strongly to the perception of authority surrounding the producer. Technological authority masks the productive process and creates a false sense of an objective reproduction of an original – justifying a perception of authenticity. A photograph or 3D model may be argued to be authentic to itself, as a thing produced with a specific set of goals in mind. In this way, Stuart Jeffery argues that due to the expertise, intentionality, and resources used to create a digital visualization, the aura (*sensu* Benjamin 1968) and authenticity of the original can be passed on to the digital replica (2015) (Jones and Yarrow [2013] have also argued for this in a physical form). On the other side, while these representations may be able to translate many visual aspects of the original that constitute our perception of pastness (Holtorf 2013; 2010), the creation of a visual representation of an artefact, be it photograph or digital model, gives the representation a separate narrative from the original (Garstki 2016). So, an argument may be made that a digital 3D artefact model is authentic because it has been created with the intention to create this new digital object, and also that it is inauthentic because an object's properties and relations are irreducible to a representation of it (Olsen et al. 2012). However, any argument for authenticity that equates representation with original negates the productive act, and all of the input that goes into the creation of the final product.

I would therefore argue that regardless of how one defines or attributes authenticity to a representational object, the technological authority to create the object should be interrogated. Would that authority still exist if the entire process of production (i.e. scanning, processing, modelling, etc.) becomes completely transparent, if the individual choices and inputs made by the producer became visible? The need for transparency has also been well articulated by Rabinowitz (2015, 34–6), as the production of digital 3D models of archaeological material is filled with choices in technology and technique. To emphasize the biases and myriad inputs that exist in the productive process of 3D artefact scanning, I present here two short case studies; one that examines how the influence of photography impacts the final digital 3D artefact model, and one that demonstrates how post-scanning input can also alter the final product.

Case study 1

In summer 2016, the Athienou Archaeological Project (AAP) began a project that attempts to integrate digital artefact models more seamlessly with a traditional publication framework. Following a pilot project in 2014 (Counts et al. 2016), a structured light scanning system was used to create a select corpus of digital 3D models of limestone and terracotta statuary recovered from the site of Athienou-*Malloura*. AAP has been examining the long-term cultural change at Athienou-*Malloura* and the surrounding region since 1990, which has evidence for domestic, religious, and funerary activity dating back to the first millennium BC (Toumazou et al. 2015; 2011). The focus during the last two decades has been on the rural sanctuary at Athienou-*Malloura*, which has brought to light significant activity from as early as the eighth century BC to the fourth century AD (Toumazou & Counts 2011). Due to being one of the few inland, rural sites in Cyprus to be excavated scientifically, the over 3,000 fragments of votive limestone and terracotta sculpture provide a useful corpus to reconstruct Cypriot religious practices during this period (Averett 2011; Counts et al. 2016; Counts 2011; 1998). A selection of these artefacts were scanned during the 2016 season and these models will be used in a digital open-access artefact catalogue.

The system used in the creation of these digital models was the HDI Advanced R1X Scanner from GoMeaure3D. As with many structured light systems, the scanner utilizes a projector, two point-grey cameras to capture the surface data, and a separate DSLR camera to capture the photo texture. And while much can be said regarding the type of surface capture technology, and its accuracy and resolution, the focus here will be on the impact that the DSLR camera had on the production of the final digital 3D model. The DSLR camera, a Canon Rebel T5 EOS 1200D (18 megapixels), was integrated with the scanning software so that all the camera settings were manually adjusted through the software (shutter speed, aperture, white balance, focus, etc.). Each of these aspects of photography that can be adjusted during a scan of an artefact impact the final 'look' of the resultant digital artefact model, and therefore, the individual operating the structure light system has significant productive influence. For example, the colour balance settings on the Canon can be adjusted to suit specific lighting conditions.

Figure 6.1. *Three digital 3D models of a Herakles head (AAP-AM 851; Larnaka District Museum, Cyprus) from Athienou-Malloura (© Athienou Archaeological Project), using different white balance settings.*

Adjusting this setting will result in drastically different colours of the artefact represented by the photo texture. Figure 6.1 shows the same artefact (a limestone head of the so-called Cypriot-Herakles type from Athienou-*Malloura*; see Counts 1998, 122–7) scanned in identical lighting conditions but with the white balance settings slightly adjusted. This example is at the extreme end of variations in photo-texture that can result from altering the photographic technique, yet it demonstrates that the process of scanning and modelling is far from mechanically automated. It is not a new idea that the location where we view an artefact can alter our perception of it; studying a limestone sculptural fragment will look slightly different in a well-lit gallery than it would outside on a sunny day, or in the attic of a museum under florescent lights. However, when one creates a 3D model of an artefact, with specific light and colour conditions, the appearance becomes fixed to the artefact; a static aspect of an otherwise dynamic representation.

Case study 2

The input that is required to complete a digital 3D model of an artefact does not end with the data capturing process. After each scan is taken (in range-based modelling systems) or image captured (in image-based systems), there may be significant processing involved in turning the initial data into a final model. This may take the form of manually aligning multiple scans to create a complete model of the artefact, or editing individual images to only highlight parts of the photographed artefact. 'Noise' is often captured by the 3D scanning technique, whether it is part of the platform that the artefact was resting on when scanned or simply a misalignment of one or two scans. This noise is manually deleted from the model within the modelling software – another input from the producer.

Once the final mesh is completed and the photo-texture is processed, it is not uncommon to notice areas of the artefact model that seem 'wrong' in their colour or shade. Figure 6.2 shows a 3D digital model made of a Roman lamp reproduction using close-range photogrammetry. A Fujifilm FinePix HS30EXR and Agisoft's Photoscan Professional version 1.2.5 were used to produce the model from a total of 74 images. After the final processing of the model, a discoloration was noted from where the lamp had rested on its side during much of the photo capture. This colouring does not represent the original colour on that part of the lamp (Fig. 6.2). How should a misrepresentation like this discoloration be handled by the producer of the model? This digital model is not 'accurate' to the original in that area of the lamp, and if someone were to interact with the new digital 3D model only, they would not be aware that this discoloration was not original to the piece. Yet, would additional input by the producer in the form of 'photoshopping' the discolored area of the model add to the misrepresentation or mitigate the issue? The photo texture of the

Figure 6.2. *A digital 3D model of a Roman lamp reproduction using photogrammetry. Discoloration on the bottom-centre of the model.*

model can be edited in Adobe Photoshop (or other illustration software) to better represent what is visible on the surface of the lamp in life (Fig. 6.3).

While this example may seem inconsequential to the production of archaeological knowledge through the interaction with 3D artefact models, it in fact illustrates the minute inputs from the producer that can all add up to greatly alter the final digital artefact model, and therefore alter our interaction with material culture. If we were to leave each 'imperfection' or discoloration created during the production of a digital artefact model, then these visual aspects of the model would become part of the object's narrative – a researcher will see a discoloration on a 3D digital model of a lamp and presume there was some process (in the past) that caused it. However, if we were to photoshop each 3D model to better suit what we 'see' in person, then we may as well create the photo-texture from scratch just as an illustrator would do.

Discussion

It is easy to understand why we can view photography as a mechanical process; early in the discipline, standards for capturing artefact images were developed (Flinders Petrie 1904), and today we continue a largely standardized practice of object photography. By standardized, I do not mean the practice is without

Figure 6.3. *(Left) The initial digital 3D model of a Roman lamp reproduction; (right) The altered digital 3D model using Adobe Photoshop.*

bias or individual choice, but merely there is a general set of guidelines used in the creation of artefact photos. Because of the perception of standardization, we do not as often consider the impact the photographer has on the creation of the image. The ability to manipulate an image while it is being created has always been present, but with the rise of digital images, manipulation of an image after it was captured can occur very easily and with little training (Shanks 1997, 81). The process of 3D scanning is far from standardized. To begin, there are still a number of technologies used in the process. Not only will a structured light scanner create a very different digital model than structure from motion, but even within a particular technology there are many types of commercial scanners, cameras, and software that can be used to create an artefact model. Moving beyond the technology itself, the locations where 3D artefact scanning can take place may be limited. It may be the case that when working in a museum, the artefacts may only be viewed in certain study rooms, which may or may not be well lit. And while it may be argued that there should be a standardized light box and lighting system used during each scan, this has yet to take place.

The two above examples demonstrate that digital 3D artefact models, just like photographs, are representations of an original object, each produced as part of archaeological practice with a series of choices and techniques. The aesthetic of the final model is largely dependent on the choices made during the production process (such as lighting and other camera settings) or during the processing of the model (such as manually manipulating the photo-texture). Archaeologists invest significant time and resources into the creation of media used to convey archaeological data, and yet the focus is rarely on the production process but only on the final product (Shanks & Webmoor 2013). Regardless of whether we consciously acknowledge it, the time and resources we put into creating archaeological representations significantly impacts the way in which archaeological knowledge is transferred, communicated, and created. It is important to discuss these otherwise innocuous steps and make these processes transparent so that by identifying the biases or choices involved in the creation of a representation, the authority of production is more strongly considered.

Without incorporating the ways in which a producer impacts the creation of a 3D model, the authority attributed to the producer presents a representation as being equivalent to the original, unintentionally reifying the information that is created in the process as being 'real' to the original. Through this reification, a colour inconsistency on the surface of a model becomes part of the artefact narrative. In the end, the creation of any visual representation in archaeology, photograph or 3D model, is an attempt to convey visual data to another person who may not be in direct contact with the original (Shanks & Webmoor 2013). The authority to create these representations is accompanied by the assumption that the data presented will be accurate to the original, in colour, shape, size, scale, etc. In order to more accurately convey the visual data to one another, and avoid the assumptions of objectivity that often accompany the attribution of technological authority, we need to be as explicit as we can in how we produce these digital representations – from the decision of what 3D scanning technology to utilize to the edits we make of the final product.

Acknowledgements

I would like to thank Michael K. Toumazou, Director of the Athienou Archaeological Project, as well as Derek Counts and Erin Averett for allowing my involvement in the 3D scanning aspects of the Athienou Archaeological Project, and for my involvement in AAP for the last 5 years, supported in part by generous funding from the National Science Foundation. Thanks are also due to the Office of Research at the University of Wisconsin-Milwaukee, which provided funds in support of our 3D scanning project. Thank you to the reviews for their time and comments. Special thanks go to Adrienne Frie for her insightful comments on earlier drafts of this work.

Notes

1 https://sketchfab.com/
2 http://visual.ariadne-infrastructure.eu/
3 http://sites.museum.upenn.edu/monrepos/index.html

References

Akca, D., A. Gruen, Z. Alkis, N. Demir, B. Breuckmann, I. Erduyan, & E. Nadir, 2006. 3D modelling of the weary Herakles statue with a coded structured light system. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 36 (5), 14–19.

Averett, E. W., 2011. The ritual context of the Malloura terracotta figurines, in Crossroads and Boundaries, in *The Archaeology of Past and Present in the Malloura Valley, Cyprus*, eds. M. K. Toumazou, P. N. Kardulias, & D. B. Counts (AASOR 65). Boston (MA): American Schools of Oriental Research, 133–47.

Benjamin, W., 1968 [1936]. The Work of Art in the Age of Mechanical Reproduction, in *Illuminations. Essays and Reflections*, ed. H. Arendt, translated by H. Zohn. New York (NY): Schocken Books, 217–51.

Bohrer, F. N., 2011. *Photography and Archaeology*. London: Reaktion Books Ltd.

Bourdieu, P., 1996. *Photography: A middle-brow Art*. Stanford: Stanford University Press.

Counts, D. B., 1998. *Contributions to the study of Cypriote sculpture: Limestone votives from Athienou-Malloura.* Unpublished PhD dissertation, Brown University.

Counts, D. B., 2011. Local styles and regional trends in Cypriot limestone sculpture: The Athienou School, in *Crossroads and boundaries. The archaeology of past and present in the Malloura Valley, Cyprus*, eds. M. K. Toumazou, P. N. Kardulias, & D. B. Counts (AASOR 65) Boston (MA): American Schools of Oriental Research, 149–62.

Counts, D. B., E. W. Averett, & K. Garstki, 2016. 3D Artifact Modeling and Customized Structured Light Scanning at Athienou-Malloura, Cyprus. *Antiquity* 90, 206–18.

Daston, L. & P. Gailson, 1992. The Image of Objectivity. *Representations* 40, 81–128.

Daston, L. & P. Gailson, 2007. *Objectivity*. New York (NY): Zone Books.

Dorrell, P., 1994. *Photography in Archaeology and Conservation*. Cambridge: Cambridge University Press.

Flinders Petrie, W. M., 1904. *Methods and Aims in Archaeology*. London: Macmillan and Co., Limited.

Garstki, K., 2016. Virtual representation: the production of 3D digital artefacts. *Journal of Archaeological Method and Theory*, DOI 10.1007/s10816-016-9285-z.

Grosman, L., A. Karasik, O. Harush, U. Smilansky, 2014. Archaeology in three dimensions: computer-based methods in archaeological research. *Journal of Eastern Mediterranean Archaeology and Heritage Studies* 2(1), 48–64.

Hamilakis, Y. & F. Ifantidis, 2015. The photographic and the archaeological: the 'other Acropolis,' in *Camera Graeca: Photographs, Narratives, Materialities*, eds. P. Carabott, Y. Hamilakis, & E. Papargyriou. Burlington (VT): Ashgate, 133–57.

Heath, S., 2015. Closing gaps with low-cost 3D, in Visions of Substance: 3D Imaging in Mediterranean Archaeology, eds B. Olson & W. Caraher. Grand Forks (ND): The Digital Press at the University of North Dakota, 53–62

Holtorf, C., 2010. The presence of pastness: themed environments and beyond, in Staging the Past: Themed Environments, in *Transcultural Perspective*, eds. J. Schlehe, M. Uike-Bormann, C. Oesterle, & W. Hochbruck. Bielefeld: Transcript, 23–40.

Holtorf, C., 2013. On pastness: a reconsideration of materiality in archaeological object authenticity. *Anthropological Quarterly* 86(2), 427–43.

Jeffrey, S., 2015. Challenging heritage visualisation: beauty, aura and democratization. *Open Archaeology 1*, 144–52.

Jones, S., 2010. Negotiating authentic objects and authentic selves: beyond the deconstruction of authenticity. *Journal of Material Culture* 15(2), 181–203.

Jones, S. & T. Yarrow., 2013. Crafting authenticity: an ethnography of conservation practice. *Journal of Material Culture* 18(1), 3–26.

Kersten, T. P. & M. Lindstaedt., 2012. Image-based low-cost systems for automatic 3D recording and modelling of archaeological finds and objects, in *Progress in Cultural Heritage Preservation*, proceedings of 4th International Conference, EuroMed 2012: Limassol, Cyprus, 29 October–3 November 2012.

Lyons, C. L., 2005. The art and science of antiquity of nineteenth-century photography, in *Antiquity and photography: early views of ancient Mediterranean sites*, eds. C. L. Lyons, J. K. Papadopoulus, L. S. Stewart, A. Szegedy-Maszuk. Los Angeles (CA): The J. Paul Getty Museum, 22–65.

Miles, J., M. Pitts, H. Pagi, & G. Earl. 2014. New applications of photogrammetry and reflectance transformation imaging to an Easter Island statue. *Antiquity* 88, 596–605.

McPherron, S. P., T. Gernat, & J. J. Hublin. 2009. Structured light scanning for high-resolution documentation of in situ archaeological finds. *Journal of Archaeological Science* 36, 19–24.

Olsen, B., M. Shanks, T. Webmoor, & C. Witmore. 2012. Archaeology: the discipline of things. Berkeley (CA): University of California Press.

Olson, B., & W. Caraher (eds.), 2015. Visions of substance: 3D imaging in Mediterranean archaeology. Grand Forks (ND): The Digital Press at the University of North Dakota.

Rabinowitz, A., 2015. The work of archaeology in the age of digital surrogacy, in *Visions of Substance: 3D Imaging in Mediterranean Archaeology*, eds. B. Olson & W. Caraher. Grand Forks (ND): The Digital Press at the University of North Dakota, 27–42.

Pires, H, P. Ortiz, P. Marques, & H. Sanchez, 2006. Close-range laser scanning applied to archaeological artifacts documentation. Virtual reconstruction of an XVIth century ceramic pot, in The 7th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST (2006), eds. M. Ioannides, D. Arnold, F. Niccolucci & K. Mania.

Shanks, M., 1997. Photography and archaeology, in The Cultural Life of Images: Visual Representation in Archaeology, ed. B. L. Molyneaux. London: Routledge, 73–107.

Shanks, M & T. Webmoor, 2013. A political economy of visual media in archaeology, in Re-presenting the Past: Archaeology Through Text and Image, eds. S. Bonde & S. Houston. Oxford: Oxbow Books, 85–108.

Toumazou, M. K. & D. B. Counts, 2011. Excavations at Malloura (1990–2010): context, methods, and results, in Crossroads and Boundaries. The Archaeology of Past and Present in the Malloura Valley, Cyprus (AASOR 65), eds. M. K. Toumazou, P. N. Kardulias, & D. B. Counts. Boston (MA): American Schools of Oriental Research, 67–86.

Toumazou, M. K., P.N. Kardulias, & D. B. Counts (eds.), 2011. Crossroads and boundaries. The archaeology of past and present in the Malloura Valley, Cyprus. (AASOR 65). Boston (MA): American Schools of Oriental Research.

Toumazou, M.K., D.B. Counts, E.W. Averett, J.M. Gordon, & P.N. Kardulias., 2015. Shedding light on the Cypriot rural landscape: investigations of the Athienou Archaeological Project in the Malloura Valley, Cyprus, 2011–2013. Journal of Field Archaeology 40(2), 204–22.

Van Dyke, R. M., 2006. Seeing the past: visual media in archaeology. American Anthropologist 108(2), 370–5.

Chapter 7

Volatile images: authenticity and representation and multi-vocality in digital archaeology

Gareth Beale

The diversification of archaeological communities of practice has created a need for multi-vocality within archaeological discourse (Hodder 2008; Yellowhorn 2015). A growing acknowledgement of the need to encourage participation in the interpretation of the past within commercial and academic archaeology has been re-enforced by moves from the cultural heritage sector and government to increase the role of communities in the management and interpretation of the material past (Department for Culture, Media and Sport 2016; Smith 2006). The challenges involved in forging new and more inclusive forms of archaeological discourse and narrative are significant and have led to considerable disruption to traditional assumptions about processes of knowledge generation within archaeological practice (Moser et al. 2002). These changing dynamics have had a considerable impact on the use of digital imaging within archaeology (Jeffrey et al. 2015). Technological developments have created new opportunities for image making and archaeology has become increasingly involved in dialogue with image making practice outside of the discipline. Perhaps most notably, collaborations between artists and archaeologists have led to the creation of novel, experimental forms of archaeological visualization which incorporate ideas of practice-led-research (Beale et al. 2013; Perry 2015) and which challenge established definitions of knowledge.

The proliferation of new forms of image making practice has called into question many of the epistemological assumptions which traditionally underpinned the use of computer graphics as an archaeological medium. Notions of accuracy and authenticity which were conceived within the relatively narrow frame of academic research and communication do not necessarily transpose easily onto different cultures or contexts of image making. Circumstances of production, display and reception of images are increasingly likely to differ in significant ways. This chapter will consider whether notions of authenticity which have developed around the use computer graphics in an academic archaeological setting are adequate as we move to describe and to understand the role of digital image making in an era of plurality, methodological diversity and shifting power relations. It will discuss and chart some of the diverse uses of image making within archaeological practice and will consider processes through which we might negotiate new forms of authenticity which reflect the diverse character of contemporary archaeology. The case studies featured within this paper describe work which I have been involved in producing. In each instance these were collaborative undertakings which incorporated, in various ways, the work of others. These collaborative undertakings describe a wide variety of archaeological research models including interdisciplinary collaborations, community archaeology projects and public art projects.

Mediating authenticity

Considerations of authenticity have been instrumental in negotiating the value and meaning of computer generated images in archaeology (Miller & Richards 1995; Frischer et al. 2000; Frankland & Earl et al. 2011). Images have played an important role as communicators of archaeological knowledge and understandings of authenticity in relation to archaeological computer graphics have tended to emphasize the representation of empirical data derived from conventional modes of archaeological research. As Frischer states '…accuracy and authenticity are two sides of the same coin. Accuracy pertains to the data and metadata; authenticity to the user's experience of the data and metadata.' (Frischer et al. 2000, 8). These words are representative of a tendency in the literature of archaeological

computer graphics to conceptualize authenticity as being something which is an empirically defined and stable property of an image.

Initiatives such as the London Charter (Chapter 3 in this volume; Denard 2012) have encouraged archaeological image makers to codify and to express the relationship between representation and knowledge using formal systems of metadata and paradata. As a mechanism and as a set of guiding principles these ideas have been highly significant. They have helped to highlight the significance of practice as a central component of the archaeological image and have promoted the need for transparency (Bentkowska-Kafel et al. 2012). The formalized representation of elements of this process enables a subset of intellectual, physical and technological processes to be made visible. However, these formalized modes of notation were not designed to fully describe or define the limits of authenticity. There is far more to an image than that which can be defined using formal methods of notation. As definitions of meaningful knowledge diversify (Yellowhorn 2015) and as image making itself becomes recognized as a meaningful form of knowledge creation it becomes necessary to reconsider what we mean by authenticity. Smith and Dean (2009) argue that in an era of practice led research 'knowledge is itself often unstable, ambiguous and multi-dimensional, can be emotionally or affectively charged, and cannot necessarily be conveyed with the precision of a mathematical proof.' (Smith & Dean 2009, 3). These arguments are particularly pertinent as archaeological communities of practice diversify and seek to express varied meanings in new ways.

What might a more subjective understanding of authenticity mean for 3D computer graphics, a technological field which so rooted in ideas of realism, accuracy and the authentic? It is clear that definitions of authenticity must be expanded in order that they are able to describe new forms of archaeological media and the forms of knowledge which they seek to express. The relationship between authenticity and media has been explored in other disciplinary settings. Funk et al.'s critique of authenticity and literary aesthetics (2012) provides several useful insights into other ways in which we might conceptualize the authentic within archaeological image making. They suggest that in order for the authenticity of a representation to be established it must attempt to be both 'subjective and collective, personal and communal; it is an attempt to understand and transcend the purely symbolic and thus penetrate the space in between experience and representation' (Funk et al. 2012,13). Authenticity is not, they argue, an inherent property of the aesthetic object (in our case the digital image) and it is not necessarily something which can be agreed upon. The idea of authenticity as something which must be enacted, performed and negotiated has, as I shall explore below in the case studies, important implications for archaeological computer graphics, as does the idea that authenticity is socially situated and discursive.

Funk et al.'s descriptions of authenticity resonate with arguments from History that narrative and representational modes used within the discipline must evolve in order to ensure the continuation of a meaningful and comprehensible dialogue between the researcher and the audience (Holly 1996, 66). These arguments acknowledge the responsibility of the researcher not just to move beyond passive transparency and towards the proactive and narration of the past in ways which are both meaningful and contextually specific (Burke 1991). The led to a broader questioning of the primacy of text in the representation of the past (White 1978) which echoes contemporary developments in practice led research (Smith & Dean 209). There has been an increasing acknowledgement across the Arts and Humanities of the role which diverse forms of practice, media and aesthetic forms can have in generating, as well as communicating, knowledge (Smiles & Moser 2005). Ideas of craft practice have been particularly prominent in archaeology (Bradley 1997) and are relevant to the creation of archaeological images (Perry 2015). Bunnell characterizes craft as being a 'continuous internal dialogue between maker and technology while being both consciously and subconsciously influenced by the external forces of the cultures of craft, design and beyond.' (Bunnell 2004, 5). Bunnell's description encourages us to consider image making as a process intertwined with other forms of archaeological practice and life more broadly and emphasizes the interplay between images, archaeology and audience. There is a long tradition of the use of craft and fine art skills in the production of archaeological imagery (Smiles & Moser 2005) but the importance of these skills in digital image making has yet to be fully recognized (Perry 2015).

As archaeological communities of practice diversify there is an increasing pressure across the discipline to recognize the diversity and instability of some forms of archaeological knowledge and to recognize the manifestation of this knowledge through different forms of practice and in different media. These changes create an impetus and a space for experimental practice in archaeological image making. The creation of digital images which communicate not just the positivistic but also the effective and emotional dimensions of archaeological knowledge represents a considerable

challenge and has the capacity to become an enormously productive area of research. The subjective character of this work and the fact that the dynamics of image making and consumption are so dependent on social and cultural factors mean that this field of research must (in order to be productive and successful) recognize and have roots in diverse and multi-vocal communities of practice and be informed by image making traditions which extend beyond the current (assumed) limits of the discipline. It is also essential that we are self-critical and recognize the range aesthetic, creative and technological assumptions which have digital image making within archaeology to this point.

The rest of this chapter will present a series of image making case studies and will examine the different ways in which authenticity has been created and maintained within a range of archaeological representations. In each case the role of images and the mode of production differs as does the combination of actors involved in the image making process. In each case, I was involved in the production process in some way but was by no means the sole producer. As such, these accounts represent my personal reflections on the work undertaken. The examples cover a spectrum of archaeological practice ranging from the artistic interpretation and re-curation of archaeological images through to the production of images for scientific analysis. A common thread running through all of the case studies in the collaborative nature of the image making process and the negotiated character of the resulting images.

Case study 1: Basing House zine printing

The first case study will focus on the production of images for the Basing House Project, a community orientated fieldwork project led by the University of York and University of Southampton. The project is based around an annual field season in which a team of students and community members conduct an excavation at Basing House in Hampshire. The research project focusses on the excavation of a country house which was largely destroyed during and soon after the English Civil Wars of the seventeenth century. The house was primarily built during the sixteenth century but incorporated earlier elements including a twelfth-century ringwork and bailey which helped to ensure that the house was defendable against siege for much of the Civil War (Allen & Anderson 1999).

The project has been running since 2013 and has made consistent use of digital imaging techniques throughout this period. This has included the production of digital drawings for on-site documentation and building survey as well as the regular production of images based upon 3D and 2D data produced during the excavations using techniques ranging from 3D modelling, laser scanning and photogrammetry to drone photography and reflectance transformation imaging. The project is committed to being public facing and as transparent as possible as fieldwork proceeds. This process has been made easier by being situated on a publically accessible site. Students from the University of Southampton who have attended the excavation have received training not just in excavation and digital recording techniques but also in the production of on-site digital exhibitions which help to communicate on-going research to the public. The public presentation of knowledge derived from the excavations has been co-supervised by artists based at Winchester School of Art. This case study will describe one instance of public exhibition which was led by artist Peter Driver. Peter worked with volunteers and students from the University of Southampton Archaeology Department to produce a series of zines which were inspired by the political and religious pamphlets of seventeenth-century Britain (Fig. 7.1).

Peter and the excavation directors saw this as an opportunity for students and volunteers to engage with the visual culture of the seventeenth century while also exploring themes ranging from

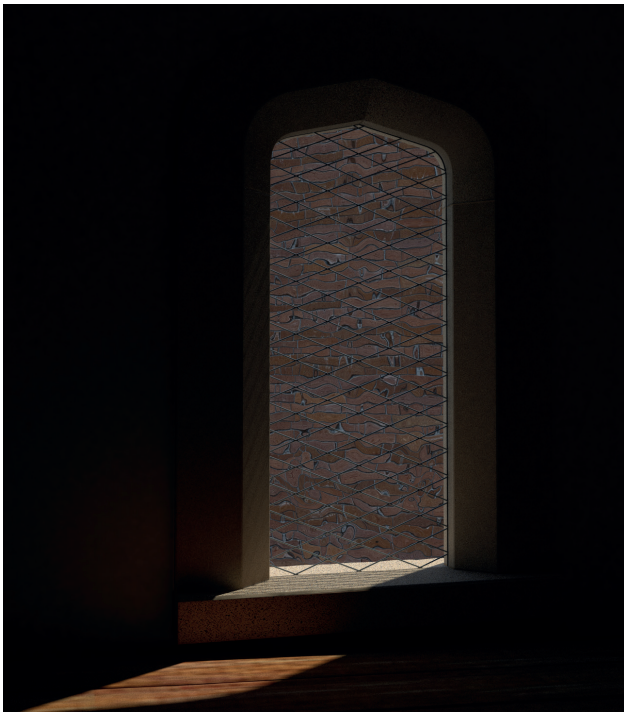


Figure. 7.1. *GCI rendering of a room interior from Basing House; just one of the digital image types to be included in the zines.*

print technology to politics and religion. The production of the pamphlets also provided students with a vehicle through which to explore the possibilities of image production based upon a wide range of digital data. The format of the zine provided a contrast to formalized methods of archaeological recording and image making which are predominant on an archaeological excavation and in which participants had been trained. In contrast to the production of site plans or context sheets the zines were an opportunity to present a more personal reflection on the archaeological process and evolving understandings (and frustrations!) which are an inherent part of the excavation process (Fig. 7.2).

The zines were produced using a digital photocopier but were based upon a wide range of imagery produced during the course of the project. This included digital images produced for documentation purposes (digitized section drawings, screen grabs of photogrammetric data, renderings of 3D models, digital photographs) but also artistic responses produced by students during print and drawing workshops which were held by Peter throughout the project. The goal of these workshops was to enable participants to develop their visual acuity using media which are not commonly employed within archaeology (such as monoprinting) or using conventional media in new ways (including sketching and photography).

The resulting zines were composite objects which deliberately juxtaposed a variety of images and text in order to produce coherent and highly compelling visual outputs. The paper based analogue medium in which the zines were produced and re-produced does not diminish the extent to which these are inherently digital artefacts. Without digital imaging these publications could not have been produced and they effectively curate and give context to a wide variety of archaeological data. The implicit knowledge claims made by the zines are quite different to those which are implied by the use of other media. For example, presenting a digitized site drawing within the zine with the caption 'Painstaking section drawing by Jamie' (Fig. 7.3) emphasized the effort and care which had been put into the creation of this image, sentiments which are generally absent from the formal publication record.

Figure 7.2. *The zines.*

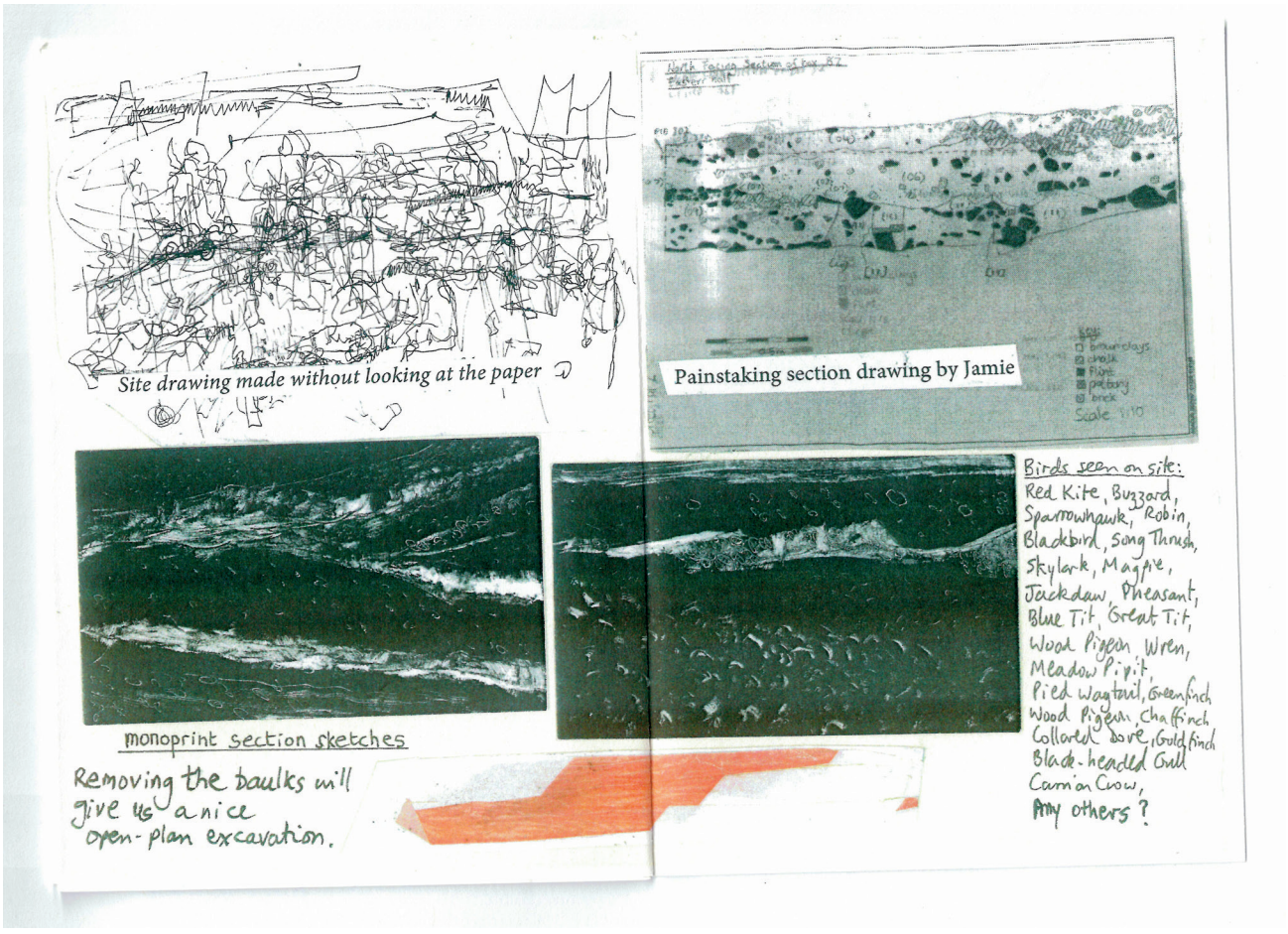


Figure 7.3. *A centrefold layout of prints and drawings by Peter Driver and students displayed in Volume 4 of the Basing House pamphlets.*

The zines augment the conventional archaeological record by providing a personal, emotive description of archaeological research. The format (including the associations of playful, satirical and anarchic content) provided a space within which the makers could articulate associations and ideas which would be excluded from conventional archaeological discourse and publication but which provide valuable insights into the archaeological process and the practice of knowledge building. The zines also provide a useful point of entry for visitors to the site by including games and things which the visitor can look out for during a visit (Fig. 7.4). Their playful presentation helps to ensure that there is no requirement for the site visitor to take the zines seriously but, none the less, they contain a wealth of valuable information and provide context to the work being undertaken. They are particularly effective at providing social and cultural context to the seventeenth-century wars which were so instrumental in creating the site as it exists today. Presentation of seventeenth-century lyrics and poetry alongside contemporary the contemporary images described above help to situate the archaeological work within a broader social and cultural milieu.

The zines described here are an effective demonstration of the importance and the value of multi-vocality and also of the use of alternative media. The zine provided a format for collaborative visualization and interpretation and enabled different voices and ideas to come to the fore. The zine format can be seen both as a medium and (in some senses) as a venue for the expression of ideas. As objects they are anarchic and playful, as such, they set an epistemological tone which is independent of the context within which they are distributed or found. Put in simple terms, they leave the viewer with a strong sense that the content within is to be enjoyed, they are not intended to be and (we hope) cannot me misconstrued as being a formal or definitive statement. The authenticity of these objects does not reside in tightly defined relationships to

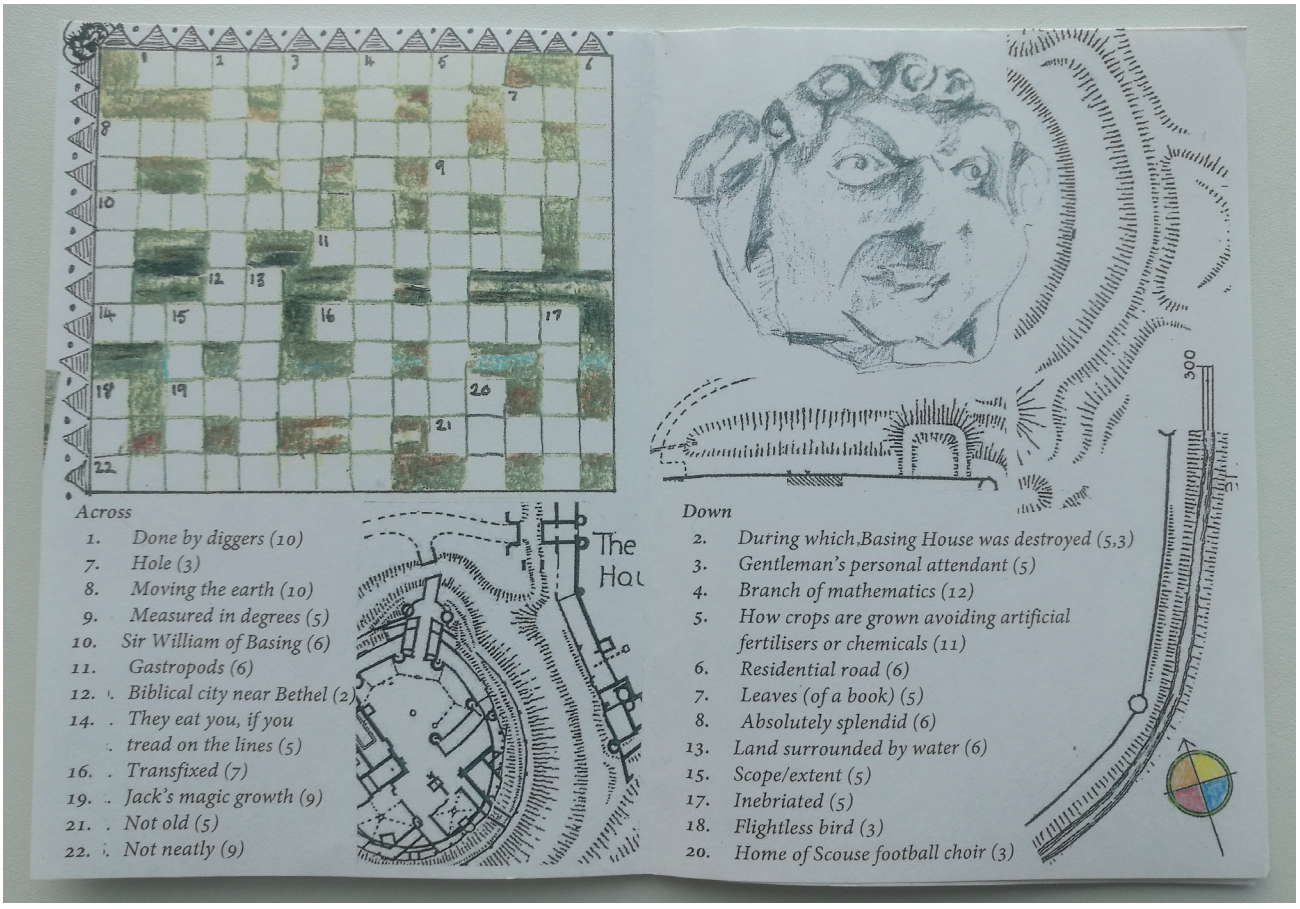


Figure 7.4. *Games and things to find on site.*

underlying data but in the use of style, medium and aesthetics to communicate subtle concepts of subjectivity, uncertainty and playfulness; as objects they speak for themselves.

Case study 2: Microlith

As part of the Cultural Olympiad accompanying the London 2012 Olympics a series of exhibitions and installations were held along the Jurassic Coast in Devon and Dorset. These exhibitions were built out of collaborations between artists and scientists and represented creative responses to the landscape and culture of this region. This case study will discuss a single image which produced for Simon Ryder to sit within his exhibition *A Natural History of Pseudomorphs* housed at the Coastwatch Station on Portland in Dorset.

The image depicts a Mesolithic chert microlith excavated at Thorncombe Beacon on the Dorset coast and lent to us by the National Trust (Fig. 7.5). The microlith is around 1 cm long and has been heavily re-touched meaning that, despite its size, a great deal of very fine detail is present. Having been commissioned by Simon to produce an image for the exhibition I decided to produce an image which was informed by traditions of archaeological artefact illustration with which I am familiar. The image of the microlith was intended to build upon these traditions but also the incorporate the possibilities offered by physically accurate rendering approaches in 3D computer graphics.

Images produced for conventional archaeological publications and venues are governed by particular aesthetic norms which allow them to be interpreted by an audience who have been trained to understand them (McIver Lopes 2009). The illustration of lithics is highly specialist and requires the image maker to develop an intimate understanding of an object in order to effectively represent it. The process of knapping by which Lithics are produced involves the systematic removal of flakes of stone using a tool. The traces of this process are revealed to the specialist through the examination of the contours of the object. Specialist

illustrators become adept, not just in reading these objects but in rendering these details in line drawing. The images which result have developed in order to serve a specific purpose. They describe the process by which the lithic was made as well as providing an image of the object.

The tradition of lithic illustration has much in common with other forms of archaeological illustration and places great emphasis on simplicity of line and on the selective representation of specific features or characteristics. This editorial process sits in contrast to prevailing traditions in archaeological computer graphics which have tended towards the naturalistic representation of the subject including photo-realistic shaders and textures to simulate materials as well as the apparently accurate reproduction of object geometry. I became interested in exploring this tension between these approaches and in producing an image which would juxtapose different styles of archaeological visualization; borrowing tropes and techniques from from each and combining them within a single image.

It was only as the process of image making unfolded that I began to know what the final image would look like. The 3D data (captured using a CT scanner) was extremely high resolution and I became very interested while processing and playing with this data in the level of detail which was visible on the surface of the object. When subjected to raking light it was possible to see fine surface details which I had not noticed while examining the original object. Processes of playful investigation and discovery were instrumental in formulating an understanding of the object. The very high resolution of the data transformed my perception of scale; marks and lines in the surface which were not obvious even while handling the microlith took on a new significance. Working within the context of the arts gave me the impetus and space to think differently about these observations. A theme running through Simon's exhibition was negative space and the significance of fissures, cavities and missing material in helping archaeologists and geologists to understand and interpret the environment. I became very interested in whether an image of the microlith could convey the fact that it had been produced through the skilled removal of material and that through a process of retouching (the continual removal of material through the use-life of a stone tool in order to maintain its sharpness and usefulness) the form of the object had evolved over time.

Figure 7.5. *The microlith.*

To Simon, the incorporation of archaeological ways of seeing the object was an important reason for including the image in the exhibition. He commented that he 'is often startled and amazed at how differently different disciplines can see the same thing, how each places its own emphasis. Priorities which might occupy you about the microlith such as how it was produced or provenance, to me I take as part of the authenticity associated with the object…' (Ryder 2016, pers. comm.). To Simon then, disciplinary traditions of thought and practice were important in defining the relationship between the object and the image. It might be argued that archaeological thought and practice (or at least the thought and practice of this archaeologist) were as much 'on show' as the microlith itself when seen within the context of an exhibition.

The image was produced using workflows which would be familiar to any digital image maker working within archaeology but in applying these approaches within a different setting (the arts), with a different venue (improvised gallery space) and with a different anticipated audience I thought differently about my practice. Knowledge of the object was acquired in the process of image making, subjective decisions relating to the mediation of the object (lighting, texture, composition) enabled and required me to become intimately familiar with the object. This familiarity went onto inform the image which I produced. The desire to highlight and accentuate the characteristics which I had observed through various stages of working with the object dictated the form which the final image took. This is precisely the kind of *dialogue between technology and maker* that Bunnell (2004) identifies as defining craft practice.

The context of display is also key to understanding biography of this image. Simon explained his attitude to the curation of *A Natural History of Pseudomorphs* in the following way; 'You can use the word image or perhaps exhibition, or show, or context, but I would put it more encompassingly as 'encounter'. When I was putting the show together I was consciously working with everything from the weather (the idea that you come in from the blustery, rainy, windswept, or perhaps sunny, becalmed world of the Bill into a quiet, pristine, idealized space) down to the presentation of the individual exhibits' (Ryder 2016, pers. comm.). It was possible then in making and in curating to anticipate the context within which the image would be seen and to incorporate this into the creative process. Ultimately though, the context in which the image was encountered was volatile and subject to change, as were the responses of the viewer. The purpose of this image was not to solely to communicate information to the audience but also to engender a response. In this instance, the authenticity of the image was deeply rooted in the perception of the viewer and the ability of the image to function effectively within a given setting.

Case study 3: Re-Reading the British Memorial

The third case study describes the co-creation of a series of images of memorials in churchyards and cemeteries using Reflectance Transformation Imaging (RTI) (Duffy et al. 2013). The images were produced in collaboration with a variety of community groups as part of the Re-Reading the British Memorial project (Beale & Beale 2015). The images shown here in non-interactive form were produced as in order to enable locally based researchers to document and study memorials in churchyards and cemeteries. They were captured as to enhance the ability of the viewer to observe fine details such as tool marking, erosion and residual traces of paint and pigment. Reflectance transformation imaging (RTI) is a multi-light imaging technique which allows the user to re-light a photograph after it has been taken. By photographing an object (in this case a memorial inscription) from multiple angles it is possible to generate a digital model of the surface topography of an object (Fig 7.6). Interactive images are derived from this model which allow the user to move the light and to alter the apparent reflective characteristics of the object using image processing algorithms.

Figure 7.6. *An RTI of an incised stone captured during a Re-Reading the British Memorial church survey.*

Ostensibly, the images produced are empirical in nature. They provide a representation of the object which can be effectively described using metadata and paradata and the work is repeatable with allowance for slight variation resulting from the inherent inaccuracies of field recording. The creation of the images was standardized to as great an extent as possible with identical camera settings used throughout and camera position remaining as constant in relation to the memorial as was possible under fieldwork conditions. The apparent objectivity of the images is further reenforced by the format used; RTI images through being interactive defer many of the activities traditionally reserved for the image maker to the viewer. Although the camera position cannot be altered the viewer can re-compose the lighting and alter the appearance of the object, transforming colour, contrast and surface texture (Fig. 7.7].

However, the images are very far from being reliable surrogates for the objects themselves and they certainly don't provide the viewer with the contextual information which would be available to them if they visited the churchyard themselves. The agency of the image makers (the survey teams assisted by a team of University of York archaeologists including myself) is evident throughout this collection of images, both in terms of the editorial decisions (which memorials are included and which are excluded) but also in terms of how the images were composed (which parts of the memorials are captured). The resulting record is, in common with all archaeological data sets, incomplete and incorporates considerable subjectivity. The images clearly represent the priories of the image makers and researchers and have been driven by the desire to address specific research questions as well as by individual interests and enthusiasms.

This dissonance between the explicit-empirical and the implicit-subjective marks a line between that which is ordinarily recorded (and which frameworks such as the London Charter are designed to describe) and that which is omitted from the formal archaeological record. Mechanically reproduced images have a hybrid character in the sense that they have a tangible, empirical and knowable relationship with the material world but are, having been wielded by human hands, profoundly subjective in acknowledged and unacknowledged ways. The images, taken collectively or as a set, reflect definite attitudes to the

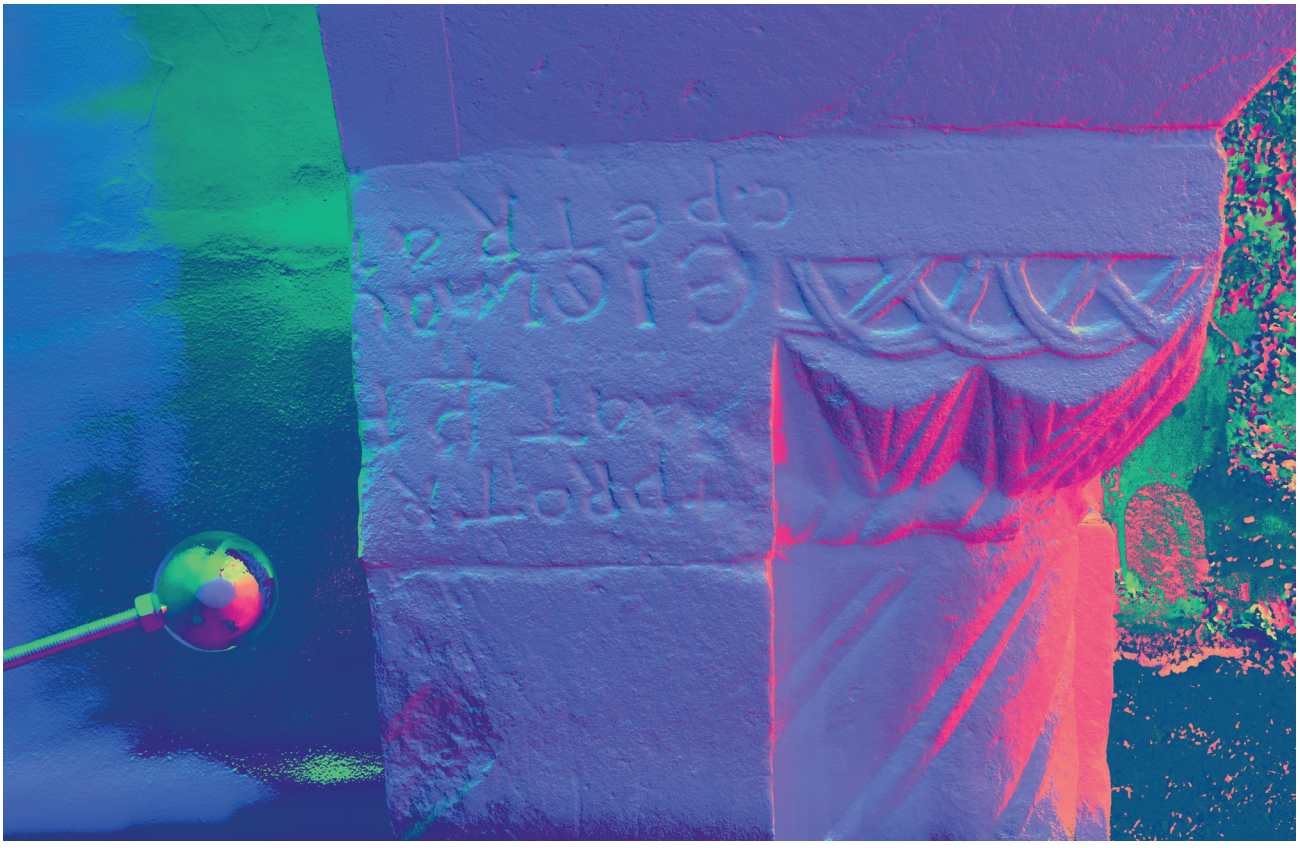


Figure 7.7. *A normal map; one of several imaging modes available easily to the viewer of an RTI file.*

perceived significance of place and the manner by which meanings are located and identified within the environment. Whether we choose to record the graves of well known people, monuments in particular styles or those of particular religious communities reflects deeper under-acknowledged subjectivities which run through the entire research process. Through documenting and recording we reveal our priorities and interests and made statements about what we perceive to be significant about places and the people who have inhabited them.

These difficulties are compounded by the fact that the objective and knowable elements of the relationship between image and subject are often so mathematically complex as to be obscure to any user without a specialism in mathematics or imaging science. Even where these specialisms exist, the ability describe this relationship does not necessarily enable the user to apply this knowledge meaningfully and in real time as they engage with images through a user interface. This black boxing of technology (Huggett 2015) is problematic but does not negate the value of this technology. Techniques such as RTI can be argued to have a performative dimension (Jones & Smith in press). By moving around the subject and by, literally in the case of RTI, shining a light onto an object, the image maker becomes uniquely acquainted with facets and details which may not be apparent to the casual observer or to viewers of resulting images. Thought of in this way the process of image making itself leads to the creation of new knowledge for the image maker. The idea that image making is a productive activity is not new (Bradley 1997) but the idea that scientific imaging techniques can be instrumental in forming new understandings of objects which extend beyond the limits of what would traditionally have been thought of as scientific knowledge has profound implications for future practice and for the role of creativity therein.

Conclusion

In each of these examples it is clear that authenticity cannot be said to reside within the image itself as has often been assumed in discourse around archaeological computer graphics. However accurate an image might be (each of the images described above might be considered to be accurate in different ways) its authenticity is always contingent on the perception of the viewer. Within the context of scientific image making authenticity has often been conflated with or closely aligned to accuracy and the clear and transparent communication of knowledge in visual form. In truth, as has been widely acknowledged in relation to conventional photography (Shanks 1997; Morgan 2015), this apparent transparency masks the inherently subjective character of the digital image and of all images. Shared visual and aesthetic cultures are a pre-requisite for anything approaching unambiguous visual communication and it is under these conditions that specialist forms of image making (resonant of specialist forms of professional language) have developed. As archaeological communities of practice diversify (and aspire to become more inclusive) it is important that we recognize authenticity as a dynamic concept which is to be re-negotiated as required. In order to achieve this is necessary that we nurture and champion emergent forms of visual expression as well as those which are more firmly established.

Any re-negotiation of authenticity must begin with detailed consideration of the image itself. The role of images has frequently been assumed (within the literature of archaeological computer graphics) to relate in some tangible way to the real. Whether 'realism' this is a positive or negative characteristic of the medium has been the subject of much discussion (Gillings 2005). The pervasive idea that computer graphics are (threateningly or promisingly) close to reality has left very little space for the positive discussion of craft, skill or creativity in digital image making. The case studies outlined above describe work in a wide variety of media including the DIY re-use of digital assets (The Basing House Zines), the creation of a single image using 3D computer graphics (the Microlith) and the use of computational photography to document archaeological material (RTI and the Re-Reading the British Memorial project). In each instance the image makers have helped to shape the resulting image through a series of decisions and actions. They have, both consciously and subconsciously, drawn upon a personal store of skills, knowledge and assumptions in order to produce something new. Even where these images might be considered to be fairly unproblematic in their depiction of archaeological material or data, there are subjective elements to the work and elements which remain poorly understood by the image maker and by the audience. In each case these personal responses to the process of image making have helped to enrich the image and have led to the creation of something entirely unique. This lack of uniformity and the presence of discretion and skill in the mediation of the past is redolent of the need, described by Burke (1991), for historical disciplines to experiment with new representational forms in order to meaningfully engage with audiences and to communicate effectively. The presence of an enormous variety of image makers and forms of image making practice within archaeology means that we have a very strong basis upon which to build diverse traditions of archaeological computer graphics.

The purpose of this chapter has been to explore some of the dynamics of digital image making practice as it occurs within archaeology. Practices described all revolve around 3D computer graphics but, as is very often the case, utilize a range of technologies and processes. These depictions of applied digital image making are consciously distinct from the kinds of 'methodological' accounts of image making which have tended to emphasize technological descriptions and formalized notation above the subjective craft of image making. The examples described here all illustrate the reflexive character of the image making process applied interweaving of knowledge and skill. The intention of these descriptions was to show how these processes can sit alongside and exist within academically rigorous image making practice.

Archaeological computer graphics have tended to underplay the importance of image making as a form of archaeological practice and have emphasizing instead the link between images and data. The influence of the image maker has been underplayed within archaeological computing literature despite having an enormous impact on the character of the archaeological image. Metadata and paradata can help us to unpick this process in limited ways but it is not possible to describe, least of all in narrow formal terms, the full breadth and subjectivity which accompanies the production of archaeological visualizations. As Earl (2005) has previously suggested, digital archaeological image making would benefit enormously from engaging in more extensive discussions of style, aesthetics and media and must acknowledge the impact of aesthetic influences communicated through technology and through emerging conventions and formalized styles of digital image making practice. Earl's fears that externally conceived aesthetic forms might crush innovation in digital image making seem not to have been realized but there is a very real risk, as we become an increasingly digital discipline, that in failing to acknowledge our debt to and place within a broader visual and aesthetic culture we might place archaeology's creative traditions at risk.

Acknowledgements

I would like to acknowledge the following people for their support in writing this chapter and for the contribution which they have made to the work described. Peter Driver was the creative force behind the Basing House zines and singlehandedly transformed my perception of the value of visual media for archaeology. Simon Ryder provided a space (physical and intellectual) within which to develop my practice and has since challenged and shaped my thinking with every conversation. Nicole Smith co-produced the images shown in the Microlith and Re-Reading the British Memorial sections and with Jude Jones helped me to discover RTI as a performance.

References

Allen, D. & S. Anderson, 1999. *Basing House, Hampshire: Excavations 1978–1991*, Hampshire Field Club and Archaeological Society.

Beale, G. & N. Beale, 2015. Community-driven approaches to open source archaeological imaging. In *Open Source Archaeology: Ethics and Practice*, eds *A.* Wilson & B. Edwards. Berlin: DE GRUYTER OPEN, 44–63.

Beale, G., Beale, N., Dawson, I., & L. Minkin, 2013. Making digital: Visual approaches to the digital humanities. In *Electronic Visualisation and the Arts, eds* K. Ng, S. McDaid, & A. J. Bowen. BCS, 240–7.

Bentkowska-Kafel, A., Denard, H. & D. Baker, 2012. *Paradata and transparency in virtual heritage*, Ashgate Publishing: Farnham.

Bradley, R., 1997. 'To see is to have seen': Craft traditions in British field archaeology. In *The Cultural Life of Images: Visual Representation in Archaeology*, ed. B. Molyneaux. London: Routledge, 62–72.

Bunnell, K., 2004. Craft and Digital Technology. [keynote paper]. *World Crafts Council 40th Anniversary Conference, 15th General Assembly*, Metsovo, Greece, 2 June 2004. Accessed 5 August 2016: http://www.autonomatic.org.uk/archive/team/kb/craft%20and%20digital%20technology.pdf

Burke, P., 1991. *New Perspectives on Historical Writing.* Cambridge: Polity Press.

Denard, H., 2012. A New Introduction to the London Charter, in *Paradata and Transparency in Virtual Heritage Digital Research in the Arts and Humanities Series*, eds A. Bentkowska-Kafel, D. Baker & H. Denard. Farnham: Ashgate, 57–71.

Department for Culture, Media and Sport, 2016. *The Culture White Paper*, Department for Culture, Media and Sport. Accessed 7 July 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/510798/DCMS_The_Culture_White_Paper__3_.pdf

Duffy, S., Bryan, P., Earl, G., Beale, G., Pagi, H., & E. Kotouala, 2013. *Multi-light Imaging for Heritage Applications*, Historic England. Accessed 30 August 2016, http://historicengland.org.uk/images-books/publications/multi-light-imaging-heritage-applications/.

Earl, G., 2005. Video killed engaging VR? Computer visualizations on the TV screen, in *Envisioning the Past: Archaeology and the ImagE*, eds S. Graeme Earl & S. Moser. Oxford: Blackwell, pp. 204–22.

Earl, G, Beale, G & S. Keay, 2011. Archaeological Computing on the Portus Project, in *Portus and its Hinterland: recent archaeological research*, eds *S.* Keay & L., Paroli, L. London: British School at Rome.

Frankland, T. & G., Earl, 2011. Authority and authenticity in future archaeological visualisation, in *Proceedings of Ads-Vis2011: Making Visible the Invisible: Art,*

Design and Science in Data Visualisation, University of Huddersfield.

Frischer B., Niccolucci F., Ryan N & J. Barceló, 2000. From CVR to CVRO: The past, present, and future of cultural virtual reality. *Virtual Archaeology between Scientific Research and Territorial Marketing: Proceedings of the VAST EuroConference, Arezzo, Italy*, 1–12.

Funk, W., Gross, F. & I. Huber, 2012. Exploring the Empty Plinth The Aesthetics of Authenticity, in *The Aesthetics of Authenticity, eds* W. Funk, F. Groß, & I. Huber. Bielefeld: transcript Verlag.

Gillings, M., 2005. The Real, the Virtually Real, and the Hyperreal: The Role of VR in Archaeology, in *Envisioning the Past*. Oxford: Blackwell Publishing Ltd, 223–39. Accessed 28 June 2017, http://dx.doi.org/10.1002/9780470774830.ch12.

Hodder, I., 2008. Multivocality and Social Archaeology, in *Evaluating Multiple Narratives, eds* J. Habu, C. Fawcett, & J. M. Matsunaga. New York: Springer,196–200.

Holly, M.A., 1996. *Past Looking: Historical Imagination and the Rhetoric of the Image*, Cornell University Press.

Huggett, J., 2015. Challenging digital archaeology. *Open Archaeology*, 1(1), 79–85.

Jeffrey S., Hale A., Jones C., Jones S. & M. Maxwell, 2015, The ACCORD project: Archaeological Community Co-Production of Research Resources. Proceedings of *CAA2014 21st Century Archaeology: Concepts, methods and tools, 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology, Paris, 22.4.2014 – 25.4.2014*, eds F. Giligny, F. Djindjian, L. Costa, P. Moscati, S. Robert. Oxford: Archaeopress, 289–95.

Jones, J. & N. Smith, *in press*. The strange case of Dame Mary May's tomb: The performative value of Reflectance Transformation Imaging and its use in deciphering the visual and biographical evidence of a late 17th century portrait effigy. *Internet Archaeology.*

McIves-Lopes, D., 2009. Drawing in a Social Science: Lithic Illustration. *Perspectives on science: historical, philosophical, social*, 17(1), 5–25. Accessed 30 August 2016, https://muse.jhu.edu/article/259146.

Miller, P. & Richards, J., 1995. The good, the bad, and the downright misleading: archaeological adoption of computer visualization, in *Proceedings of the 22nd CAA Conference*, eds J. Huggett and N. Ryan. Oxford: Tempus Reparatum.

Morgan, C. & J. Winters, 2015. Introduction: Critical Blogging in Archaeology. *Internet Archaeology* 39. Available at: http://intarch.ac.uk/journal/issue39/editorial.html.

Moser, S., 2002. Transforming archaeology through practice: Strategies for collaborative archaeology and the Community Archaeology Project at Quseir, Egypt. *World archaeology*, 34(2), 220–48.

Perry, S. E., 2015. Crafting Knowledge with (Digital) Visual Media in Archaeology, in *Material Evidence: Learning from Archaeological Practice*, eds R. Chapman & A. Wylie. London: Routledge, 189–210.

Shanks, M., 1997. Photography and Archaeology, in *The Cultural Life of Images: Visual Representation in Archaeology*, ed. B. Molyneaux. London: Routledge, 73–104.

Smiles, S., & S. Moser, 2005. *Envisioning the Past: Archaeology and the Image.* Oxford: Blackwell.

Smith, L., 2006. *Uses of Heritage*, London: Routledge.

Smith, H. & R. Dean, 2009. *Practice-led research, research-led practice in the creative arts*, Edinburgh: Edinburgh University Press.

White, H., 1978. *Tropics of Discourse; essays in cultural criticism*, Baltimore: John Hopkins University Press.

Yellowhorn, E., 2015. Just Methods, No Madness: Historical Archaeology on the Piikani First Nation, in *Ethics and Archaeological Praxis. Ethical Archaeologies: The Politics of Social Justice*, eds C. Gnecco & D. Lippert. New York: Springer, 245–56.

Part 4
Uses

Chapter 8

Ektypa and 3D models of Ektypa: the reality(ies) of a digital object

Eleni Bozia

> 'The authenticity of a thing is the essence of all that is transmissible from its beginning, ranging from its substantive duration to its testimony to the history which it has experienced. Since the historical testimony rests on the authenticity, the former, too, is jeopardized by reproduction when substantive duration ceases to matter. And what is really jeopardized when the historical testimony is affected is the authenticity of the object.' (Benjamin 1999)

> 'Beyond the cult of the valuable object…the predominant element in these museums, much more than the object in itself, is the discourse – the logical sequence, the syllogistic chain, the reasoning process which each individual display and the overall script of the exhibition as a whole seek to expound.' (Montaner 1990, 18–21)

The two statements above summarize the controversy regarding authenticity – the traditional viewpoint that authenticity is the property of one and only one object against the counterpoint that there are other parameters, such as experience, representation and the subsequent discourse with an artefact that can redefine its value and authenticity. Similarly, Dutton (Dutton 2003, 258ff.) considers two types of authenticity, nominal and expressive. In the case of historical artefacts there is also the consideration of the authenticity of experience, as described by Phillips (Phillips 1997, 1–4). A comprehensive overview of the matter that should also problematize any attempt to argue in favour of the singularity of authenticity is the NARA document compiled by UNESCO in 1993, establishing quantifiable parameters for the definition of authenticity. The following two articles offer us a framework for the consideration of authenticity, as it will be discussed in this chapter:

> '11. All judgements about values attributed to cultural properties as well as the credibility of related information sources may differ from culture to culture, and even within the same culture. It is thus not possible to base judgements of values and authenticity within fixed criteria. On the contrary, the respect due to all cultures requires that heritage properties must be considered and judged within the cultural contexts to which they belong.'

> '13. Depending on the nature of the cultural heritage, its cultural context, and its evolution through time, authenticity judgments may be linked to the worth of a great variety of sources of information. Aspects of the sources may include form and design, materials and substance, use and function, traditions and techniques, location and setting, and spirit and feeling, and other internal and external factors. The use of these sources permits elaboration of the specific artistic, historic, social, and scientific dimensions of the cultural heritage being examined.'

Here my intention is to discuss the stratification and multifaceted nature of authenticity against the backdrop of authentic copies of inscriptions. More specifically, I examine ektypa (cliché, squeeze, Abklatsch, estampage), which are the paper casts of physical inscriptions, and argue that their existence and usage as mediums of research redefine the traditional appreciations of authenticity. A major issue that surfaces against

the backdrop of the study of ektypa and that will be addressed throughout is the degree of authenticity they afford. Scholars have raised questions such as: 'Can an ektypon rival the original inscription?' 'Does the 3D model of the ektypon bring us closer to the real artefact, or does it simply fake reality?'

The first section relays aspects of and thoughts on authenticity in the literary and archaeological worlds and briefly discusses the idea of authentic copies that the passing of time has legitimized, arguing that authenticity is not only a relative term, but also a relative and acquirable quality for any object. The following section furnishes a discussion focused on ektypa, the authentic paper copies of inscriptions, through the practices of the Digital Epigraphy and Archaeology project, which is an online database for the electronic preservation and dissemination of the 3D models of ektypa and their enhanced automatic analyses. The third section offers a discussion of the levels of authenticity and reality(ies) of an artefact. It will be argued that the nature of the artefact, including considerations of its authenticity, relies on the way it is being utilized. Therefore, it seems that there are other levels of authenticity that presuppose the scholar's appreciation of the non-authenticity (in the traditional definition of the term) of the artefact that is being examined.

Thoughts on authenticity

The word 'authentic' rings heavily in both experts' and non-experts' ears. It can validate and ultimately bestow dignity on a work of art – whether a book, painting, statue or historical artefact – or compromise it. How should one perceive authenticity, though? Even the most basic dictionary lemma furnishes us with an umbrella definition.

> 'authentic: real or genuine; not copied or false; true and accurate; made to be or look just like an original' (Merriam-Webster Dictionary)

Against this backdrop, how are we to interpret the image in Figure 8.1? Medieval copyists for centuries copied manuscripts that would otherwise have been lost forever. Their art relied as much on the precise copying of the text as on the beautification of their *oeuvre d'art*. Each copied manuscript then was an original of its own accord and was in turn consulted and copied. Therefore, the word 'copy' does not necessarily betray fallacy or lack of originality. Additionally, when typography was developed, albeit more prodigious in manuscript preservation, it did bear for a while the stigma of mass technological production. Indeed the personal hand-wrought copy, the product of the artistic sensibilities of each copyist, ceased to exist and gave its place to the more mass-produced typo graphed copy.[1] However, it is this multitude of copies that has safeguarded the very existence of the text. Subsequently these initially condemned copies have become pieces of history. The initial manuscript may have been lost or is inaccessible; however, the text itself has been given eternal life and thus will continue to contribute to literary history. Therefore, when we study a work of art, we need to appreciate that there is multifariousness in its nature. A book, for instance, can be appreciated holistically, or as a text, a product of a certain quality paper and ink, or as the property of an individual or an institution that has a life of his/her/its own.[2] Henceforth, the socio-political, historical and manufacturing attributes of any object can render it an original.

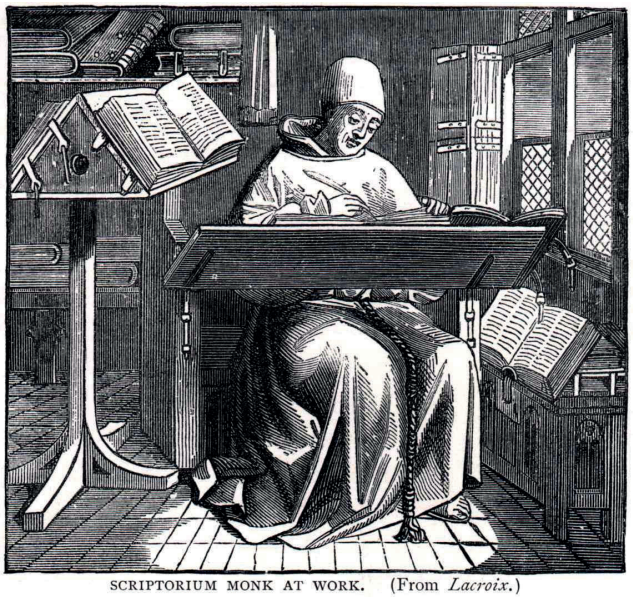

SCRIPTORIUM MONK AT WORK. (From *Lacroix.*)

Figure 8.1. *Scriptorium monk at work. Illustration from 'Pentateuch of Printing with a Chapter on Judges' by William Blades (1891).*

Discussions on and determinations about authenticity in archaeology and epigraphy are considered pertinent to the study and subsequent evaluation of artefacts. The seminal importance of original artefacts is undeniable. Our knowledge of material, architecture, engineering techniques, lifestyle in ancient and medieval communities, socio-political and religious constructions, and ultimately the piecing together of history rely heavily on close examination of original artefacts and building constructions. It cannot be denied, though, that after the initial excavation,

preservation and cataloguing, environmental conditions, or even political discrepancies, render the removal of objects to safer conditions pertinent – preferably within condition controlled museum rooms. This authentic archaeological process deprives everyone not involved in the excavations of experiencing the aura of viewing and appreciating objects in their original findspot. Ultimately, though, their long-term preservation is contingent on this deprivation and lack of authenticity.

Figure 8.2 also prompts us to other courses of thinking. During the nineteenth century, museums favoured the creation of casts of their exhibits. The advantages are obvious, as this approach favours accessibility, education and archaeological training. The Victoria and Albert Museum displays such objects in their Court of Casts.[3] One has to consider that these (in)authentic creations have enhanced the study of antiquity, by training future archaeologists not simply through theory and behind museum glass, but through hands-on experience.[4] We should also note that these casts have an originality of their own; their social history is inextricably interwoven with the human record, independent of the original artefact from which they derive.

Archaeology is also the science of the recreation of the past based on facts and tangible evidence. Flavio

Figure 8.2. *Court of Casts in the Victoria and Albert Museum.*

Biondo, the Italian Renaissance humanist historian who created a guide to the ruins and topography of Ancient Rome in the fifteenth century, now considered an early founder of archaeology, essentially recreated something non-existent. Archaeologists throughout the centuries have been excavating sites that will never return to their original state, essentially manipulating the findspots. Therefore, there is in archaeology an inherent condition of recreation of the authentic.

There are numerous cases of essential reformation and recreations on different levels in order to preserve the 'pristine' condition of what we consider part of the human record. Glasgow cathedral with its imposing gargoyles (some of them reconstructed),[5] the case of the copy of the Nozze di Cana of Venice housed in the Louvre with its unexpected potency,[6] and the cast of Trajan's column in the Victoria and Albert museum that was created in the nineteenth century and that preserves the reliefs in much better state than the original, are testaments to the role of (in)authentic creations in recreating, studying and preserving the past.

Therefore, it seems that authenticity can be bestowed upon an artefact at later points in its life. Historical significance, for instance, usually cannot be claimed during the first lifetime of any object. Additionally, an object does not have a uni-modal nature. An inscription is an artefact as such, but it is also about the text it carries, a part of an archaeological site, a product of a scribe, and of course an historical and/or sociopolitical medium due to the ideas it purveys. Consequently, the changing quality of some of the above may also alter the level of authenticity. More specifically, if an inscription is weathered, then its copies in whatever form are bound to be the more authentic versions of the inscribed text.

Digital epigraphy: a new version of epigraphy or a new-found authenticity

Epigraphy: a collaborative matter

Epigraphy is the discipline tasked with collecting, deciphering, classifying and interpreting inscriptions. They are published in editions and commentaries, with indices and concordances to facilitate the use of the collections of texts, which are usually arranged geographically or by categories of inscription. Because the material is so varied, epigraphic techniques must always be applied in the context of the relevant branch of classical studies, and epigraphy is thus a research field that invokes the entire spectrum of classical studies. For, in every case, epigraphy depends on archaeology and historical topography to evaluate the inscription bearer and its archaeological context; it depends on palaeography to classify and date the script, on philology to reconstruct the text and place it in its literary context, and, according to the particular problems raised, on onomastics, linguistics and so on.

Ektypa are the legitimate paper copies of stone inscriptions. Their treatment is twofold; they are not despised or critiqued, as they are by definition copies, but they are not valorized either. Determinations of their usefulness have been mainly practical. The possibility of making a copy of the inscription that one can study in the future, re-examine and use with students has been the primary benefit. The general appreciation, though, is that an ektypon can never rival the original inscription.

Collections of ektypa provide a unique insight into the study and understanding of Greco-Roman History. The study of this material requires the involvement of a wide variety of specialists, as discussed above. Consequently, accessibility is the only way to actually achieve a profound, meaningful and all-encompassing study of the inscriptions. Furthermore, some ektypa can no longer be manually handled due to their fragility. The only way to facilitate and advance research, therefore, is electronic preservation, dissemination, and study.

On the other hand, most classical disciplines are themselves dependent on the results of basic epigraphic research, as new finds of inscriptions are the only source of significant additions to our corpus of ancient texts. Whole branches of research into the ancient world, such as prosopography or social, economic, administrative, and military history, are based for the most part on epigraphic sources. Where the literary tradition is silent or has come down to us only in fragments or excerpts, as is the case for the history of the third century AD, epigraphic evidence can sometimes fill the gap. Or sometimes an inscription can throw a whole new light on what has been transmitted in literary sources, as has happened through recent finds in Spain (the *Senatus consultum de Cn. Pisone patre* and the *tabula Siarensis*) which offer a contemporary, official version of events to set alongside Tacitus's account of the death of Germanicus and its consequences. Lexicographers too see inscriptional evidence as of equal worth to the language of literature transmitted in manuscripts and often distinguished from it only by the accident of transmission, so it is no surprise that the *Thesaurus Linguae Latinae*, the comprehensive dictionary of the Latin language, relies on epigraphic corpora and new findings.

Why does an ektypon matter?

Epigraphers utilize various documentation techniques to make a copy of their find that will serve as a complete and reliable basis for restoring and editing the text, of which usually only fragments remain. Sometimes,

however, after returning from an epigraphic field trip, the find needs to be re-examined: perhaps the reading, which initially seemed completely obvious, fails to stand up to subsequent scrutiny; perhaps doubt is subsequently cast on a reading previously believed to be absolutely certain. Often it is only then that the unity of fragments is recognized – if, for example, notes made on adjacent fragments are discovered lying next to one another in the folder, while the originals are kept at different locations. A fraction of a dedication may be housed in an epigraphic depot, while the altar itself bearing the rest of the inscription has been set up in the courtyard of a museum.

On occasion, it may be helpful to draw on the aid of a photograph. Yet it is much more beneficial if the epigrapher has ektypa at his/her disposal, for thus, should the occasion arise, ektypa of various fragments can be joined together. Often a reading is impossible until the ektypon itself is at hand. While a paper cliché can be read in appropriate lighting conditions at any time, a photograph only shows the artefact at a particular moment in time and can on occasion distort the appearance of the actual find. The ektypon is indeed even superior to the original in cases where the item bearing the inscription is standing in the shade and cannot be moved on account of its great weight.

Furthermore, one should also consider cases in which the original inscription is now misplaced, lost or destroyed. It is then that the ektypon acquires a new sense of originality, as it is the closest witness to the stone inscription. Researchers are faced with similar situations when the inscription is badly weathered and no longer legible, or when it is significantly more weathered than at the time when the ektypon was created.[7] It is then that we are faced with a different aspect of originality. The inscription itself may lay a claim on authenticity of material and construction. The ektypon, on the other hand, is the one that extends the life of the text and is closer to the original. If the lettering techniques and strokes of the scribe are not visible any longer on the inscription, then the ektypon is even more authentic and can be considered to be the only artefact that actually preserves these types of ancient metadata.

Finally, readings of weathered inscriptions can prove to be challenging and occasionally rely on philological knowledge or even on conjecture and educated assumptions. A term that was coined within this context by Jameson (Jameson 2004), 'democratization of knowledge', can contribute to achieving better readings.[8] Accessibility of the text to a larger number of readers enhances the possibility that the inscribed text will be read correctly. At this point, though, we are assuming open access and dissemination of the ektypa themselves or a level of academic mobility, if one is to visit multiple museums and institutions to lay their hands on the ektypon. The alternative, the photograph, cannot capture the lettering details and the attributes of the scribe.

The Digital Epigraphy and Archaeology Project

The Digital Epigraphy and Archaeology project (DEA)[9] is a novel and technologically advanced scientific tool for the effective study and comparative analysis of Greek and Latin inscriptions. It provides archaeologists and epigraphists with a cost-effective and efficient method for 3D digitization of inscriptions based on ektypa as well as access to an online dynamic library of 3D ektypa. Additionally, the system provides options for enhanced visualizations and further automatic analysis. The project can be accessed at: http://www.digitalepigraphy.org.

The Digital Epigraphy and Archaeology (DEA) Toolbox is a unique initiative in the field of digital epigraphy as it provides the methods to digitize ektypa with minor handling with the use of an office scanner. The Toolbox runs as a web application that focuses on the digitization, 3D visualization, data mining and electronic dissemination of ektypa and other archaeological artefacts. A new technique was developed that automatically creates a 3D model with the use of an office scanner.[10] The tridimensional digitization of ektypa is achieved through the bidirectional scanning of the ektypon using a typical scanner with a moderate 300 or 600 dpi (dots per inch) resolution. The scanned images are then being processed by the algorithm that was developed, which analyses the depicted shading in the images and reconstructs in 3D the original inscription. The advantages of this process are numerous: 1) It does not require any additional expensive equipment. 2) The ektypa can be safely preserved in a digitized form, thus eliminating the possibility of deterioration of the squeezed paper. 3) They can also be distributed electronically, facilitating epigraphic studies. 4) Finally, the digital ektypa can be more effectively visualized compared to 2D images, as they can be viewed from different angles, under different artificial lighting conditions, and in different zooming scales.

An experimental scientific toolbox that performs various levels of post-processing analysis of the digital inscriptions was also designed. Our set of algorithms includes letter segmentation and grouping, calculation of statistics in their shape variation, visualization of the statistics in the forms of dendrograms, and comparison of lettering techniques. These functions can facilitate the identification of letterforms, even in the case of corrupted fragments.

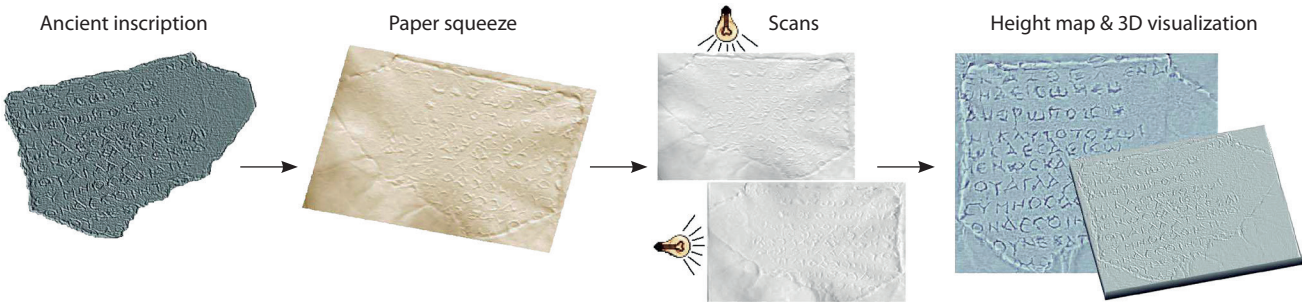


Figure 8.3. *Illustration of the Digital Epigraphy Toolbox's 3D digitization process.*

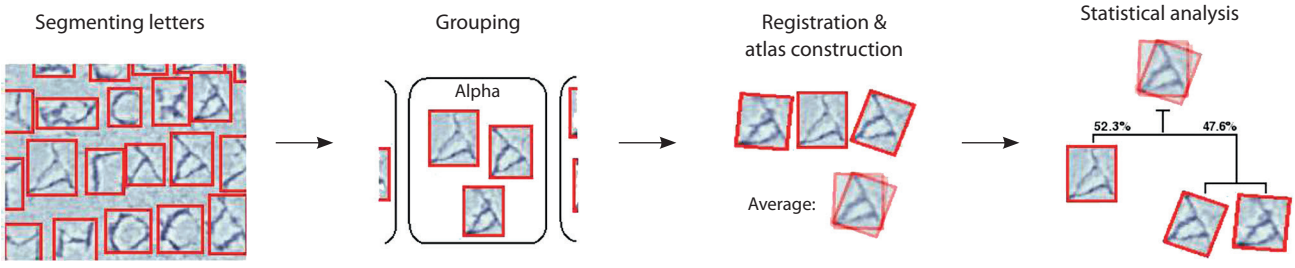


Figure 8.4. *Illustration of the analysis of lettering techniques.*

The Digital Epigraphy Toolbox offers a graphical interface that includes user-friendly options for 3D visualization of inscriptions, 3D navigation, and comparative analysis of letterforms. The user can upload an inscription in various formats, such as scanned images of ektypa, photographs of inscriptions or even 3D object files produced by 3D scanners, laser and depth scanners, etc. He/she then has the option to reconstruct the tridimensional shape of the inscription from images, view, rotate and zoom into the 3D model of the inscription, and apply different virtual lighting conditions. The user also has the option to automatically segment the letters and statistically compare the letterforms in a group of inscribed characters. The variability of letterforms is then plotted as a comprehensible dendrogram. This tool can prove very useful especially in cases where the epigraphist needs to compare and analyse the letterforms of a large group of inscriptions. Finally, the user has the option to save, download and share the digitized inscriptions with the scientific community as well as search through a semi-supervised dynamic library of uploaded inscriptions. This dynamic library is thematically organized according to language, area of origin, date, etc. Each database entry contains a comprehensive record of the inscription in the form of plain text, 3D model, photograph of the original inscription, and other information about the inscription. Figures 8.3 and 8.4 illustrate the main steps of the method.

Copy vs. original: how a copy verifies the original

An ektypon is by definition a copy-imitation of the original. However, its authenticity relies on its preservation of the original form of the physical object. Letter shape, text and other content information are more reliably preserved on an ektypon than in a picture or simply an edited text of the stone inscription.

Furthermore, occasionally the original inscription has been lost, destroyed, or is more weathered than at the time that the ektypon was created. That grants the latter another degree of authenticity, and an issue that surfaces is how to retain this newly modelled authenticity of the ektypon. The most reasonable response to this issue is the development of the 3D models of existing libraries of ektypa, which will contribute to their electronic preservation, accessibility and dissemination to the scholarly community.[11]

A case study is presented below. Cornell University launched an expedition to Asia Minor and the Assyro-Babylonian Orient (1907–1908) that was planned by John Robert Sitlington Sterrett, Professor and Chair of the then Department of Greek at Cornell. He had selected three Cornell alumni to lead it: Albert Ten Eyck Olmstead, Jesse E. Wrench and Benson B. Charles. At the beginning of the expedition, they spent two weeks creating ektypa of the *Res Gestae* of the emperor Augustus inscribed on the walls of the temple of Rome and Augustus in Ancyra (modern

Figure 8.5. *1907 Cornell expedition making an ektypon at Quru Bel, Arslan Tash.*

Ankara, Turkey), the *Monumentum Ancyranum*. Figure 8.5 documents the expedition.[12]

The ektypa travelled back to Cornell and have been housed there ever since. It should be noted that ektypa, albeit made of durable paper, still succumb to environmental conditions, humidity, dryness and tearing (Figs 8.6, 8.7).[13]

Other copies of the *Res Gestae* exist in the form of photographs (Fig. 8.8), a popular and easily manageable form of digital preservation and dissemination. Photographs, however, as discussed above, heavily depend on lighting and the surrounding conditions. Additionally, they do not offer the possibility of accurate measurements, the study of lettering techniques or any similar close study or analysis.

Attempting to find a solution to the aforementioned limitations of those epigraphic media, the DEA offers the 3D model of the ektypa (Fig. 8.9).[14] Parry (Parry 2007, 5881) discusses the initial hesitation to accept the digital object and the juxtaposition between

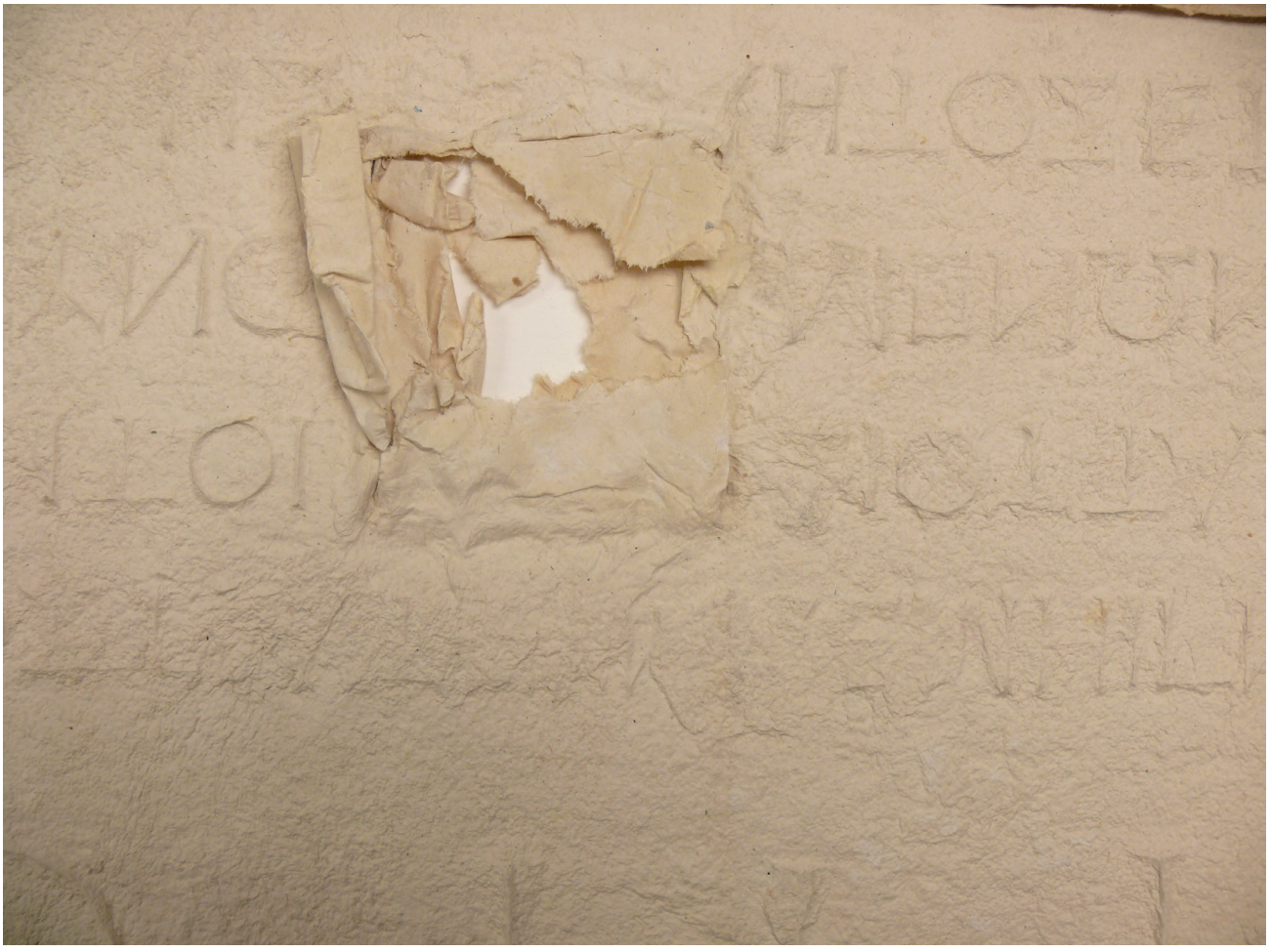


Figure 8.6. *Ektypa of the Res Gestae of the emperor Augustus. Photograph by Cornell University Library.*

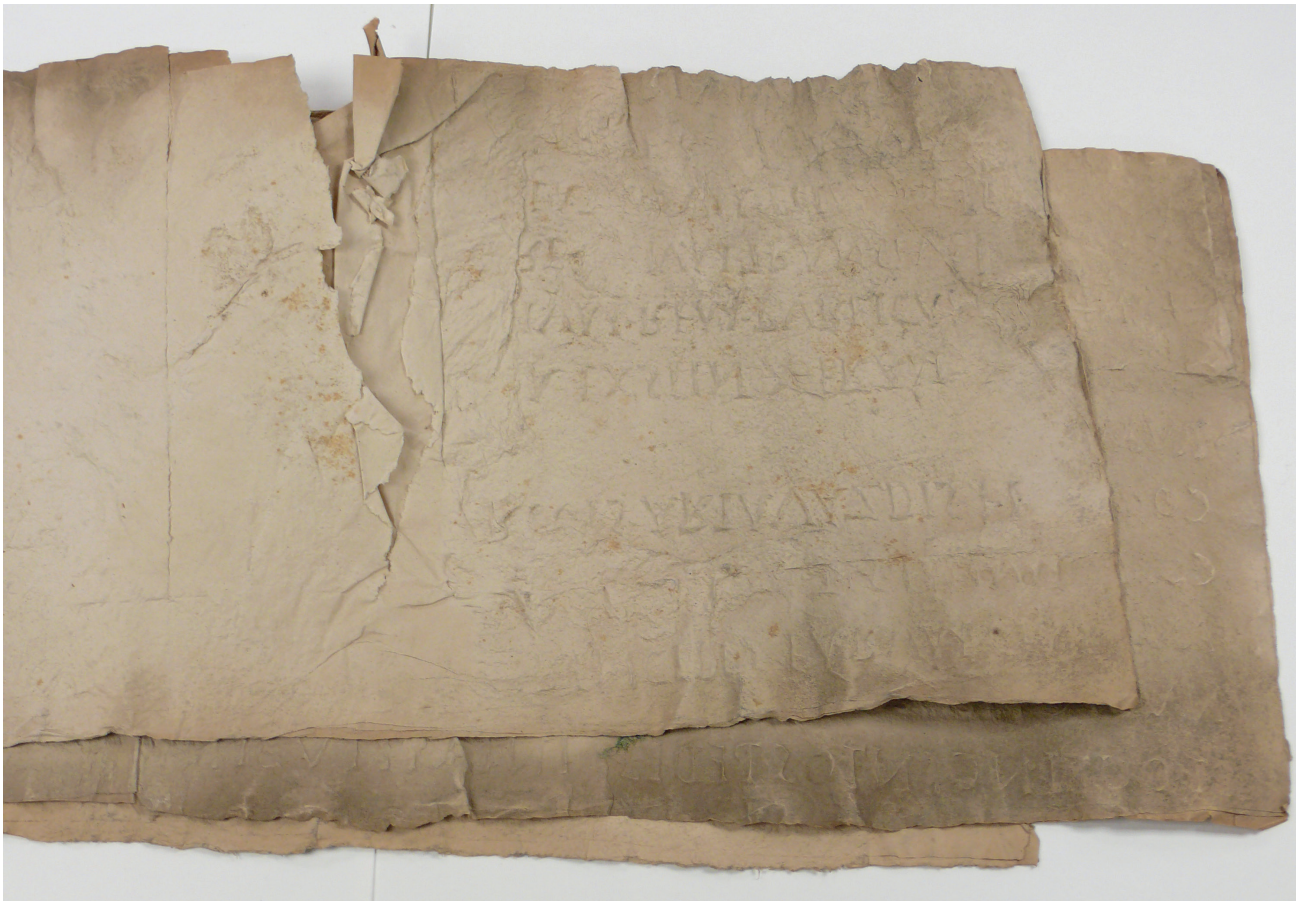


Figure 8.7. *Ektypa of the Res Gestae of the emperor Augustus. Photograph by Cornell University Library.*

'virtual' and 'real'. He does suggest, though, that with the advent of technology it is a matter of 'recalibrating authenticity'.[15]

The DEA project is also working with 3D printing, essentially rematerializing the digital file into a tangible copy of the inscription. Neely and Langer (Neely & Langer 2013) call the process 'a physical embodiment of the engagement'. The 3D-produced inscription does not bear the aura of the original stone one, and obviously lacks the original material. The inscribed text, though, is a more reliable descendant. Therefore, its authenticity should not be brought into question. Also one should not forget the cases of fragmentary inscriptions that have been separated and housed in separate locations. Their online accessibility in 3D can significantly assist in identification and immediate comparison of letterforms and lettering techniques. Neely and Langer (Neely & Langer 2013) make the case of re-materialization of the web in the form of 3D printing. Sloan (Sloan 2012) coined the phrase 'flip-flop' to verbalize the physical existence-digital existence-physical existence cycle.

It should be noted at this point that museums and institutions that house historical artefacts have always been the purveyors *par excellence* of knowledge, physicality and originality. Eitner (Eitner 1975, 78) states that: 'quality resides in the object'. Macdonald (Macdonald 1998, 11) validates objects as 'instantiation of scientific and political certainty'. The preponderance of museums, the originality of their nature, the aura of centuries, lives and civilizations that they bear is undeniable. However, how are newly moulded 3D models to be treated? Do they pose a threat to museum objects? Apocalyptic opinions were of course inevitable (James 1995; Saumarez-Smith 2000). I, in turn, contend that we are dealing with new authentic descendants-representations of the primary artefact that can fulfil different potentials. First, there is not an issue of originality, as we talk about authentic copies. There is not an issue of misplacement and out of historical context consideration, as the objects housed in museums have already been relocated and thus removed from their original historical and archaeological context. The 3D models are new objects that can assist more people

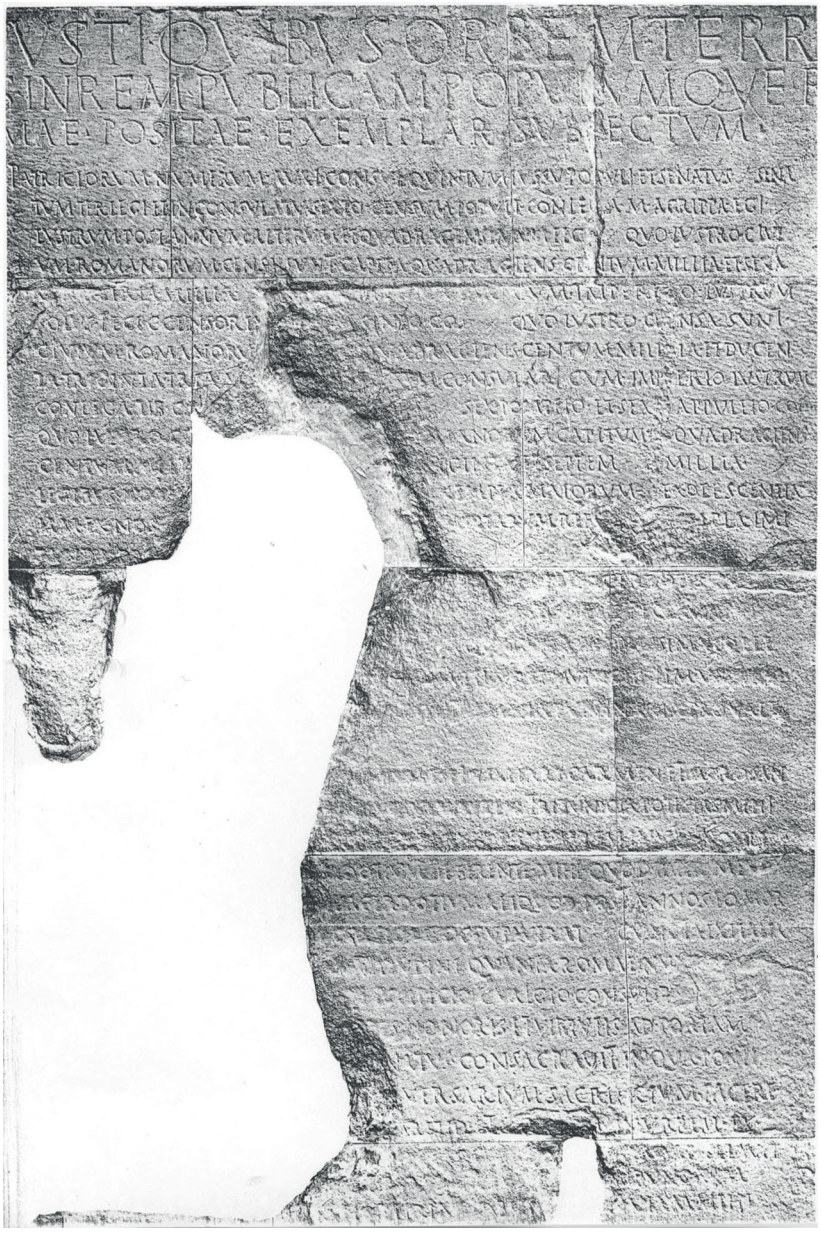


Figure 8.8. *Photograph of the Res Gestae inscribed on the Monumentum Ancyranum, Ankara, Turkey, 1883. Res gestae Divi Augusti: acc. Tab 11 / ex monumentis Ancyrano et Apolloniensi iterum edidit Th. Mommsen Ref CIL 03, p. 774.*

in realizing the authenticity of the originals, as they afford accessibility that may lead to closer study and scrutiny of details, physical contact that is otherwise prohibitive, and the ability to provide new experiences to people – experiences that will also be inextricably connected to the one original primary object. It is not a matter of physicality any longer or of authenticity, it is a matter of revitalizing the life of *the* artefact via the copious new models.[16]

Another aspect of 3D models that is criticized is the obfuscation and adulterated nature of the authenticity of experience. According to the critics, when an artefact is taken out of its natural environment, it is being deprived of its nature and intrinsic value. Benjamin (Benjamin 1999), in his famous essay, claims that: 'Even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be.' While this thesis is valid, one needs to consider that not all historical artefacts that are studied are located in their original find spot. *Au contraire*, more often than not, environmental conditions, natural catastrophes, shifts in the political landscapes as well as the simple need for restoration and preservation lead experts to transfer artefacts to museums and condition-controlled places. In the case of the ektypa, it is important to try to contextualize the artefact with respect to the inscription, the inscription bearer and

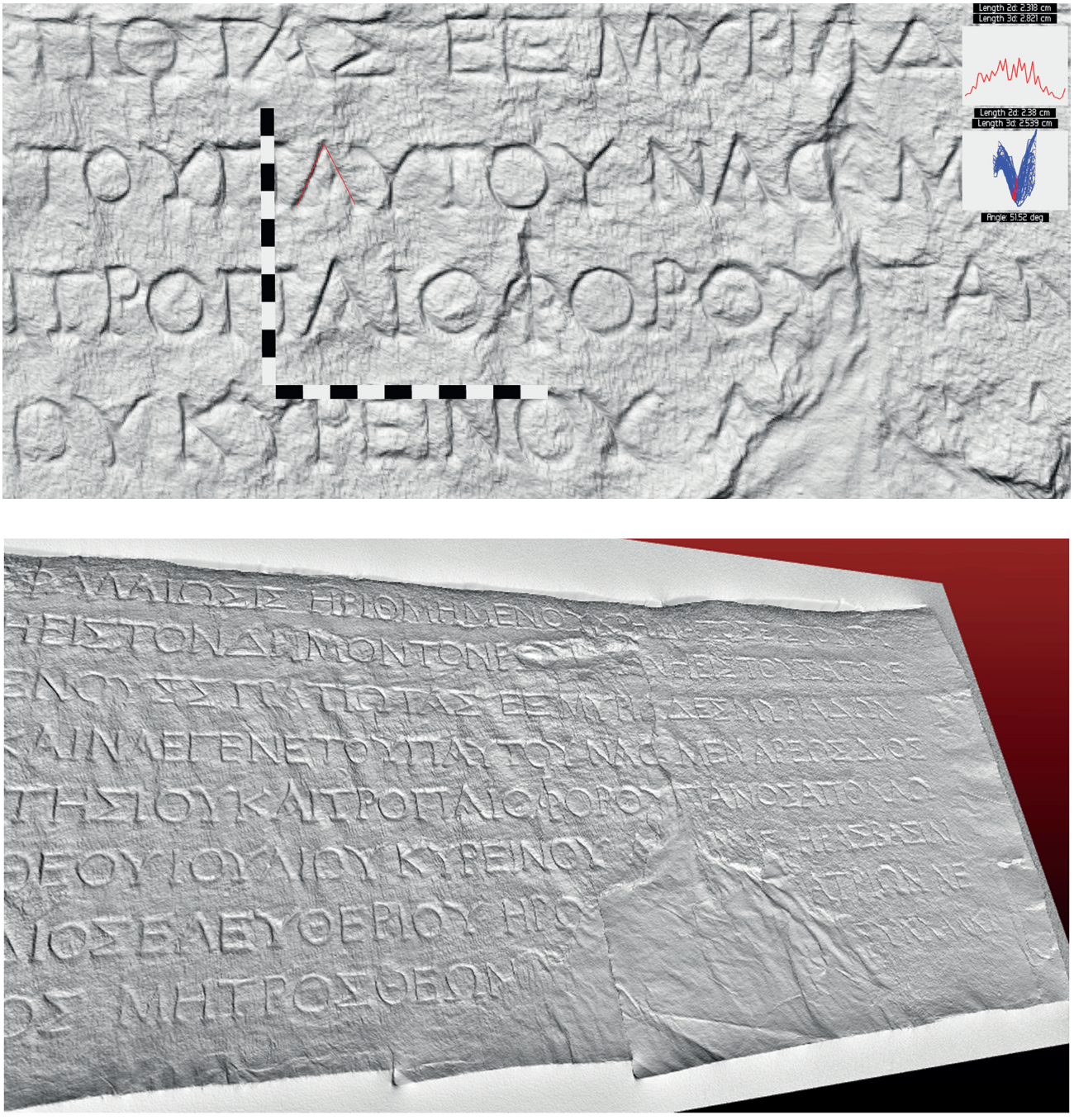


Figure 8.9. *Res Gestae of the emperor Augustus: 3D model of the Ektypa.*

the site where it was located, and then employ the 3D model to minimize the distance from the physical object.[17] An option in the DEA is to visualize the 3D ektypon with the original ektypon surface (see Fig. 8.10).[18] Furthermore, the metadata are meant to be an all-encompassing record of the artefact, and the system also allows for other additions, such as images of the monuments, 3D digitizations of the monument as well as the inscription bearer and in general everything that could render a digital archive the source of the afterlife of each artefact. The *Res Gestae* constitutes an interesting case study for another reason: the only other surviving copy of this work existed on the bronze pillars crowning the Mausoleum of Augustus. However, they have long been lost. The other surviving inscriptions of the text are not complete.[19]

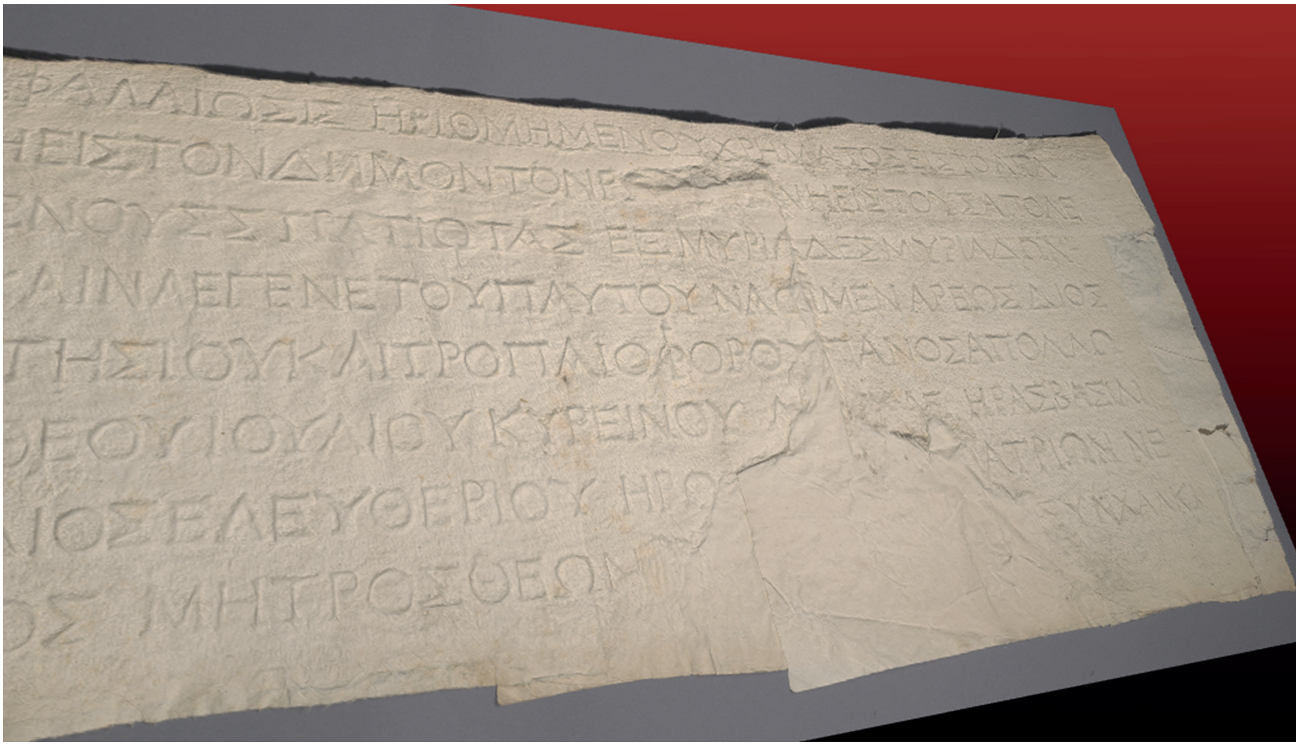


Figure 8.10. *Visualization of the 3D ektypon with the original ektypon surface.*

Through my analysis it becomes apparent that in the case of inscriptions, we should consider that we are dealing with a multi-levelled authenticity. First the authenticity of the object is twofold – one that relates to the stone itself and another to the text. Moreover, the age of the artefacts that results in their fragility, destruction, loss and inaccessibility bestows upon the digital copies and 3D-digitized and 3D-printed objects a new aura of authenticity. Wilkinson (Wilkinson 2012) suggests that 'the difference between "make-and-take" and "makerspace" is the variety in the end product, and the ownership over the full process that the maker feels.' We should not perceive this to be an intrusion on or vitiation of authenticity. As a matter of fact, we should appreciate it as a more authentic cognitive experience, as the 3D digital existence involves scanning and physical contact along with the concept of creation that is prevalent in the 3D printing process.[20] Britton (Britton 2012) commented that libraries tend to be the maker spaces that: 'foster play and exploration, facilitate informal learning opportunities, nurture peer-to-peer training, work with community members as true partners, not as users or patrons, develop a culture of creating as opposed to consuming.' This statement validates the assumption that 3D digitization actually authenticates the learning process and produces a more original experience for the participant. It is the process of re-appropriating authenticity, appreciating the original artefact, preserving digitally as many of its qualities and information as possible, and enhancing our understanding of the object by being permitted to re-examine it via different media and processes.[21] This re-appreciated authenticity abides by the constructivist approach in Western philosophical culture that argues in favour of authenticity as cultural construct and suggests that replicas can have authentic qualities.[22]

The value of artefacts, monuments and knowledge itself is established against the backdrop of their social appreciation and standing. Archaeology is the study of the human record, but it also relies heavily on the human factor being preserved. The more authentic part of the edification process is the ability to have contact with the object of your study. Digitization, 3D printing and virtual reality that allows for virtual reconstructions of ancient sites do not simply reignite the public's interest, but also give every new generation the opportunity to develop personal connections with the artefacts, contribute to their study and understanding, and henceforth to their preservation. As a matter of fact, Dutton (Dutton 2003) suggests that authenticity relies heavily on the audience's perception and appreciation. Their educated and conscious reception and consideration is a seminal factor towards bestowing

authenticity on any product. Trant and Wyman (Trant & Wyman 2006) argue that: 'Built on the constructivist educational theory that emphasize personal meaning-making and a user-centred focus in the development of on-line and in-gallery experiences, these projects (3D printing) strive to provide a unique and compelling engagement with works of art.'[23] Niyazi (Niyazi 2013) suggests that giving people the option to have a hands-on experience with the artefacts may lead to new amalgamated yet fresh creations molded through different peoples' diverse experiences and breath new life to an artefact.[24]

Conclusion

This chapter has explored the multi-levelled nature of authenticity. Living in the era of 3D digitization and printing, hence of recreation and different representations of artefacts, we need to reconsider authenticity and originality. Objects acquire new afterlives that subsequently grant them eternity. Accessibility also contributes to making them part of multiple lives in different countries and under different conditions, hence rendering them intrinsic parts of cultures to which they would otherwise have been foreign. Therefore, it should come as no surprise that even the authenticity of experience is more variegated.

This chapter discussed as proof of concept the Digital Epigraphy and Archaeology project that promotes the multi-modal nature of historical artefacts through their 3D digitization, analysis and preservation. 3D models of ektypa furnish the realities of an inscription, as they provide scholars with advantageous access to the text of the inscription, thus facilitating and promoting research. 3D models of the ektypa, especially in case of lost, fragmentary or severely weathered inscriptions, constitute the only survivor of the original text and the sole possibility to join fragments of texts through automatic textual analysis. Consequently, I contend that 3D representations of ektypa consider other existential realities of inscriptions and stimulate their examination as textual entities without being reductive to the inscription itself.

Notes

1 Along these very lines of prolificity, see Schwarzt (Schwarzt 1996) and Boon (Boon 2010). Boon discusses the fundamental human need for copying. Both authors appreciate the multitude of copies to social cornucopia.
2 Rothenberg (Rothenberg 2000) explores aspects of authenticity – its broad sense, and multifarious nature. He stresses that 'the meaningful preservation of any information entity is ultimately defined in terms of which of its attributes can and must be preserved to ensure that it will fulfill its future use, whether originally intended, subsequently expected, or unanticipated.'
3 On replicas and their quality, as well as authenticity as established through socio-cultural circumstances, see Foster and Curtis (Foster & Curtis 2016)
4 Hein (Hein 2000), the museum philosopher, discusses at length the inevitable shifts in museums that prioritize the public's experiences.
5 Jones and Yarrow (Jones & Yarrow 2013) discuss conservation, socio-cultural practices, and influences on authenticity against the backdrop of the Glasgow Cathedral.
6 A valuable accompaniment for our appreciation of the particular case of the Nozze di Cana and the aura of facsimiles is presented by Latour and Lowe (Latour & Lowe 2011).
7 On a larger scale the Georgia O'Keeffe museum launched a project to recreate the O'Keeffe home in the form of 3D models so as to document any changes in its condition.
8 On democratization, see also Neely & Langer 2013.
9 The *Digital Epigraphy Toolbox* is part of the Digital Epigraphy and Archaeology Project [DEA], an interdisciplinary initiative by researchers from the Digital Worlds Institute and the Department of Classics at the University of Florida. Its Advisory Board includes scholars from both the United States and Europe. The goal of the DEA is to develop new open-access scientific tools and apply concepts from digital and interactive media and computer science to the Humanities.
10 For details on the methodology, see Barmpoutis (Barmpoutis et al. 2010)
11 See Barmpoutis (Barmpoutis & Bozia 2016)
12 See Charles 1911, 32
13 I would like to thank Cornell University Library for granting me permission to use the images.
14 Lynch (Lynch 2000) furnishes a detailed discussion of the authenticity of digital objects.
15 Jones (Jones 2010) elaborates on authenticity as determined by a network of people, places, and objects accompanied by a case study of the Hilton of Cadboll.
16 Conn (Conn 2010, 20–57) discusses the shift in the focus of museums and the revised nature of the previously object-oriented museums.
17 Jeffrey and Jones (Jeffrey & Jones 2016) discuss the ACCORD project that focuses on 3D reproduction of objects of historic heritage of Scotland. Although they admit that the 3D objects 'include the absence of touch…the absence of experiential dimensions such as weather, sound…', they note that 'nevertheless, complex and dynamic relationships are set up between heritage objects and their digital replicas…'
18 See Barmpoutis (Barmpoutis et al. 2014)
19 Shipley (Shipley 1924, 333)
20 On cognitive development, see Cohen (Cohen 1983). The results can be found on the Georgia O'Keeffe Museum Imaging Project blog (http://www.gokmconservation.org/resources/blog/) (visited 19 August 2016).
21 Jeffrey (Jeffrey 2015) as well as Latour and Lowe (Latour & Lowe 2011) suggest that part of the aura of the original

artefact can be transferred to its reproduction, crediting a large portion of responsibility to the quality of the latter. However, I believe that the aura or even the quality of the reproduction need to be judged on individual basis against the backdrop of the intentionality of each object-reproduction.

22 Jones 2010; Hall 2006; Holtorf 2015; Holtorf & Schadla-Hall 1999; Lowenthal 1992; Pye 2001.

23 See also Museum: A Culture of Copies on http://www.hf.uio.no/ikos/english/research/projects/a-culture-of-copies/ Published Jun 27, 2013 12:27 PM – Last modified Nov 13, 2015 06:53 PM (accessed 19 August 2016).

24 Jeffrey and Jones (Jeffrey & Jones 2016) also make the case that '3D printing creates a further element of complexity as the digital object "migrates" back into the material world. In this case, we can see an analogue-digital-analogue cycle at work, in which some original forms of authenticity are lost, but new ones are created through the production process.'

References

Barmpoutis, A., Bozia, E., & R.S. Wagman, 2010. A novel framework for 3D reconstruction and analysis of ancient inscriptions. *Journal of Machine Vision and Applications* 21(6), 989–98.

Barmpoutis, A., Bozia, E., & R.S. Wagman, 2014. Open-Access Epigraphy: Electronic Dissemination of 3D digitized Archaeological Material. In *Proceedings of the International Conference on Information Technologies for Epigraphy and Digital Cultural Heritage in the Ancient World* (EAGLE 2014), Roma: Sapienza Università Editrice 29–30 September and 1 October 2014, 421–35.

Barmpoutis, A. & E. Bozia, 2016. Augmenting the workspace of epigraphists: An interaction design study. In Proceedings of the International Conference on Digital and Traditional Epigraphy in Context (EAGLE 2016), Sapienza Università Editrice 27–29 January 2016 (forthcoming)

Benjamin, W., 1999. The Work of Art in the Age of Mechanical Reproduction, in *Illuminations*, ed. H. Arendt. London: Pimlico.

Blades, W. 1891. The Pentateuch of Printing with a Chapter on Judges. Chicago: A.C. McClurg and Company.

Boon, M., 2010. *In Praise of Copying*. Cambridge, MA: Harvard University Press.

Britton, L., 2012. The makings of maker spaces, part 1: Space for creation, not just consumption. *The Digital Shift*. 1 October 2012. Accessed 21 August 2016: http://www.thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-1-space-for-creation-not-just-consumption.

Charles, B.B., 1911. Travels and Studies in the Nearer East by A.T. Olmstead, B.B. Charles, J.E. Wrench. Volume 1, Part 2 Hittite Inscriptions. Ithaca, NY: Cornell University Press.

Cohen, H. G.,1983. A comparison of the effect of two types of student behavior with manipulatives on the development of projective spatial structures. *Journal of Research in Science Teaching* 20(9), 875–83.

Conn, S., 2010. *Do Museums Still Need Objects?* Philadelphia: University of Pennsylvania Press.

Dutton, D., 2003. Authenticity in Art, in *The Oxford Handbook of Aesthetics*, ed. L. Jerrold. New York: Oxford University Press, 258–74.

Eitner, L., 1975. Art History and the Sense of Quality. Art International 19, 75–80.

Foster, S.M. & N. Curtis, 2016. The Thing about Replicas – Why Historic Replicas Matter. *European Journal of Archaeology* 19(1), 122–48.

Hall, M., 2006. The Reappearance of the Authentic, in *Museum Frictions*, eds I. Karp, C.A. Kratz, L. Szwaja, & T. Ybarra-Frausto. Durham, NC: Duke University Press, 70–101.

Hein, H.S., 2000. *The Museum in Transition*. Washington: Smithsonian Institution Press.

Holtorf, C., 2005. *From Stonehenge to Las Vegas: Archaeology as Popular Culture*. Walnut Creek, CA: Altamira Press.

Holtorf, C. & T. Schadla-Hall, 1999. Age as Artefact: On Archaeological Authenticity. *European Journal of Archaeology* 2(2), 229–47.

James, B., 1995. The Age of the Museum is here, even virtually. *International Herald Tribune*, 14 August 1995.

Jameson, M., 2004. Promises and Challenges of Digital Libraries and Document Image Analysis: a Humanist's Perspective. *Proceedings of the First International Workshop on Document Image Analysis for Libraries* (DIAL'04), 54–63.

Jeffrey, S., 2015. Challenging Heritage Visualization: Beauty, Aura and Democratization. *Open Archaeology 1*, 144–52.

Jeffrey, S. & S. Jones, 29 January 2016. Accessed 8 August 2016: http://savageminds.org/2016/01/29/materialdigital-authenticity-thoughts-on-digital-3d-models-and-their-material-counterparts/.

Jones, S., 2010. Negotiating Authentic Objects and Authentic Selves. *Journal of Material Culture* 15(2), 181–203.

Jones, S. & T. Yarrow, 2013. Crafting Authenticity: An Ethnography of Conservation Practice. *Journal of Material Culture*18(1), 3–26.

Latour, B. & A. Lowe, 2011. The Migration of the Aura, or How to Explore the Original through Its Facsimiles, in *Switching Codes*, eds T. Bartscherer & R. Coover. Chicago: The University of Chicago Press.

Lowenthal, D., 1992. Authenticity? The dogma of self-delusion, in *Why Fakes Matter*, ed. M. Jones. London, UK: British Museum Press, 184–92.

Lynch, C., 2000. Authenticity and Integrity in the Digital Environment, in *Authenticity in a Digital Environment*, ed. A. Smith. Washington, DC: Council of Libraries and Information Resources, 32–50.

Macdonald, S., 1998. Exhibitions of Power and Powers of Exhibition, in *The Politics of Display: museums, science, culture*, ed. S. Macdonald. London: Routledge.

Montaner, J.M., 1990. *New Museums*. London: Architecture and Technology Press.

Neely, L., & M. Langer, 2013. Please Feel the Museum: The Emergence of 3D Printing and Scanning. In *Museums and the Web 2013*, eds N. Proctor & R. Cherry. Silver Spring, MD: Museums and the Web.

Niyazi, H., 2013. Alteration and invention – Raphael, Vermeer and the mashup. *Three Pipe Problem*. 24 January

2013. Accessed 16 August 2016. http://www.3pipe.net/2013/01/Vermeer-mashup-girl-with-camera.html
Parry, R., 2007. *Recoding the Museum*. London: Routledge.
Phillips, D., 1997. *Exhibiting Authenticity*. Manchester: Manchester University Press.
Pye, E., 2001. *Caring for the Past*. London: James and James.
Rothenberg, J., 2000. Preserving Authentic Digital Information, in *Authenticity in a Digital Environment*, ed. A. Smith. Washington, DC: Council of Libraries and Information Resources, 51–68.
Saumarez-Smith, C., 2000. What the Future Holds for the Past. *The Daily Telegraph*, 16 December 2000.
Schwartz, H., 1996. *The Culture of the Copy*. New York: Zone Books.
Sloan, R., 2012. Dance the flip-flop. *Hi: I'm Robin Sloan, a writer × media inventor in California*. March. Accessed 21 August 2016. http://www.robinsloan.com/note/flip-flop/.
Trant, J., & B. Wyman, 2006. Investigating social tagging and folksonomy in art museums with steve.museum. Accessed 15 August 2016. http://www.ra.ethz.ch/cdstore/www2006/www.rawsugar.com/www2006/4.pdf.
Velleius Paterculus, 1924. *Compendium of Roman History. Res Gestae Divi Augusti.* Translated by Frederick W. Shipley. Loeb Classical Library 152. Cambridge, MA: Harvard University Press.
Wilkinson, K., 2012. Quote from 'What's the point of a museum makerspace?' panel. Seattle, WA: 2012 Museum Computer Network Conference.

Chapter 9

Theorizing authenticity – practising reality: the 3D replica of the Kazaphani boat

Nicola Amico, Paola Ronzino, Valentina Vassallo, Nicoletta Miltiadous, Sorin Hermon and Franco Niccolucci

3D printing is considered the new revolution in the field of cultural heritage and archaeology, contributing to the definition of new horizons in the conservation and communication sector (Foster & Curtis 2016; Alemanno et al. 2014; Scopigno et al. 2014; Tucci & Bonora 2011). 3D physical replicas may replace original objects that cannot be moved, because of their value, or that are inaccessible, or not available, due to their conservation state or fragility, or because they are considered valid substitutes for lost museum artefacts.

Much has been written about authenticity. Concepts associated with authenticity such as truthfulness and integrity are discussed in the definition of the word given in the last version of the World Heritage Operational Guidelines published in 2015 (UNESCO 2015).

Furthermore, according to Adam (Adam 2010), the term authenticity has different definitions depending on the context of its use. If the term 'authentic' is used to define something original and unique, the authenticity of digital objects or their physical replicas, generated from a real object, cannot be applied because 'all digital object are copies' (Lynch 2000) and infinitely replicable and modifiable. In this case, the term 'faithful' seems to fit better. It can mean being original, but also being faithful to an original; it can mean accurate, with known provenance (Cullen et al. 2000).

The concept of authenticity in DH is often related to provenance (as widely discussed by Hermon and Niccolucci in Chapter 1), completeness, integrity, accuracy and context (Lynch 2000). These aspects are endorsed by various scholars (Amico et al. 2013; Damnjanovic, Hermon & Iannone 2013; Ronzino, Niccolucci & Hermon 2012; Niccolucci et al. 2010; Koller, Frischer & Humphreys 2009; Beacham, Denard & Niccolucci 2006) who address the importance of scientifically authenticated 3D data, by adopting effective metadata structures, to ensure long-term preservation and data interoperability.

The importance of documenting the digital provenance of data is largely a matter of intellectual transparency (Beacham, Denard & Niccolucci 2006); there is a chain of events and elements (including activities, actors, devices, parameters, contextual information, and so forth) that connects the 3D digital or physical replica to the real object (Amico et al. 2013). By preserving the integrity and the transparency of the chain of activities involved in the creation of the 3D digital or physical reproduction, we can ensure its authenticity.

As far as the authenticity discourse is concerned, how are replicas conceived? What does an observer looking at a 3D digital or physical replica perceive? These questions arose from our observations by applying 3D acquisition and 3D printing to a case study.

In the next section, we will describe the recreation of the so-called 'Kazaphani boat', a Late Bronze Age pottery artefact found in Cyprus and permanently exhibited at the Cyprus Museum. Recently, the boat was chosen to be part of a travelling exhibition hosted at the National Museum of Natural History, Smithsonian Institute, USA, but due to its fragility, it was decided that the artefact could not be moved.

In describing in detail the chain of activities involved in the production of the 3D physical replica of the Kazaphani model boat, we attempt to demonstrate how the 3D technologies can contribute to the work of conservators in understanding, analysing and interpreting the tangible heritage, and engage the public in an experience that, due to logistical issues, was not previously possible.

Size, shape, colours, surface markings, even evidence of the past damage and previous restorations were recorded. Then, an accurate physical replica of the boat was created with a 3D powder printer.

Besides the opportunity to show the replica in a travelling exhibition, the digital and physical reproduction enabled conservators to interact and analyse the replicated boat in detail, preventing any damage to the original.

The lessons learned through the case study in question, which involves not only the application of 3D technologies and the replica-making process, but also community engagement, will enable us to discuss the limits and the strengths of 3D replicas in archaeology, re-focusing the concept of authenticity by defining a new 'augmented authenticity'.

The 3D replica of the Kazaphani boat.
A case study of a fragile archaeological artefact

The Kazaphani model boat was found in a tomb in the locality of *Ayios Andronikos* in the village of Kazaphani, Kyrenia District, Cyprus. It is a clay model of a ship, the hull of which is canoe-shaped, deep and hollow, dating to the Late Bronze Age in Cyprus (between 1550 and 1200 BC). It is made of reddish clay and it is not decorated. The dimensions of the Kazaphani model boat are: length 45 cm, beam amidships 20.5 cm, height amidships 15 cm (Nicolaou & Nicolaou 1989; Karageorghis 2002; Pilides & Papadimitriou 2012). The model boat (inv. no. Kazaphani Tomb 2B/249+377) is currently on display at the Cyprus Museum in Nicosia. In 2010, the Kazaphani model boat was chosen to be part of a travelling exhibition titled 'Cyprus: Crossroads of Civilizations', which was on display at the National Museum of Natural History, Smithsonian Institute, USA, between October 2010 and April 2011 (Hadjisavvas 2010).

The model boat was in a fragile condition and was not intact, having been reassembled in a previous conservation effort. The surface was worn in some areas, mostly from flaking. The adhesive used in the initial conservation needed replacement to ensure the stability of the object. A number of minor and major scratches were visible on the boat's surface. Some old residues of silicon rubber were also visible from a previous casting process.

The conservators in charge, after examining the object and evaluating its fragile condition, recommended that a replica of the original be sent to the exhibition so as to avoid the risk of damage during transportation to the USA.

For many years, the Casting Laboratory at the Cyprus Museum had been replicating a variety of archaeological artefacts, such as small statues, heads, tools, etc., using the traditional silicon rubber method for creating a mould that is a 'negative' impression of the original. Incidentally, a cast is a 'positive' replica made from the mould, which has the exact shape and dimensions, surface markings, details and evidence of the original object. Casts are made of plaster of Paris (casting plaster) or polyester resin.

However, due to the fragile state of the model boat, coupled with the overhung and undercut parts of its interior, which would make the process of casting

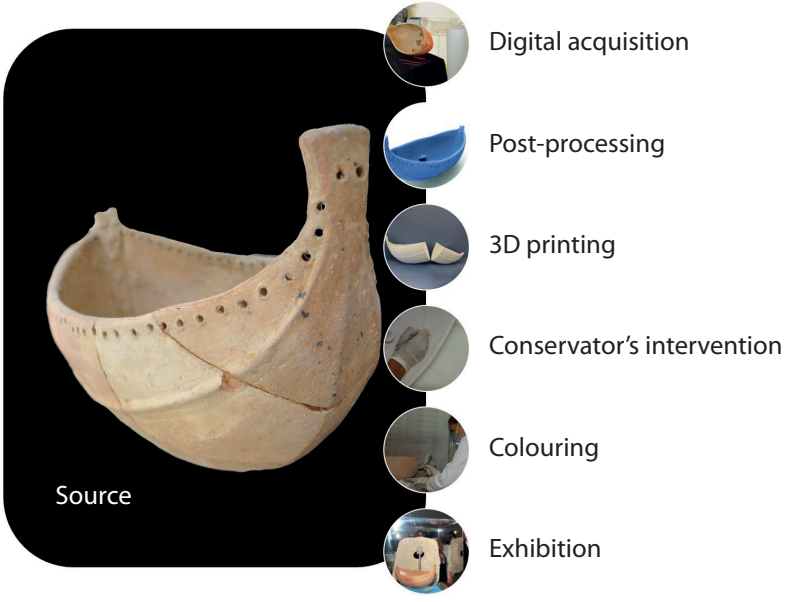


Figure 9.1. *From the real artefact to the 3D physical replica.*

Figure 9.2. *The 3D scanning of the Kazaphani model boat.*

more difficult and dangerous for the integrity of the object, the conservators decided to avoid using the traditional silicon rubber method of casting.

Given the difficulties, a proposal was put forward for collaboration between three institutions for the creation of a 3D replica of the model boat: the Cyprus Institute – STARC, the Department of Architecture at the University of Cyprus, and the Department of Antiquities Cyprus.

A pipeline was developed for the project. The workflow consisted of the 3D scanning phase; the post-processing of the digital data acquired and the final creation of the 3D model; the phase of rapid prototyping; the testing of the glue, stabilizers and colours to be used; the 3D printing of the replica; and, finally, the colouring of the replica. Figure 9.1 provides an overview of the entire process.

Creating the 3D digital model

A campaign of 3D data acquisition was planned to create an accurate digital replica of the artwork with the aim of making a physical replica to substitute the real object.

The original object was carefully scanned using a NextEngine laser scanner (Fig. 9.2), a low cost portable laser scanner that allows digital acquisition of small and medium objects. Beyond the digital acquisition of the object geometry, this laser scanner has an integrated camera that is able to record the texture of the object as well. However, the quality of the integrated camera was not good enough for the expected results; therefore, it was decided to integrate the results of the laser scanner with another technique.

The object was digitally acquired through a photogrammetric technique using ARC3D, a free online service.[1] Through a photographic campaign of high resolution images, a model with an accurate texture was created. After the digital acquisition phase, the data were post-processed in Meshlab[2] and a 3D model was created (Fig. 9.3). The results of the two digital acquisition campaigns have been successfully integrated and the model has been texturized. This created an accurate 3D digital copy of the boat, which reproduced the size, shape, colours, surface markings, and evidence of the past damage and the previous restoration of the real artefact.

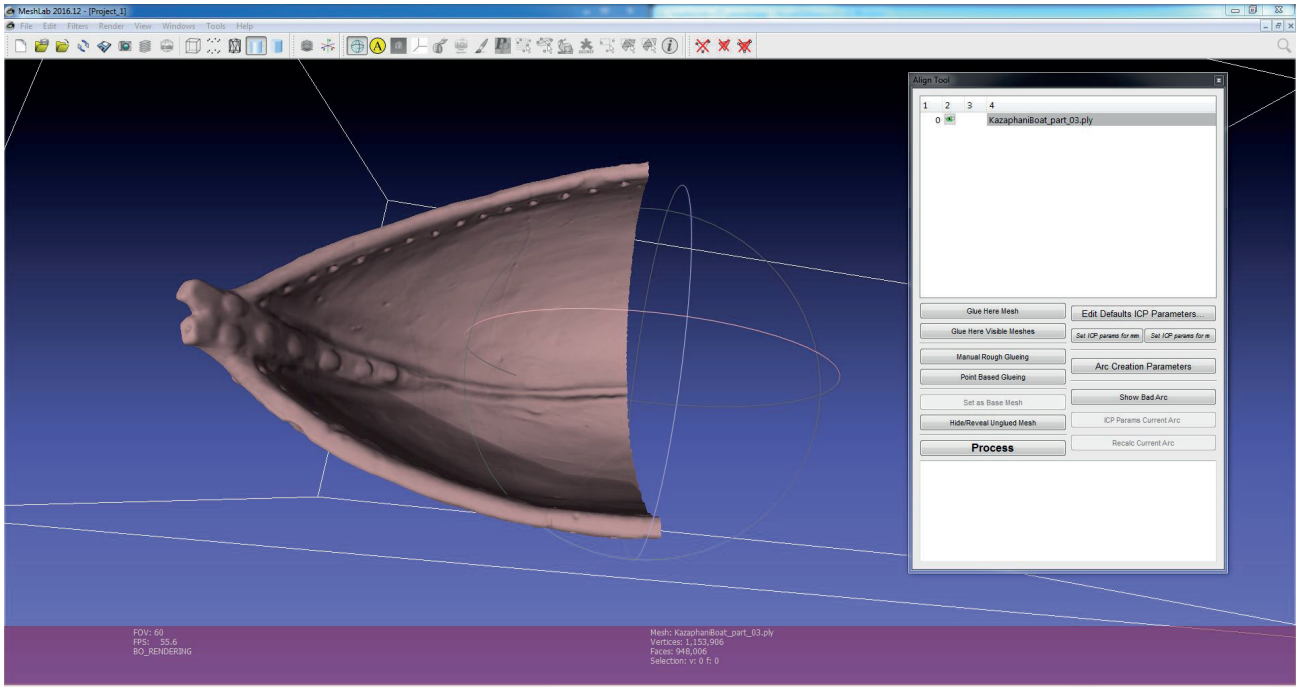


Figure 9.3. *Creation of the 3D digital model.*

From virtual to physical. The new identity of the object

The 3D digital model obtained was used for the creation of the replica. An accurate physical replica of the boat was created by the Department of Architecture at the University of Cyprus, using a 3D powder printer, whereby layers of powders are deposited with the use of photopolymer and UV laser to build up the model. The model was printed in 3D using a SPECTRUM Z510.

Once the 3D physical replica was created, it was delivered to the Casting Laboratory of the Cyprus Museum. Due to the limitations of the 3D printer, which could only produce items under 30 cm across – the length of the Kazaphani model boat was 45 cm – the replica was made in two pieces (Fig. 9.4). Furthermore, as the 3D printer was limited to a single colour only and, since the model would subsequently have to be painted, white was chosen.

The first step consisted of connecting the two pieces, something that worked out well, using the same materials with which the replica was produced. Powder ZP131 and Clear Binder ZB60 were mixed to produce a paste, which was used to fill the gaps created when the two units were put together. Once it was applied and left to dry, sandpaper of different grades was used to create a smooth area, eliminating the signs of the join (Fig. 9.5).

Following assembly, the next important step was mirroring the original artefact with the replica and dealing with the details. To achieve this, the original Kazaphani model boat was placed next to the replica. Even though the 3D printer produced an as-accurate-as-possible copy, it was noted that the replica lacked certain details, so it had to be manually treated in order to closely reflect the original. The recreation of the holes situated below the gunwale in the original model was done using a dentistry tool with edges of various sizes, drilling to imitate the original ones.

On both the exterior and interior sides, where the marks of the joins from previous conservations on the original were visible, those on the replica were less intense and had to be engraved with a pointed tool (Fig. 9.6).

Some additional minor corrections were made to the replica, such as gap-filling of small holes, smoothing and imitating specific areas. Once all the details were finalized, Zbond 101 binder agent (hardener) was applied to the surface of the replica to add stability (Fig. 9.7).

This is an integral part of the 3D process and generally takes place right after the production of the 3D item. The reason behind the timing of the delayed application of the binder agent in this case was to allow changes to be made to the model.

The final step was the reproduction of colour, which was carried out with the same method that was used by the Casting Laboratory of the Cyprus Museum to colour replicas. Paraloid B72 thermoplastic

Figure 9.4. *The replica of the Kazaphani model boat in two pieces.*

Figure 9.5. *The completed assembly of the two pieces.*

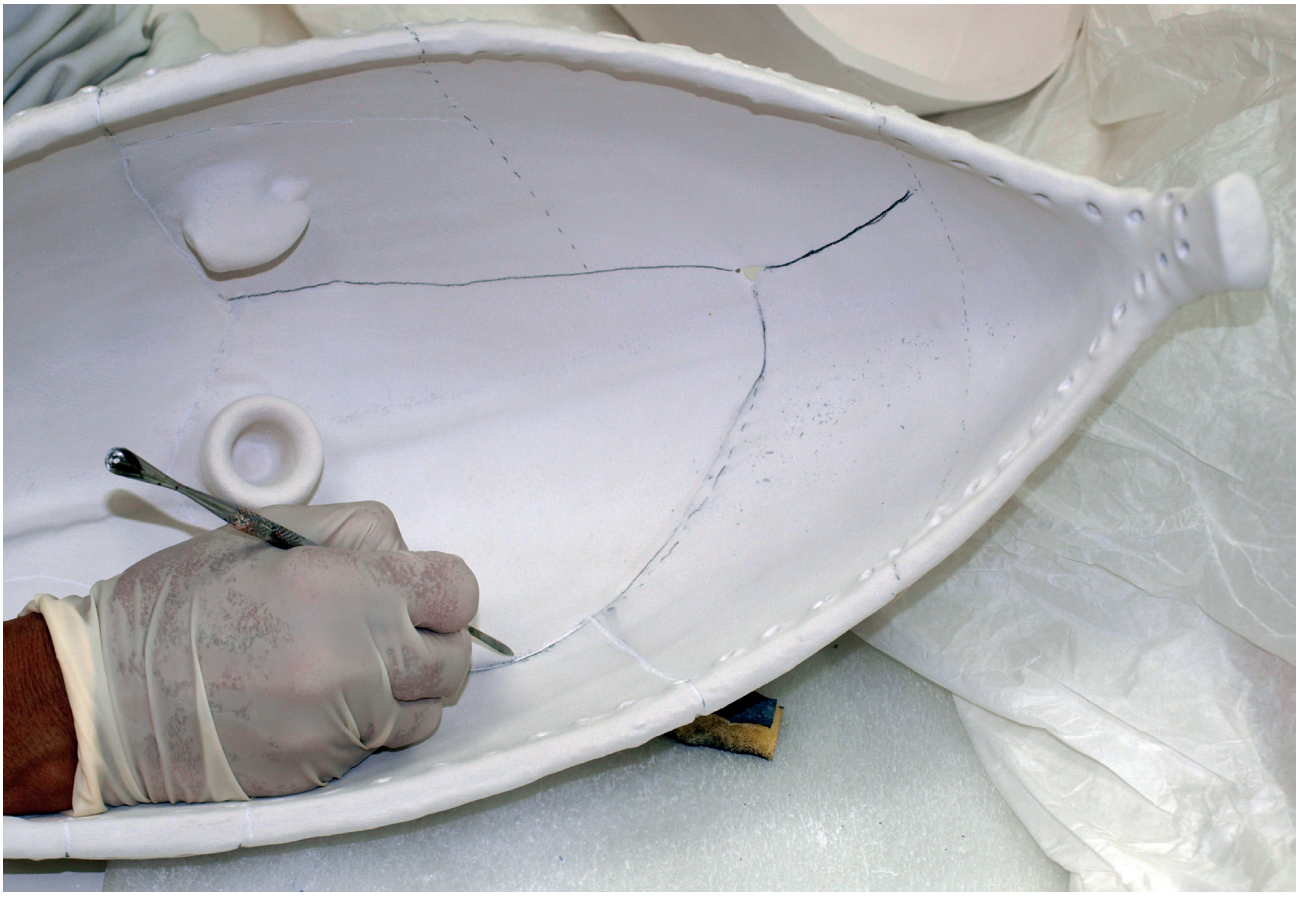


Figure 9.6. *Engraving the marks of the joints from previous conservation.*

Figure 9.7. *Application of the binder agent.*

Figure 9.8. *The colouring of the replica.*

resin was diluted in acetone at the proportion of 10 per cent of Paraloid B72 with respect to the total solution, along with colour pigments (mostly composed of iron oxide and earth colours). This solution is suitable for achieving high accuracy of different colour shades; it is easy to apply and ensures longevity. A paint gun was used to colour the replica using layers of different shades to reflect the original model boat colour (Fig. 9.8).

With the completion of this experimental project, the 3D version of the Kazaphani model boat successfully replicated the original artefact for the exhibition (Fig. 9.9).

Even though human intervention was needed, and several steps had to be followed for the 3D replica to resemble the original model boat, the result was encouraging and the original artefact was preserved in the Cyprus Museum. The 3D scanning process has enabled conservators to analyse the boat in greater detail without risking any damage to the original. The experiment has also shown how simple and cost effective this method of creating replicas can be, with obvious benefits for curators, education and merchandise.

Following the success of the project, it can be said that the 3D printing method can offer many opportunities in the field of conservation and is a particularly promising area of development. As regards the experimental project presented above, the 3D model substituted an original artefact, which was not in a good physical condition, and enabled it to be displayed in an exhibition, providing the opportunity to cast a difficult and fragile artefact, saving time, and avoiding direct contact with the original artefact.

Every time an object goes through a casting process with silicone rubber, it becomes increasingly more fragile and may eventually reach a stage where it can no longer be subjected to this process.

Although the 3D method has both advantages and limitations, the former outweighs the latter, and

Figure 9.9. *Details of the 3D replica.*

ensures the safety of the originals. Limitations can be overcome, manually for the present, and will hopefully be eliminated in the near future as the technology improves.

As we have experienced in our case study, the sub-millimetric errors added to the replica by the instrumental and operational errors (Beraldin 2004; Boehler, Bordas & Marbs 2003), did not affect the final aim of the project. Although one can think that the transformation of a virtual object diverts from the concept of topological authenticity, when the DH object is printed with the same material and texture, and then exhibited in a museum showcase, what does an observer perceive?

Visitor's experience: 'A wonderful deception!'

The 3D physical replica was used for the aim initially planned, allowing the Department of Antiquities to permit the object loan, and avoiding any problems of insurance costs and fragility issues. The replica of the boat was exhibited at the National Museum of Natural History, Smithsonian Institute, for the temporary exhibition. During this period the 3D replica was placed, as any other ancient object, behind glass and it was explained that the object was the replica of an original located somewhere else (Fig. 9.10). Interestingly, a journalist, while interviewing the museum curators regarding the exhibition, appeared surprised when he learned that the object was a replica, commenting that it was 'a wonderful deception!'. This might have been the same reaction most visitors had immediately after reading the label.

The misunderstanding could have been caused by the peculiar exhibition of the object. The replica was exhibited under glass, exactly as an original masterpiece. The use was completely different from the role usually attributed to 3D prints, such as giving a sensorial experience usually denied to the museum visitors for obvious security reasons. It would be interesting to understand what the motivation for this choice was.

Unfortunately, the choice made by the museum curators was not made explicit and there is no formal explanation for this approach instead of another one that would have allowed sensorial interaction with

the replica (Di Giuseppantonio Di Franco et al. 2016). Most probably this might be explained with the aura of an object. The aura and the expression of these intangible feelings are widely discussed in museum studies regarding exhibitions and use of technologies (Dorrian 2014; Hazan 2001; Battani 2011; Jones 2010). As Maxwell et al. write in their excerpt, the 3D replica created after their experiments, 'except for one specially organised handling event, as per typical museum rules of engagement the display was behind glass' (Maxwell, Gray & Goldberg 2015). In a way, the words 'as per typical museum rules of engagement' explain the reason for such a choice. This can be further explained as a *semiophore* ('that

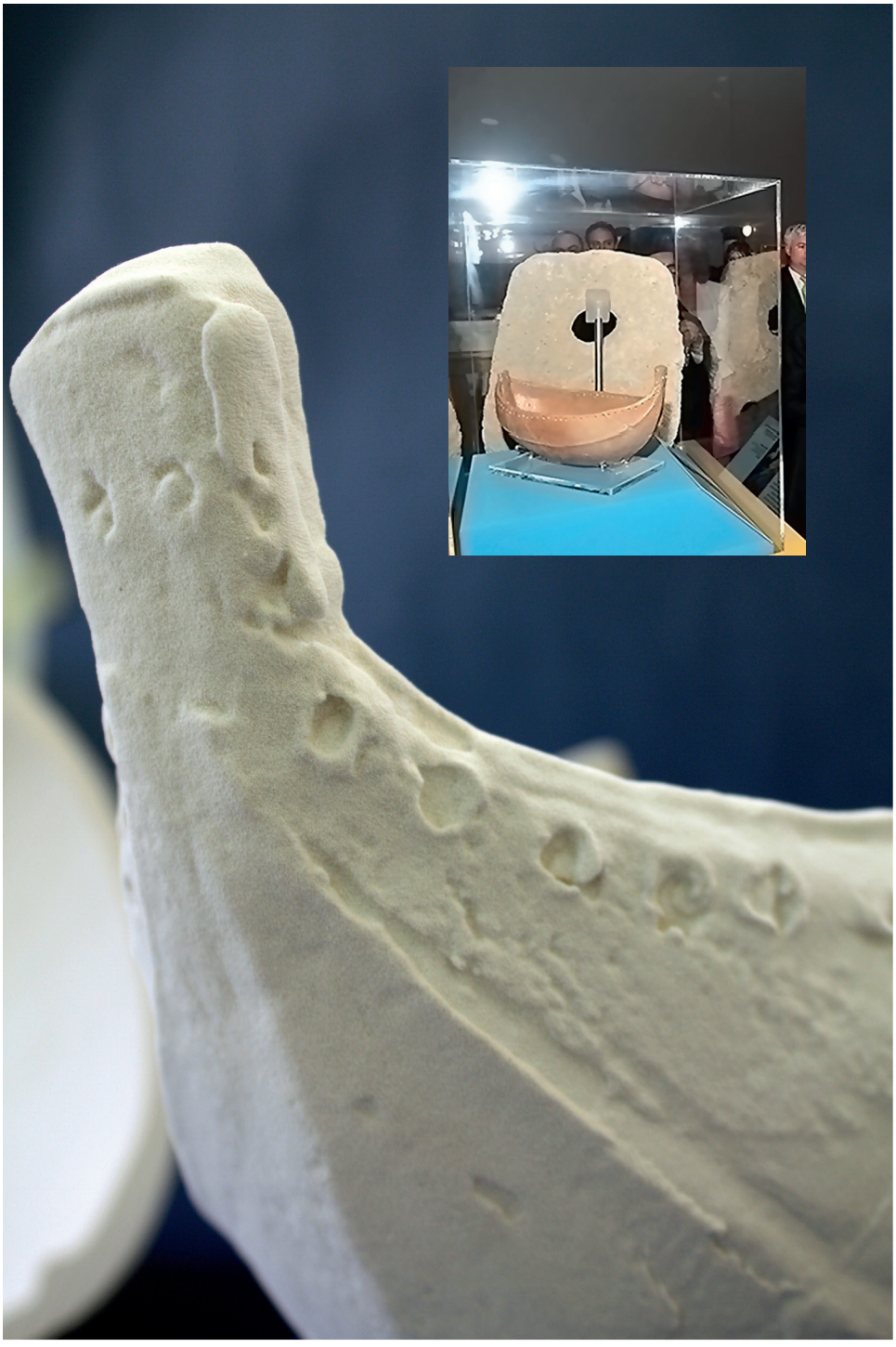


Figure 9.10. *The 3D replica exhibited at the Smithsonian behind glass.*

brings along a meaning') (Pomian 1987): the object, as soon as it loses its utilities, assumes a pure semantic function. The *semiophore* is in front of the observer and acts as an intermediary between the visible and the invisible, the observer and the hidden meaning (or what is now far or absent). Differently from a common object that has its meaning in the present and in its daily use, the *semiophore* reveals its meaning only when it is exhibited in front of the observer, and therefore when it becomes a piece of a collection. In this way, the object that lost its utility, takes the role of representing something now invisible. The curator gives the 3D replica the importance of a *semiophore*: s/he puts the copy at the same level of the original, since it brings along a meaning that connects the visible with the hidden meaning, in the same way as the original objects in the exhibition cases do. Therefore, only when the objects are seen by the observer and are under the care of the curator, they assume meaning and significance. These circumstances put the replicas at the same level of the originals, assuming the same value of their originals. An artwork, or more extensively an object of the past, once in a museum, is detached from its original context and from its world (Heidegger 1950). The artwork stops being what was before and becomes an object in a new context: from that moment its *authentic reality* is conserved. Besides 'being a thing' (in the philosophical/ontological sense) there is its character of authenticity and the first is the *conditio sine qua non* for the second (Martino 2010).

Conclusions

Differently from Benjamin (Benjamin 2008), according to whom the technical reproduction annihilates the authenticity of the artwork, in our case the 3D replica makes possible a new cultural value, a new identity that enhances and spreads knowledge among the audience. Even if the identity and the aura of the artwork, determined by its unicity in a spatio-temporal interval (the *hinc et nunc* of the artwork), cannot be replaced, nevertheless another identity and another aura is created.[3] The aura of the new object acts as intermediate between its origin and the present, providing living information about its existence through time. As discussed above, great importance is given to the digital provenance and data transparency. Indeed, by preserving the integrity and the transparency of the chain of activities that lead to the creation of a 3D digital or physical reproduction, its authenticity can be ensured.

The use of digital technologies has raised various ethical issues and new challenges. Rights and intellectual properties, originality and reproducibility are just some of the possible consequences. According to Morgan & Morgan the advance of information technology created an expansion in innovation, communication, education, etc. Nevertheless, ethical issues increased exponentially: *'ethical implications associated with the topics of veracity, identity and ownership and the impact of these fundamental ethical issues on human behaviour in emerging digital technologies.'* (Morgan & Morgan 2008). Ethics in 3D digital reproduction can be connected with the concept of transparency and the other suggestions proposed to the scientific community by the London Charter less than 10 years ago. If the digital copy (or the 3D replica) provides information on its provenance, the transparency of all its production processes and, in the case of a 3D replica the specification of being a replica and not the original, the matter of ethics is not an issue anymore.

Quoting Perry, '*the more meaningful displays of ethically-loaded objects are those that are well-contextualised, that use both visuals and text to jar viewers out of simplistic interpretations of the subject matter, that weave displays together into a larger critical narrative; and that attempt to trace – or account for the lack of tracing of – consent*' (Perry 2011).

As in the words of Terdiman about online digital media, the '*3D printed object* [should] *be* clearly labeled *so all viewers or listeners understand the altered or artificial nature of the content. This labeling is the only way to maintain standards of truth, accuracy, and fairness.'* (Terdiman 2011). The 3D replica represents a tool for storytelling and might have ethical implications concerning its appropriate or inappropriate use (When is it appropriate to provide a 3D object? How can the legitimacy of a 3D copy be authenticated?).

The traditional boundaries of disseminating knowledge are somehow outdated and we have to find a new method of communication. This communicative approach's aim is not that of substituting the ancient object but presenting 'A' reproduction (nor 'THE' reproduction, nor an unoriginal copy) and the affordances that it brings with it.

Therefore, based on the results of the case study presented, we can assert that the replica recreated with 3D technologies brings along all the processes of creation, giving life to a new identity. Through the new identity of the object, a new biography is given: we might now introduce the concept of *augmented authenticity*. Similarly to augmented reality whereby the virtual environment is something more than the reality itself – because the virtual world can be enriched with data that in the real world does not exist – the physical replica represents an 'augmented' copy of the real object, on which new actions can be performed, that are otherwise not possible on the real object.

Acknowledgements

The authors would like to thank all the people involved, without them this project would not have been realized: Giancarlo Iannone and Denis Pitzalis former researchers at the Cyprus Institute; Odysseas Kontovourkis for the Department of Architecture of the University of Cyprus; Despina Pilides, Curator of Antiquities, Eleni Loizides, Conservator, Elias Kyriakides, Conservator Technician, at the Department of Antiquities Cyprus.

Notes

1 Other software applications are available for photogrammetry today. At that moment it was decided to use ARC3D since it was developed by the University of Leuven within the 3DCOFORM project, which also made possible this research (http://www.3d-coform.eu/index.php/tools/arc-3d-webservice).
2 The software is developed by ISTI-CNR and it is freely available at http://meshlab.sourceforge.net/.
3 Similarly to what Hazan calls 'virtual aura' in regards to virtual exhibitions in museums (Hazan 2001).

References

Adam, S., 2010. Preserving Authenticity in the Digital Age. *Library Hi Tech* 28(4), 595–604.

Alemanno, G., Cignoni, P., Pietroni, N., Ponchio, F. & R. Scopigno, 2014. Interlocking pieces for printing tangible cultural heritage Replicas. *Eurographics Workshop on Graphics and Cultural Heritage*, 145–54. Accessed 17 September 2016: http://diglib.eg.org/handle/10.2312/gch.20141312.145-154

Amico, N., Ronzino, P., Felicetti, A. & F. Niccolucci, 2013. Quality management of 3D cultural heritage replicas with CIDOC-CRM. *Practical Experiences with CIDOC CRM and its Extensions (CRMEX 2013) Workshop, 17th International Conference on Theory and Practice of Digital Libraries (TPDL 2013), Valetta, Malta, 26 September 2013*, CEUR-WS.org/Vol-1117, 61–9. Accessed 23 April 2017: http://ceur-ws.org/Vol-1117/paper6.pdf

Battani, M., 2011. Aura, Self, and Aesthetic Experience. *Contemporary Aesthetics*, 9, 1–11.

Beacham, R., Denard, H. & F. Niccolucci, 2006. An Introduction to The London Charter, in *VAST 2006*, eds M. Ioannides, D. Arnold, F. Niccolucci, & K. Mania. Budapest: Archaeolingua, 263–9.

Benjamin, W., 2008, (trans. By Underwood, J.A.). *The work of art in the age of mechanical reproduction*. London: Penguin Books.

Beraldin, J.A., 2004. Integration of laser scanning and close-range photogrammetry – The last decade and beyond. XX ISPRS Congress: Proceedings of Commission V, Istanbul, Turkey.

Boehler, W., Bordas, V.M. & A. Marbs, 2003. Investigating Laser Scanner Accuracy. XIX CIPA Symposium, Antalya, Turkey.

Cameron, F. & S. Kenderdine (eds.), 2007. *Theorizing digital cultural heritage: A critical discourse*. Cambridge (MA): MIT Press.

Cullen, C.T., Hirtle, P.B., Lynch, C.A. & J. Rothenberg, 2000. *Authenticity in a Digital Environment*. Washington, D.C.: Council on Library and Information Resources. Accessed 23 April 2017: https://www.clir.org/wp-content/uploads/sites/6/pub92.pdf

Damnjanovic, U., Hermon, S. & G. Iannone, 2013. Documentation of decision-making process in the analysis of digital heritage objects, in *Digital Heritage International Congress*, eds A. Addison, G. Guidi, L. De Luca, & S. Pescarin. Marseille: IEEE, Vol. I, 743–6.

Di Giuseppantonio di Franco, P., Matthews, J.L. & T. Matlock, 2016. Framing the past: How virtual experience affects bodily description of artefacts. *Journal of Cultural Heritage* 17, 179–87.

Dorrian, M., 2014. Museum atmospheres: Notes on aura, distance and affect. *The Journal of Architecture* 19(2), 187–201.

Duranti, L., 2006. Reliability and authenticity: The concepts and their implications. *Archivaria* 39, 5–10.

Foster, S.M. & N.G.W. Curtis, 2016. The thing about Replicas – Why historic Replicas matter. *European Journal of Archaeology* 19(1), 122–48. Accessed 13 September 2016: http://www.tandfonline.com/doi/pdf/10.1179/1461957115Y.0000000011?needAccess=true

Hadjisavvas, S. (ed.), 2010. *Cyprus: Crossroads of Civilizations*. Nicosia.

Hazan, S., 2001. The Virtual Aura – Is There Space for Enchantment in a Technological World?, *Museums and the Web 2001*: Archives & Museum Informatics. Accessed 23 April 2017: http://www.museumsandtheweb.com/biblio/the_virtual_aura_is_there_space_for_enchantment_in_a_.html

Heidegger, M., 1950. *Der Ursprung des Kunstwerkes*. Frankfurt: Klosterman.

Jeffrey, S., 2015. Challenging heritage visualisation: beauty, aura and democratisation. *Open Archaeology*, 1(1).

Jokilehto, J., 2006. Considerations on authenticity and integrity in world heritage context. *City & Time* 2 (1).

Jones, S., 2010. Negotiating authentic objects and authentic selves. *Journal of Material Culture* 15(2), 181–203.

Karageorghis, V., 2002. *Early Cyprus: Crossroads of the Mediterranean*. Los Angeles, CA: J. Paul Getty Museum.

Koller, D., Frischer, B. & G. Humphreys, 2009. Research challenges for digital archives of 3D cultural heritage models. *Journal on Computing and Cultural Heritage* 2(3), 1–17.

Lynch, C.A., 2000. Authenticity and Integrity in the Digital Environment: An Exploratory Analysis of the Central Role of Trust', in *Authenticity in a digital environment*: May 2000. Washington, D.C.: Council on library and information resources, 32–50. Accessed 14 September 2016: http://www.clir.org/pubs/reports/pub92/contents.html

Martino C., 2010. L'archiviazione dell'aura. Ontologia degli oggetti ed epistemologia del collezionismo in Walter Benjamin. *Bollettino Filosofico – Dipartimento di Filosofia – Università degli Studi della Calabria* 26, 246–62.

Maxwell, M., Gray, J., & M. Goldberg, 2015. The Interplay of Digital and Traditional Craft: re-creating an Authentic Pictish Drinking Horn Fitting. *CAA2015*, 35–40. Accessed 13 September 2016: http://www.archaeopress.com/ArchaeopressShop/DMS/275B6D1BA3F04AF29F983F242F34ACE4/CAA2015%20contents.pdf

Morgan, K. & M. Morgan (eds), 2008. Ethical Issues in Digital Information Technology. Ch. 29 in *Handbook of Research on Digital Information Technologies: Innovations, Methods and Ethical Issues*, 455–64.

Niccolucci, F., Beacham, R., Hermon, S. & H. Denard, 2010. Five Years After: The London Charter Revisited, in *VAST 2010*, eds A. Artusi, M. Joly, G. Lucet, D. Pitzalis & A. Ribes. Eurographics Association, 101–4.

Nicolaou, I. & K. Nicolaou, 1989. *Kazaphani: A Middle/Late Cypriot Tomb at Kazaphani-Ayios Andronikos: T. 2A, B*. Department of Antiquities.

Parry, R., 2007. *Recoding the museum: Digital heritage and the technologies of change*. Routledge.

Perry, S., 2011. *Ethics and the display of human and non-human remains*. Accessed 20 April 2017: https://saraperry.wordpress.com/2011/12/05/

Pomian, K., 1987. *Collectionneurs, amateurs et curieux. Paris, Venise: XVIe–XVIIIe siècle*. Paris: Gallimard, 16.

Pilides, D., & N. Papadimitriou (eds), 2012. *Ancient Cyprus: Cultures in dialogue: Exhibition catalogue; royal museums of art and history, Brussels, October 31, 2012 – February 17, 2013*. Nicosia: Department of Antiquities.

Ronzino, P., Niccolucci, F., & S. Hermon, 2012. A metadata schema for Cultural Heritage documentation, in *Electronic Imaging & the Visual Arts: EVA 2012 Florence*. Firenze: University Press, 36–41.

Scopigno, R., Cignoni, P., Pietroni, N., Callieri, M. & M. Dellepiane, 2014. Digital fabrication technologies for cultural heritage (STAR), in *12th Eurographics Workshop on Graphics and Cultural Heritage*, Darmstadt, Germany, 75–85. Accessed 13 September 2016: http://vcg.isti.cnr.it/Publications/2014/SCPCD14a/STAR-Fabrication-final_c.pdf

Terdiman, D., 2011. 3D Printing Creating a 'Whole New World.' In *CNET*, 20 June. Accessed 20 April 2017: http://news.cnet.com/8301-13772_3-20072236-52/3d-printing-creating-a-whole-new-world/

Tucci, G., & V. Bonora, 2011. From Real to… 'Real'. A Review of Geomatic and Rapid Prototyping Techniques for solid modelling in Cultural Heritage Field. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XXXVIII-5-W16/575, 575–82.

UNESCO, 2015. *Operational Guidelines for the Implementation of the World Heritage Convention*, World Heritage Committee and World Heritage Centre. Accessed 16 September 2016: http://whc.unesco.org/archive/opguide13-en.pdf

UNESCO, 2016. *United Nations educational, scientific and cultural organization*. Accessed 13 September 2016: http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/preservation-of-documentary-heritage/digital-heritage/concept-of-digital-heritage/

Chapter 10

Pitoti Prometheus, virtual reality 360: Valcamonica rock art between naturalism and alienation

Frederick Baker

> Prometheus:
>
> They may be bound here
> by their lifelessness,
> But they are free
> And I feel their freedom!
>
> Johann Wolfgang von Goethe
> 1773, 181.

The demi-god Prometheus dreams of making static human figures come to life and rise from the rock. What Goethe wrote and Prometheus dreamt of is now within the realms of possibility, thanks to the digital revolution and the creation of 360-degree virtual reality (VR). Digital archaeologists and VR filmmakers can be modern-day Prometheans, puppet masters able to draw life from stone. In the valley of Valcamonica, the rock art figures are known as 'Pitoti', or 'little puppets'.

The tale of Prometheus is the story of a demi-god's rebellion against the gods. It has been told by the likes of Hesiod, Coleridge and Kafka and has even been set to music by Schubert and Beethoven. Now a 17-minute virtual reality film, 'Pitoti Prometheus', draws from the tale, using Copper Age and Iron Age rock art from Valcamonica (Baker & Karnapke 2016a). It is probably the film with the longest production time in history: much of the pre-production artwork was done in *c*. 2000 BC and the final post-production animation was completed in AD 2016 (Fig. 10.1).

In many senses Prometheus stands as a model for the creative possibilities offered by digital archaeology and particularly virtual reality filmmaking. The Promethean forces of creativity are similar to those of a hacker unleashing the powers of disruption into the settled world of archaeological recording and visualization. As his name suggests, Prometheus is '*Literally the "man with foresight" (from Greek pro, "before", and Medea, "thoughts"')*; Hicks 2015:1).

Looking ahead, the key question posed by these Promethean possibilities is how can rock art be brought to life in an authentic manner, that satisfies both academic as well as entertainment criteria? This is new territory. While the field of archaeological film (i.e. film about archaeology) is old, true archaeological film, in the sense of making film directly out of archaeological material such as 3D scans, is in its infancy. It will therefore be argued that differing claims for the authenticity of digitally captured archaeological artefacts requires a nuanced approach, one that has much in common with debates around the realm of theatre and must start with the nature of digital archaeology itself.

Digital vs virtual

The first question is what we should call this new field of inquiry: digital or virtual archaeology? This is important, because it influences the question of authenticity across the whole field.

The term 'virtual archaeology' was first coined in 1991 by Reilly to describe the new visualization techniques that had then started to be used for examining archaeological data sets (Hook 2014). But the essential problem with the word 'virtual' is that it suggests a dichotomy between a virtual and a real archaeology. Anthropology has had a similar dilemma. Daniel Miller and Barbara Horst rejected 'virtual anthropology' in favour of 'digital anthropology' on the following grounds.

> 'Materiality is the bedrock of digital anthropology, and this is true in several distinct ways of which three are of prime importance. First, there is the materiality of digital infrastructure and technology. Second, there

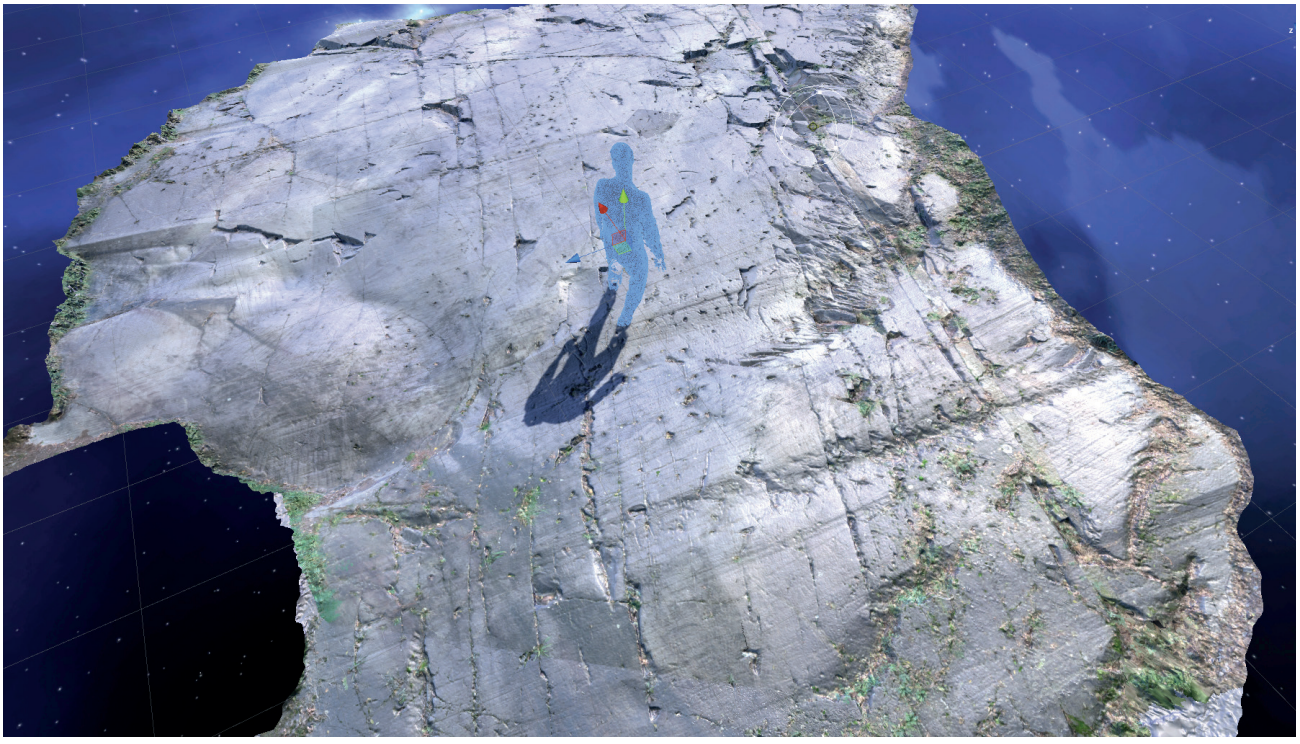


Figure 10.1. *Prometheus on Seradina 12a. Still from 'Pitoti Prometheus' (Dir. Baker 2016).*

> is the materiality of digital content, and, third there is the materiality of digital context' (Horst & Miller 2012, 13–25)

Anthropology has a whole range of material and immaterial culture to work from, since it is largely dealing with extant societies. But for archaeologists there are no immaterial cultural sources, such as song, dance and language.

The comparison between archaeology and anthropology is similar to the difference between the Olympics and the Paralympics. Anthropologists can study a full corpus of evidence, whereas archaeologists are forced to evaluate the merits of data sets that are by their nature fragmentary and incomplete. This is where digital technology steps in, because the 'digital' in archaeology can play the same role as prosthetics do in sports medicine (Baker 2014).

The Greek word 'prostheses' comes from the word for addition, application or attachment. Digital visualizations are additions grafted onto excavated material data so as to complete a fragmentary view of a city or a building, until it is deemed 'life like' and therefore successful. The most powerful and evocative are examples of buildings that have been destroyed in war like the arch at of the Temple of Baal in Palmyra, which has been physically reconstructed at two thirds size by the Institute of Digital Archaeology under the leadership of Roger Michel in London and New York (Clammer 2016). Film and 3D computer reconstructions have had to suffice for the long-demolished church of San Per Maggiore in Florence. In this case the main aisle of the church has become a street and the digital reconstruction led by Francois Penz and Donal Cooper shows that Francesco Botticini's striking 'Assumption of the Virgin' would have beeen hanging above the altar in what is now thin air. Now at London's National Gallery, this reconstruction has helped scholars to understand that the Renaissance painting's abnormal circular depictions of celestial bodies were meant to be appreciated by worshippers looking upwards and not straight ahead, as is normal in an art gallery (Cooper & Penz 2015).

As with prosthetic reconstructive medicine, digital archaeology requires an interdisciplinary team – historians, computer scientists, graphic designers, statisticians and heritage managers – to get results. These heritage professionals work on the shattered bones of the past. Digital archaeology can record this incompleteness and can then facilitate a proposed reconstruction of each ruin, each shard and each skeleton.

The difference afforded by the digital revolution, over and above the traditional reconstruction

techniques available to the archaeologist, is that of the speed, scale, exactitude and interactivity offered by computerized information technology (greatly surpassing the old analogue methods). In the digital realm the micro and the macro become telescoped and therefore more malleable. Time is extendable and more precise than before. The time taken for processes within the data set is also decreased, allowing more iterations and modelling. The same can be said of space. Here seamless transitions can be made in orders of magnitude from the sub millimetre to hundreds of kilometres. The 'copy and paste' reproducibility of data is another key feature of the digital sphere. The concept of the 'original' is replaced by the technical qualities of copies. Finally, interactivity is a crucial addition to the repertoire of possibilities that historical researchers have on offer to analyse and represent data gleaned from the past.

In my understanding of digital archaeology, reconstruction is not virtual or based on fantasy, but rather is subject to the rigorous analytical application of digital reconstructive techniques, which mobilize the past through a combination of historical imagination, precise data sets and an exacting use of information technology; hence the need for the self-regulating charters of London, Seville and Ename. Maurizio Forte (2015) argues that these charters are impractical in the field and proposes a form of 'cyber archaeology', with an emphasis on the interactive potential of avatars and feedback loops aiding investigation and not just the display element foregrounded by virtual archaeology. While highly supportive of the investigative use of computer-aided techniques, the term 'digital archaeology' seems to embrace both of these schools.

Naturalism – recording rock art

In 'Pitoti Prometheus', both the viewer and Prometheus look upon a digital 3D simulacrum of the Valcamonica rock art panel known as Seradina 12c, the second largest panel of its type in the valley (Fig. 10.2).

The 3D panel is an exact copy of the original created by a scanner developed by the Technical University of Graz and the associated 3D-Pitoti research consortium (3D-Pitoti Consortium 2014). It fulfils the authenticity criteria of an icon or simulacrum, or, put another way, a naturalistic recording. 'An icon is a direct representation of something already known; a simulacrum for something in the real world. It is not the referent itself (i.e. the thing in the world) but it shares the properties with that referent – it is 'like it' in a recognisable way' (Webb 2009, 47). The history of rock art research in Valcamonica shows that the key question is how much information is needed to be 'Like it in a recognisable way': black and white or colour, 2D outlines or 3D?

The rock art in Valcamonica dates from the Neolithic to the Iron Age, with some outliers in Middle Ages. An estimated 150,000 engraved images have been hammered into the glacier-smoothed flanks of the sandstone valley that runs south from the Adamello National park down to Lake Iseo, entering the Po plain at Brescia in present-day Italy.

The art is attributed to an Alpine tribe the Romans called the Camuni, and it has been known to the academic world for over 100 years. Until now only one form of recording has managed to record the art in its true three-dimensional nature: the so-called 'calchi' are plaster casts made in the 1960s by the local craftsman to record the curvature of the natural rock and the indentation of the engraving as a positive preclusion. (Marretta 2008). The 'calchi' are very sculptural, but do not record the colour of the art or its larger context, since the art is organized in panels, that contain up to 100 images.

The recording of larger panels has been done by a process of tracing developed in the 1960s that is still in use to this day (Anati 2008; Maretta & Cittadini 2011). Large, transparent plastic sheets are taped to the panel surfaces and the outlines of the rock art figures are drawn on to the plastic with felt-tipped pens. These collections of black outlined figures show the graphic forms of the works and the composition of a panel, but lose all information about the figures' colour, depth and the subtle shading. One way around this has been to use academically trained painters to produce oil paintings of the rock art panels, as was done by a Frobenius Insitute expedition in the 1930's (Kohl et al. 2015). Even when all forms of photography are added to the list of recording techniques, we still are left with 100 years during which no medium has been able to authentically and fully record this unique collection of UNESCO-listed rock engravings.

That is, until the Prehistoric Picture Project and its off-shoot the 3D-Pitoti Project started to use digital technology to record and analyse the rock art in 2010. Scanning is based on the realization that rock engravings are as much about air as about stone. This proved key to guiding the micro volumetric work undertaken by Marcel Karnapke with the 3D scanner and later the 3D printer (2014, 2015). The 3D scanner has been able to record the the depth of the engravings, as well as in their other two dimensions. This has allowed the volume of rock that was extracted at the engraving's creation to be calculated and reconstructed using 3D printing. What was then dust is now air, a volume that becomes the thin plastic body of a sculpture when

Figure 10.2. *Sunset on Seradina 12a, with ploughing scene. Photo Hamish Park.*

printed. The prints recall the work of the modernist sculpture Alberto Giacometti. The digital difference is that the 3D prints can stand alone as the extracted volume, as thin as the true Pitoti engravings (Karnapke 2012; 2015).

In digital rock art exhibitions at Milan and Cambridge, 3D plastic prints of the engraved rock surfaces have allowed the public to touch the art and feel the indentations with their fingertips. This authentic measurement and reproduction of depth thus facilitated a playful tactile encounter with the work of the anonymous artists of Valcamonica – an encounter that was especially useful for visually impaired visitors. The lightness and durability of the plastic prints also made it possible to let children explore the engravings without fear of destruction.

By linking the rock scans with mid-level scans from drone flights and satellite data of the valley, the 3D-Pitoti Project has been able build a scalable picture of the pitoti in their valley context. After Marcel Karnapke and Felix Trojan's initial test scans it was clear that the scanner needed to be specially developed for work in the mountains. It can now record the undulations of the rock and its engravings in fine detail, and crucially it can also gather photographically correct colour information (Höll et al. 2014).

The 3D Pitoti team faced one huge challenge in attempting the record the corpus of work in Valcamonica and that is space. The rock engravings are spread across over 100 km of alpine terrain. An estimated 150,000 images form the 'big picture', rather like the many small figures that make up a Bosch or Breugel painting. That means that much more than any other art form, the Pitoti art goes from the macro to the micro. They are one large collection of figures and patterns spread across a vast area, but that have been created by a millions of millimetre-size hammer blows. GIS research by Craig Alexander (2012) has shown that the rock art sites form a pattern of intervisibility that goes beyond the chance positioning of locations, making a macroscale understanding of the art all the more important.

The scalability of the digital realm has proven to be an ideal asset in capturing this micro/macro-scale corpus, with drones being programmed to scan whole panels in 3D and so providing the mid-range linkage between the satellite data and the micro scanner information (Mostegel et al. 2014)

Naturalism and authenticity – the fourth dimension, time

The fourth dimension for an authentic appreciation of Valcamonica rock art is time. The indicator of time in open-air rock art is the sun. It is with the observation of the passage of light across the Pitoti that the true nature of the rock carvings comes to life. In this form of proto-cinema, the morning and evening light creates a natural 3D effect. The long shadows cast by the low light make the figures seem to protrude from the rocks (Fig. 10.2). In contrast, when the sun reaches its high point at midday, the images disappear as they merge with the surrounding natural rock.

These proto-cinematic effects underline why the rock art figures are referred to as Pitoti. This local dialect word roughly translates as 'little puppets'. It is a reminder that the engravings are not neutral, but in the mind of the prehistoric artists will have had meaning and that those artists were part of a historical process. The Pitoti appear and disappear, just as puppets enter and exit during the performance of a play.

This is not a chance analogy since links have been discovered between art and theatre in Greek art that is contemporary with some of the Pitoti. In his study of the interaction between Greek drama and the visual arts of sculpture and vase painting, the classicist Herbert Golder reminds us that the ancient writer Athenaeus recalls that 'gestures in sculpture were said to be the relics of old dances' (1996a, 326). Research into other plays has revealed links between the gestures on vases and those used in plays (Golder 1996b).

This was of considerable interest when considering the question of what would be an authentic production design for the Prometheus film, where the hero has to stand above the rock art and say

> Prometheus
>
> Here is my world, my heavens!
> Here I feel myself to be;
> Here are all my desires
> In physical form.
> My spirit a thousand-fold divided
> and whole with my dear children
> What a special moment!
>
> von Goethe 1773, 178

The stone upon which he stands is authentic. The valley that surrounds him has the exact topography of Valcamonica thanks to digital cartography. But how should his 'little children', the rock art figures, move and be dressed, if dressed at all. The research question posed was: how far should authenticity go, in a digital world were almost everything is technically possible?

Fundamentally, there are two concepts of authenticity regarding the portrayal of the past. The first is naturalism and the second is alienation. Both have a tradition in theatrical stage design and warrant a close

examination. Robin Boast has made a particular study of the origins of naturalism:

Nowhere is this preoccupation with re-presenting the objective past so apparent as in the theatre. In its ability to provide a three-dimensional, visually realistic experience of an accurately reproduced setting of the past, the theatre was unrivalled in the nineteenth century. The historical theatre of the middle and late nineteenth century in Europe, and primarily in England, was increasingly a site of collaboration between actors, artists, scenic specialists and archaeologists. This collaboration was exemplified by the productions of two men, Charles Kean and William Godwin. Both Kean and Godwin had trained as architects, published extensively on classical architecture, and both were Fellows of the Society of Antiquaries.

Kean was an avid supporter of historical reconstruction in the theatre. In his 1853 production of *Sardanapalus*, at the Princess's, Kean produced what was seen at the time as a masterful re-presentation of the Assyrian setting. Kean's purpose went well beyond performing Byron's tragedy 'to render visible to the eye… the costume, architecture, and customs of the ancient Assyrian people, verified by the bas-reliefs… to convey to the stage an accurate portraiture and living picture of an age long since past away.' (Cole 1859, 58–9).

The computer has become a *scientific* stage upon which archaeologists can finally re-enact the past 'accurately', 'authoritatively', and without the annoying subjectivity of human actors. Archaeologists, like the nineteenth-century theatregoer, 'register the image not only as an accurate record, designed to satisfy antiquarian interest, but as a "shifter" (to use the linguist Jakobson's term) between present and past.' (Bann 1995, 120). It does not matter that much if the contemporary archaeologist uses the computer-generated stage as Godwin intended, as an objective detached view of a scene from the past, or as an engaged post-processualist interpreter; the game is the same:

> 'The computer program requires the archaeologist to make decisions about the original texture and colour of all the surfaces of the buildings. Decisions have to be taken, or alternative possibilities formulated, about the destroyed upper parts of buildings. The computer reconstruction also brings to the surface interesting questions about the original lightning of each room and house. The resulting 3-D experience has to be seen to be believed: that is what virtual reality is about.' (Renfrew 1997, 7)

Indeed it is. It is a spectacular performance, one that again demands that we suspend our belief that the object we are engaging with is a contemporary computer with a keyboard and mouse, as the theatregoer of the mid-nineteenth century was to suspend their belief that they were looking at a contemporary stage. We must convince ourselves that we are looking at 'the *real* past' (Boast 2002).

Alienation

The original emphasis of the word '*real*' reeks of Boast's scepticism and irony when it comes to the question of authenticity. One man who would have shared Boast's opinion was the Bavarian born playwright and theorist Bertolt Brecht. His mission was to purge theatre of its nineteenth-century practitioners like Kean and Godwin. Brecht developed his 'Verfremdungstechnik' or alienation technique in 1935, after a trip to Moscow and then attendance at a performance of traditional Chinese opera in Berlin. Brecht writes that his actors should be: 'Playing in such a way that the audience was hindered from simply identifying itself with the characters in the play. Acceptance or rejection of their actions and utterances was meant to take place on a conscious plane, instead of, as hitherto, in the audience's subconscious' (Willett 1966).

Brecht's 'alienation technique' means actors should not act as if there were a fourth wall to the audience. Stage design was to be sparse and anti-illusionist: for example, a scene set in Rome would be indicated by a sign reading 'Rome', rather than by a backdrop of classical columns. In terms of practice-based research, I share Brecht's worries that too much naturalism can make the audience switch off its critical faculties towards the historical narrative that is being depicted. In his short Organum for the theatre he wrote:

> '…we must drop our habit of taking the different social structures of past periods, then stripping them of everything that makes them different; so that they all look more or less like our own, which then acquires from this process a certain air of having been there all along, in other words of permanence pure and simple. Instead we must leave them their distinguishing marks and keep their impermanence always before our eyes, so that our own period can be seen to be impermanent too…. The classical and medieval theatre alienated its characters by making them wear human or animal masks; the Asiatic theatre even today uses musical and pantomimic effects. Such devices were

> certainly a barrier to empathy, and yet this technique owed more, not less, to hypnotic suggestion than do those by which empathy is achieved. The social aims of these old devices were entirely different from our own…'. (Willett 1966, 190).

For Brecht, the viewer (and/or archaeological researcher in our case) needs to

> '…transform himself from general passive acceptance to a corresponding state of suspicious inquiry he would need to develop that detached eye with which the great Galileo observed a swinging chandelier. He was amazed by this pendulum motion, as if he had not expected it and could not understand its occurring, and this enabled him to come on the rules by which it was governed. Here is the outlook, disconcerting but fruitful, which the theatre must provoke with its representations of human social life. It must amaze its public, and this can be achieved by a technique of alienating the familiar'. (Willett 1966, 192).

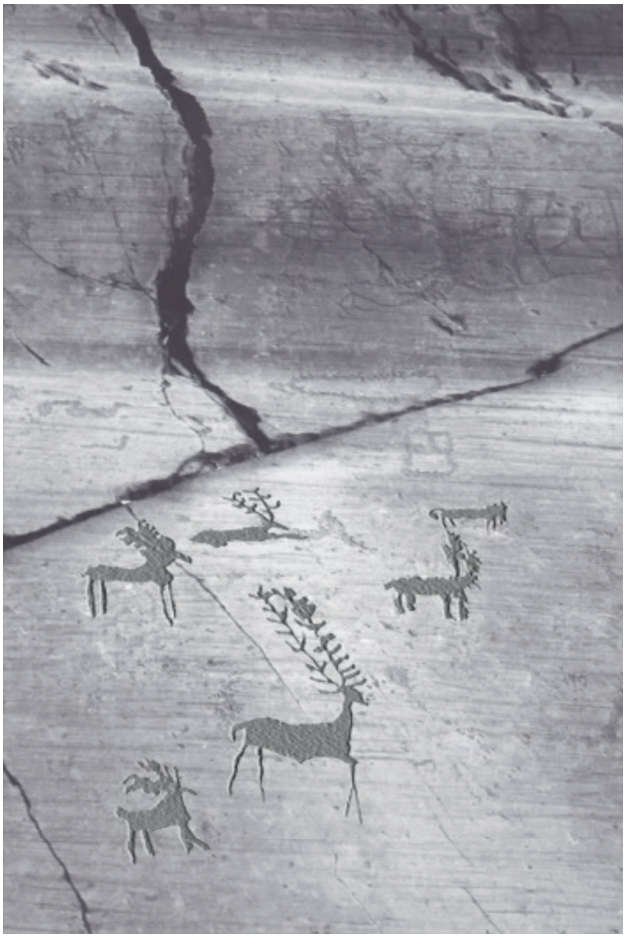


Figure 10.3. *'The Hunt' (Dir. Kren 2012).*

It is fitting that apart from meaning 'little puppet', the word Pitoti also means 'strange' or 'abnormal' in the local dialect of Valcamonica. The clearest example of the use of alienation technique in a digital archaeology context came with the 2D Pitoti film 'The Hunt', with animations by Mike Kren (Kren et al. 2012, Chippendale & Baker 2012, 78–9). (Fig 10.3).

One evening after the first field season, the animator Mike Kren called me and asked:

> '*Can I put some knees in the legs of the ancient deer? The prehistoric artists have not included them. They have just engraved straight lines for legs*.'

I must admit I had not really noticed this kneelessness of the prehistoric deer before, as it just seemed part of the minimalist charm of the work. I answered:

> '*No. Let's see how the deer move the original artists saw it, that is according to their skeletal and kinetic understanding of movement*.'

That was the birth of 'Pitoti film rules': the animator is only allowed to move joints that are clearly indicated in the engraving. That means that the exhibited animations of deer move in a stiff manner with unbent knees, just as drawn by the Camunian artists. The effect is slightly comical, but has the advantage is that is does not allow the public to think in the safe categories of Walt Disney's Bambi. Instead Mike Kren rose to the challenge of working with the Pitoti film rules as creative restrictions to preserve the potential otherness of the Pitoti. This is not to say that the Camunians could not draw knees or that prehistoric deer did not have them; it only shows that, for the ancient artist, the knee was not important enough to be emphasized. This is an key example of why I would classify the rock-art of Valcamonica as an ancient form of minimalism that runs in parallel to the naturalistic tradition of depiction that was perfected in classical Athens, and was much copied there after (Baker 2015).

Arts-based research

> 'The key value to be defended is the potential "otherness" of the past. That which is known, but diverges from the expectations of today. The paradoxical otherness of

> the Pitoti and the past in general is neatly summed up in, the co-curator of the Pitoti exhibition, Christopher Chippindale's observation: *Pitoti are aliens, but aliens like ourselves*' (Chippindale & Baker 2012)

As Christopher Chippindale's insight suggests, the key question is then how to move forward with the paradoxes surrounding Pitoti in an authentic manner of self alienation. The path taken has been arts-based research. We must realize that rock art is just as much about the art as about the rock. It therefore often takes an artist to authentically understand the work of another artist. Take, for example, Dr Hamish Park. He is both a trained anthropologist and a professional photographer and it was his job to photograph the Pitoti for research purposes. He describes his technique as follows:

> 'The great photographer of Paris, Brassai, reported showing Picasso his prints of street graffiti; Picasso was so taken with them that he proposed that he make a graffito which Brassai would photograph. Whilst it is not recorded that this happened, their capacity for appreciation was always in my mind when photographing Pitoti. What might Brassai or Picasso have made of them? I think they would have been delighted not just by the inventiveness and the observation, but also by the wit, which is frequently evident. I am certain that he would have drawn out his pen-knife and pecked images in the rocks. What Brassai's (1983) observation of Parisian graffiti and Picasso's appreciation show is that art does not always reside in the great museums and galleries, nor is it necessarily the provenance of acknowledged masters; it is often found in unexpected places made by the hands of those whose names were never recorded. So, it is with the Pitoti of Valcamonica. When I came to photograph them I did so in the spirit of Brassai, taking each incision seriously; trying to understand the way in which it had been crafted into the surface of the rock and to use that knowledge to convey my appreciation of those unknown artists'. (Park 2012)

When it came to the question of chiselling into rock, England's leading letter cutter, Lida Cardozo Kindersley (2013), came to inspect the engravings, so as to authenticate the craft, by answering technical questions as to how the art could have been made. The approach is what the cognitive psychologist Gibson (1979) calls investigating 'affordances', i.e. the action possibilities offered by a material or an environment independent of an individual's ability to recognize them. Lida is a skilled explorer of the authentic affordances offered by the rock surfaces of Valcamonica. She spent a great deal of time looking at the figures and said she could detect right-handed and left-handed artists, based on her years of stone working experience.

The minds of the prehistoric artists are clearly difficult to know, yet there is little point in falling into the academically pure but nihilist position that nothing can be known. For example, it is highly opportune that the Pitoti have not been moved from the site of their creation. This symmetry can act as a link to the past. 'Brosumer' is what Beer and Burrow call a consumer and producer combined (2010). The basic view and the fall of light across the engraving have not changed and so form the beginnings of an experiential bridge to the creators and the viewers of the art in the past. It is a point encapsulated in the network of spherical panorama photos set up by Thomas Bredenfeld for an exhibition in Milan and Cambridge (Chippindale & Baker 2012, 48–9).

The next logical step was to embrace the three dimensionalities of the art and the passage of time by making a spherical film using 360 VR (Baker & Karnapke 2016a). This built on previous efforts in story telling, for example involving ambient cinema (Baker 2007). The 3D animation of the Pitoti that were depicted with knees brought the next digital challenge (Fig. 10.4).

Marcel Karnapke created 3D prints from the first 3D scans of the Pitoti (2012). When shown in the exhibition (Chippindale & Baker 2012, 97), the small scultures clearly showed the visual affinity between the aesthetics of the Camuni and modernists like Giacometti (Baker 2015).

The Pitoti are likely a form of ancient minimalism, a tradition to be seen as another form of classical art that existed in the Alps alongside the naturalism of the Ancient Greeks in the coastlands (Baker 2015). By minimalism I mean an artistic aesthetic in which a minimal number of lines is sufficient to indicate a human figure or an animal, or most interesting of all a piece of mechanical equipment.

The graphic analysis of a plough scene shows that the Camuni artists rejected a central perspective and undertook a multi-dimensional approach, which is much closer to engineering drawings. The plough is 'blown up' to show how it works and not just illustrate how it looks. Kren had first discovered the multi-dimensional approach with an engraved cart (Chippindale & Baker 2012, 83, Kren et al. 2012).

Figure 10.4. *'The Gladiators'; animation production still for 'Pitoti Prometheus' (Dir. Baker 2016).*

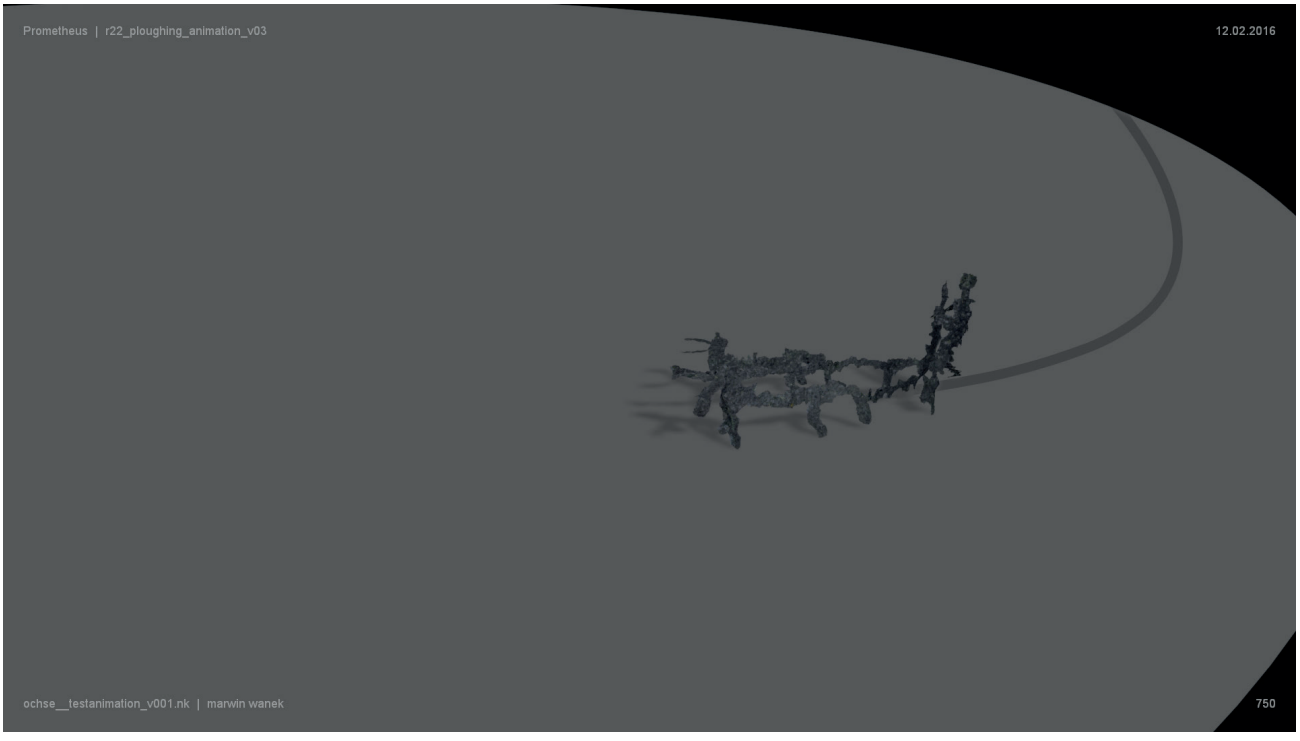


Figure 10.5. *'The Plough'; animated pre-production still from 'Pitoti Prometheus' (Dir. Baker 2016).*

A later 3D film challenge was to see if a similarly depicted plough had enough detail to be made to move realistically. As shown in Figure 10.5, the Camunians passed the test. There were enough likes to make the oxen pull the plough in the film without any additions.

The importance of this animation for our research was that it proved that in virtual reality naturalism and alienation can work together, shown by the fact that all the Pitoti figures can move anatomically and correctly if the limbs are drawn in the proper way. However, the figures are all as thin as the genuine engravings are deep in the rock. This creates a paradoxical aesthetic. Massive figures from one side and wafer thin ones from the other. This thinness was at first resisted by the animators, but as with the earlier case of the knees, has now been accepted as adding to the unique 'alien' look of these little puppets. The thinness has had the benefit of throwing back attention to the way in which the long shadows cast by the morning and evening light is essential to give the Pitoti their massive effect on real rocks.

In another example of VR's mix of naturalism and alienation, the digital skeletons of Kinect systems and the Bauhaus Weimar allowed authentic human movement to be recorded and placed inside the Pitoti figures to produce a naturalism of modern motion inside a prehistoric artistic creation. I first worked with Kinect with Andreas Wappel in the editing of the Ambient film 'Pixel to Pexel', where the Pitoti were first coaxed to rise form the rock (Chippendale & Baker 2012, 91). The digital skeletons allow us to replace the dancers with whom we first worked at Ben Sassen's Bauhaus Studio in 2011 and then formed part of the Pitoti Media Opera that was performed at the E.U. Researchers Night in 2011 in St Pölten. (Chippindale & Baker 2012, 89) The latest versions of this work have become a virtual museum and part of Karnapke display at the summer exhibition at the Bauhaus in Weimar (2015).

Virtual Reality systems now allow the 360-degree re-creation of locations. What started with the ambient cinema presentation of 'Pixel to Pexel' in the Triennale art gallery is now possible with a set of Oculus Rift Gear VR glasses, which increase the level of authenticity, since the viewer is immersed in a 360-degree filmic reconstruction of Valcamonica which is 3D within 3D, and also includes the 4th dimension – time. This makes the VR 360 film 'Pitoti Prometheus' (Baker & Kanapke 2016a; 2016b) both totally authentic and totally artificial, a prime example of my process of evidence-based imagination. A story (i.e. agency) that is true in a generic, rather than a specific sense, is added to the images and the archaeological space of the valley, to act out an authenticity, By that I mean Prometheus is an authentic narrative created by Hesiod at a point that will have been contemporaneous with at least some of the Pitoti, which were created in 4000–16 BC (Anati 2008; Marretta 2008).

The VR film is an experiment in gesture and form, with the aim of performing a narrative. The goal is to provide the viewer with a narrative using the graphic language of the Pitoti. The advantage of this arts-based practice is that once this form of performance has been recreated it is easier to return to the panels and – in a form of reverse engineering – start to imagine them in terms of movement and narrative. The digital world can give life back to ancient art. This is not just in the mind's eye, but now in both eyes, staring onto the lenses of the Oculus Rift Gear VR view.

Conclusion

In conclusion, when it comes to understanding the nuanced nature of authenticity and the act of looking at both digital and analogue rock art, it is Giacometti the modernist heir to the Pitoti's minimalist tradition, who has some insights worth considering:

> 'The extreme position on which Giacometti based all his mature work was that no reality – and he was concerned with nothing else except the contemplation of reality – could ever be shared. This is why he believed it impossible for a work to be finished. This is why the content of any work is not the nature of the figure or the head portrayed, but the incomplete history of *his* staring at it. The act of looking was a form of prayer for him – it became a way of approaching but never being able to grasp an absolute. It was the act of looking, which kept him aware of being constantly suspended between being and the truth'. (Berger 1980 Original emphasis)

In this spirit the digital rock art is just another phase in the history of the gaze from the Camuni to the VR cinema-goers of today, suspended between the moment of being and the possible truth of what they are seeing. In this sense I was genuinely pleased at way the prehistorian Timothy Taylor reacted to his first experience of putting on the Occulus Rift head set and seeing digital Valcamonica all around him:

> 'My first reaction to *Pitoti Prometheus* was copious swearing, followed by surprise when it did not echo off the surrounding mountains. I was standing in the office but my feet had gone. Below me, around me, prehistoric rock art in its geological setting.

> Not quite knowing what to expect, donning the specs, I had half feared a tedious re-exposure to videogame cliché. Instead there was thrilling duality: petroglyphs, intelligently marked out in their own world, and, as they became animated, a power of proper imagination (not fantasy) conjuring the lost mythic realities of the first Alpine farmers. The afterimage has stayed, indelibly now part of my view of how the past may have been. *Proper prehistory*' Taylor pers. comm. 2017 original emphasis.

Acknowledgements

The research reported in this paper has been carried out as part of the 3D-Pitoti project (http://www.3d-pitoti.eu/), which is funded from the European Community's Seventh Framework Programme (FP7/2007–2013) under grant agreement no. 600545; 2013–2016.

Thanks are due to the whole 3D-Pitoti Consortium. Special help came from Marcel Karnapke, Stefan Beck at the Virtual Reality Lab, Professor Jens Geelhaar, Professor Ursula Damm and the team at the Digtial Movement Lab at the Bauhaus University, Weimar. My thanks also to my Prehistoric Picture Project co-director Christopher Chippindale with whom I also curated the exhibition 'Pitoti – Digital Rock-Art from Ancient Europe'.

References

3D-Pitoti Consortium, 2014. 3D-Pitoti: Acquisition, Processing and Presentation of Prehistoric Rock Art. *Proceedings of EVA Berlin 2014*, 28–31. http://3d-pitoti.eu/

Alexander, C., 2012. G.I.S., in *Pitoti. Digital Rock-Art from Prehistoric Europe: Heritage, Film, Archaeology*, eds. C. Chippindale & F. Baker. Milano: Skira, 50.

Anati, E., 2008. *The Civilisation of Rocks. Valcamonica. A History of Europe*. Capo di Ponte: Edizioni del Centro.

Baker, F., 2007. *Art of Projectionism*. Vienna: Czernin Verlag.

Baker, F., 2014. Rock-art and the digital difference, in *Proceedings of Cultural Heritage and New Technologies*, CHNT 19. http://www.chnt.at/wp-content/uploads/eBook_CHNT19_Baker.pdf.

Baker, F., 2015. Prähistorischer Minimalismus. Pitoti-Felsgravierungen auf der Schwelle zwischen Analogem und Digitalem, in *Kunst der Vorzeit. Texte zu den Felsbildern der Sammlung Frobenius*, eds K-H. Kohl, R. Kuba, H. Ivanoff & B. Burkard. Frankfurt am Main: Frobenius-Institut an der Goethe Universität: 107–15.

Baker, F. & M. Karnapke, 2016a. *Pitoti Prometheus. When the Rocks Came Alive*. Cambridge University – 3D-Pitoti Consortium. VR360 film for Occulus Rift Gear VR. 17 mins.

Baker, F. & M. Karnapke, M. 2016b, Beyond stereoscopic. Combining spatial acquisition technologies in real-time engines to produce immersive virtual reality film experiences for the dissemination of archaeological research. *Proceedings of IEEE Xplore. 3D imaging (IC3D) International Conference on 3D Imaging (Liege, 13–14th December).* Electronic ISSN: 2379-1780. DOI 10.1109/IC3D.2016. 7823466.

Bann, S., 1995. *Romanticism and the Rise of History*. New York: Twayne Publishers.

Beck, A., 2015. Die Felsgravierungen in Valcamonica. Bildgebender Verfahren und mediale Aneignung in der Wissenschaft in *all-over. Magazin* für Kunst und Ästhetik *Ausgabe #8, April*. http://allover-magazin.com/?p=2016

Beer D. & R. Burrows, 2010. Consumption, prosumption and participatory web cultures: an introduction, in *Journal of Consumer Culture 10*: 3–12

Berger, J., 1980. *About Looking*. London: Bloomsbury.

Brassaï, 1993. *Brassai Graffiti. Le Language du Mur*. Paris: Xavier Barral.

Boast, R., 2002. Computing futures: A vision of the past, in *Archaeology: the Widening Debate*, eds B. Cunliffe, W. Davies & C. Renfrew. London: British Academy: 567–92.

Booth, M., 1981. *Victorian Spectacular Theatre: 1850–1910*. London: Routledge.

Cardozo Kindersley, L., 2013. *Letters, Slate, Cut*. Cambridge, UK: Kindersley Workshop Publications.

Chippindale C. & F. Baker, 2012. *Pitoti. Digital Rock-Art from Prehistoric Europe: Heritage, Film, Archaeology*. Milano, Skira.

Clammer, P. 2016 Erasing Isis: how 3D technology now lets us copy and rebuild entire cities. *The Guardian*. Accessed 27 May: https://www.theguardian.com/cities/2016/may/27/isis-palmyra-3d-technology-copy-rebuild-city-venice-biennale

Cole, J.W., 1859. The Life and Theatrical Times of Charles Kean, in *Victorian Spectacular Theatre: 1850–1910*, ed. M.R. Booth 1981. London: Routledge, 57–9.

Cooper, D. & F. Penz, 2015. *Visions of Paradis. Botticini's Palmieri Altarpiece*. Accessed 29 June 2017: http://www.nationalgallery.org.uk/visions-of-paradise.

Forte, M. 2015, Cyber archaeology: a post-virtual perspective, in *Between Humanities and the Digital*, eds P. Svensson and D.T. Goldberg. Cambridge (MA): MIT Press, 295–310.

Gibson, J.J., 1979 *The Ecological Approach to Visual Perception*. London: Routledge.

Golder, H., 1996a. Visual meaning in Greek drama: Sophocles' Ajax and the art of dying, in *Advances in Non Verbal communication*, ed. F. Poyatos. Amsterdam: John Benjamins Publishing: 323–62.

Golder, H., 1996b. Making a scene: gesture, tableau, and the tragic chorus,

Arion: A Journal of Humanities and Classics 4(1), 1–19.

Hicks, G., 2015. *Prometheus a German Myth*. Cambridge University German Department BA Thesis.

Höll, T., Holler, G., & A. Pinz, 2014. A novel high accuracy 3D scanning device for rock-art sites. Proceedings of

2014 ISPRS Technical Commission V Symposium, *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences,* 23–25 June 2014, Riva del Garda, Italy, Volume XL(5), 285–91.

Hook, D. Y., 2014. From illusions to reality: transformation of the term 'virtual archaeology'. *Archaeological and Anthropological Sciences*, 8(4), 646–50. https://www.academia.edu/30395794/From_illusions_to_reality_transformation_of_the_term_virtual_archaeology_

Horst, H. A. & D. Miller, 2012. The digital and the human: a prospectus for digital anthropology in *Digital Anthropology*, eds H.A. Horst & D. Miller. London: Bloomsbury Publishing. 13–25.

Karnapke, M., 2012. *Human Computer Interaction for Digital Representation of Cultural Heritage. Understanding (New) Media to Develop Better Applications for Archaeology Research and Museums.* Bauhaus University, Weimar. Faculty of Media. B. A. Thesis.

Karnapke, M., 2015. *Transmedia Storytelling for Digital Representation of Cultural Heritage. Exploring the Application of Media-Technologies for Research and Representation of Archaeological Narratives and Theories*. Masters Thesis Bauhaus University Weimar, Faculty of Media. Matrikel Nr. 60508.

Kennedy, M., 2013. Valcamonica rock carving brought to life in digital animations. *The Guardian*, 19 March. Accessed 29 June 2017: http://www.theguardian.com/science/2013/mar/19/valcamonica-rock-carvings-animations?INTCMP=SRCH

Kren, M., Baker, F., & C. Chippindale, 2012. Pitoti – Eine Bewegungsanalyse der prähistorischen Felskunst von Valcamonica anhand von Animation und Grafik, in *Mitteilungen der Anthropologischen Gesellschaft in Wien (MAGW) Band* 142, 1–28.

Kohl, K.-H., R. Kuba, H. Ivanoff & B. Burkard, 2015. *Kunst der Vorzeit. Texte zu den Felsbildern der Sammlung Frobenius*. Frankfurt am Main, Frobenius-Institut der Goethe Universität.

Kuba, R., 2008. Leo Frobenius in New York. Felsbilder im Museum of Modern Art, in *Zwischen Aneignung und Verfremdung*, eds V. Gottowock, H. Jebens & E. Platte. Frankfurt/ New York: Campus Verlag, 138–55.

Marretta, A. 2008. Digging the past: one hundred years of research on Valcamonica rock art. *Adoranten 8*, 36–54.

Marretta, A. & T. Cittadini, 2011. *Valcamonica Rock-Art Parks. Guide to Visiting Routes*. Capo di Ponte: Edizioni del Centro.

Mostegel, C., A. Wendel, & H. Bischof, 2014. Active monocular localization: towards autonomous monocular exploration for multirotor MAVs. Proceedings of *IEEE International Conference on Robotics and Automation*, Hong Kong (China), *2014*, 3848–55.

Renfrew, A.C.R., 1997. Forward, in *Virtual Archaeology: Great Discoveries Brought to Life Through Virtual Reality*, eds M. Forte & A. Siliotti, London: Thames and Hudson, 7.

Scagliarini Corlaita, D., 2015. Arte e civilta Romana nell' Italia Settentrionale dalla Repubblica alla Tetrarchia, in *Brixia Roma e le Genti del Po. Un incontro di culture III-I Secolo* A.C. Brescia Museo di Santa Giulia. Brescia: Giunti, 26–9.

Park, H., 2012. See, in *Pitoti. Digital Rock-Art from Prehistoric Europe: Heritage, Film, Archaeology*, eds C. Chippindale & F. Baker. Milano: Skira, 32.

Webb, J., 2009. *Understandng Representation.* London: Sage Publications.

Willett, J., 1966. *Brecht on Theater. The development of an aesthetic*. New York: Hill and Wang.

von Goethe, J. W., 1773. Prometheus. Dramatisches Fragment, in *Johann Wolfgang von Goethe. Werke Kommentare und Register Hamburger Ausgabe in 14 Bänden*. Band 4. Dramen II. München, C.H.Beck, 176–87. English Translation F. Baker 2016.

Index

S

T

U

V

W

Z

Authenticity and cultural heritage in the age of 3D digital reproductions

This volume represents the first attempt to collate an organic collection of contributions on authenticity and the digital realm in heritage and archaeology. It analyses the concept of authenticity from different perspectives and with different multidisciplinary contributions, together with theoretical debate. The collection of papers explores the concept of authenticity in a comprehensive way, engaging with theories relating to the commodification of ancient material culture, heritage-making processes, scholarly views and community engagement. These papers also take into account current digital practices for the study of past material culture and how their use affects and redefines interpretation processes in archaeology. This will provide a key reference text for archaeologists, museum and heritage specialists, and other readers interested in authenticity, cultural heritage and 3D reproductions.

Editors:
Paola Di Giuseppantonio Di Franco is Eastern ARC Fellow at the University of Essex and Affiliated Scholar at the University of Cambridge. Her research combines studies of material culture, heritage and cognitive science to analyse how new technologies affect how we engage with and understand our heritage. Her current project focuses on the role of new technologies in recovering heritage in the aftermath of natural disasters.

Fabrizio Galeazzi is a Research Associate of the Department of Archaeology at the University of York, and Visiting Scholar at the McDonald Institute for Archaeological Research. His research focuses on the use and integration of 3D technologies for the documentation, visualization and analysis of tangible heritage and how they can impact archaeological methods and theory.

Valentina Vassallo is an assistant researcher at the Science and Technology in Archaeology Research Center (STARC) of the Cyprus Institute. She is a PhD candidate in Classical Archaeology at Lund University and in Science and Technology in Cultural Heritage at The Cyprus Institute. Her research focuses on 3D analysis and semantics for archaeology.

Published by the McDonald Institute for Archaeological Research,
University of Cambridge, Downing Street, Cambridge, CB2 3ER, UK.

The McDonald Institute for Archaeological Research exists to further research by Cambridge archaeologists and their collaborators into all aspects of the human past, across time and space. It supports archaeological fieldwork, archaeological science, material culture studies, and archaeological theory in an interdisciplinary framework. The Institute is committed to supporting new perspectives and ground-breaking research in archaeology and publishes peer-reviewed books of the highest quality across a range of subjects in the form of fieldwork monographs and thematic edited volumes.

Cover design by Dora Kemp, Fabrizio Galeazzi and Ben Plumridge.

ISBN: 978-1-902937-85-4

UNIVERSITY OF CAMBRIDGE

MARIE CURIE ACTIONS PEOPLE

ISBN 978-1-902937-85-4
9 781902 937854