

Terras, M. (2010). Review of "Beyond Illustration: 2D and 3D Digital Tools for Discovery in Archaeology". Eds Frischer, B. and Dakouri-Hild, A. (2008). BAR International Series 1805. Archaeopress, Oxford. Internet Archaeology, Issue 28.

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The creation of images has been a human activity since the beginning of human society: our early ancestors painted or carved rocks with depictions of their lifestyles and beliefs. Rocks are not very portable, however, and humans like to share their visualisations, and the knowledge contained within them. Much investment in technology has focused on the ability to create, replicate, and disseminate visual information, from early print materials, to attempts at chemical photography, and recently, the development of ever more complex computational methods to represent visual information in a variety of ways. Visualisations are an important means of communication, source of information, and focus of both social interaction and scholarly activity. Images and visualisations play an important role in cultural and social history, can contain valuable historical information, and are used more and more in academic research which aims to study culture in its widest sense: focussing on artefacts and cultural produce.

Why are images and visualisations so popular? Human perceptual and cognitive systems have limited capacities for processing information, but much of it is devoted to dealing with visual input. A relatively large proportion of human brain activity, estimated at above fifty percent, is devoted to vision. Research into how we see, perceive, and interpret the world around us, and our reaction to images, is wide, varied, and spans an interdisciplinary reach encompassing psychology, biology, physiology, chemistry, physics, philosophy, and beyond (Bruce et al 1996 introduces many of the theories and debates postulated so far). What is certainly true is that the human brain can process complex visual information quickly, does so by various mechanisms which are not fully understood, and that humans can be stimulated in various emotional, intellectual, physical, and behavioural ways by imagery and image content (Lang et al 1993, Lang et al 1998). It is little wonder that the ease of producing, manipulating, and disseminating images and related visual models afforded by digital media and networks has resulted in an exponential increase in image material for personal and cultural consumption, and the adoption of available technologies for academic research. We create visualisations to understand complex data structures that we otherwise would not be able to interrogate: the improvement in cost, availability, and usability of imaging and visualisation technologies has allowed them to be increasingly adopted for this task.

Beyond Illustration is a timely edited collection of essays that look at our fascination with the use of visual models, and visual evidence, particularly applied to the study of the past. Many of the chapters in the book rightly make the point that visualisation is not a novel process created by the advent of computational technology, but has been used for centuries to refine, process, and aid us in understanding complex information. For example, the Severan Marble Plan of Rome, or *Forma Urbis Romae*, was an enormous 18 metre wide map of Ancient Rome depicting the ground plan of every architectural feature in the ancient city at a scale of 1:240, created during the reign of the Emperor Septimius Severus (203-211 CE). Likewise, models, macquettes, and illustrations have been used as tools for hundreds of years by

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architects, historians, and archaeologists, as individuals try to investigate and understand the relationship of complex spatial and historical data.

Beyond Illustration is particularly concerned with the use of computational tools for archaeological visualisation. Early Virtual Reality and 3D modelling projects involving archaeological data began in the 1980s and early 1990s (for an extensive survey of the application of visualisation technologies in archaeology during this period see Barcelo et al 2000). It not difficult to understand archaeology's attraction to such methods: 2D and 3D models of cultural monuments allow us to visualise their use and evolution from inception to latest phase, and computational technologies are increasingly used to create visually stunning, photorealistic, persuasive representations of the past. Therein lies the problem, however. The application of these tools and techniques has, until recently, been fairly random, with no firm research methodologies and protocols being established, whilst the visually persuasive models created have had limited use for novel research an interpretation, with few projects looking beyond the gloss and technological innovation to actually prove hypotheses, generate novel research, or link models to their underlying data structures to facilitate further study. *Beyond Illustration* aims to survey recent, pioneering research in the application of visualisation technologies in archaeology, moving beyond the tacit assumption that visualisation is only for teaching and illustration, and employing the computer model as a research tool to generate new archaeological knowledge.

The book's strength is in its dual approach. Although many projects are featured here, demonstrating how individual research teams are utilising emergent technologies in different ways, the text is careful to cover the theory and history of using visualisation as a tool, particularly for archaeological research. The introduction provides a useful bibliography regarding previous use of VR in archaeological research, whilst the beginning chapters, Gooding's "Envisioning Explanation: The Art in Science" and Forte's "Virtual Archaeology: Communication in 3D and Ecological Thinking" sees two leading scholars in the field cover important issues regarding the role of representations in academic understanding. Virtual Reality emerges as an ideal ecosystem, which is able to host both top-down and bottom-up processes of knowledge and communication when representing complex spatial and historical data. Likewise, Hermon's chapter on "Reasoning in 3D, A Critical Appraisal of the role of 3D modelling and Virtual Reconstruction in Archaeology" makes explicit issues of simplistic illustration versus useful, versatile research tools, underpinning the text's central thesis that advanced approaches and utilisation of visualisation tools can facilitate novel archaeological research.

The remainder of the book provides project based examples that all focus on different aspects of visualisation technologies, covering both polygon and voxel based Virtual Reality reconstruction, GIS, Light Detection and Ranging (LIDAR) remote sensing technologies, Artificial Intelligence, and 3D scanning techniques. By demonstrating how these techniques can be appropriated by specific projects, for particular archaeological application, the book indicates the breadth of visualisation technology currently available to aid the archaeologist in research. For example, 3D laser range scanning of the remaining fragments of the Forma Urbis Romae has allowed

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researchers to create a detailed dataset of pictorial evidence, three dimensional scans, and related documentary evidence, to help in piecing together over 1000 extant pieces of the map. The online research tool allows researchers to organize and share fragment representations, and to incorporate them with related scholarly materials, in order to support further study of the Plan. Computer aided fragment reconstruction is being investigated to aid in the matching of fragment edges, discovering a number of new fragments and joins which had been overlooked in the previous centuries of reconstruction scholarship.

Figure 1: A screenshot of the Stanford Forma Urbis Romae Project database, demonstrating how the visual evidence of the map fragments can be presented in various ways, including links to the underlying database, photographic evidence, documentary source material, and 3D visualisation.

Virtual Reality and 3D reconstructions can also be used for testing hypothesis. A model of the Inca Sanctuary of the Sun, at Lake Titicaca, Bolivia was created to test hypotheses regarding time and celestial activity. It had previously been postulated that the alignment of the two towers at the north end of the sanctuary were markers of the position of the sun at sunset on the winter solstice. The creation of a virtual reality model allowed the visualisation of a phenomenon which is only visible once every year, providing the means to visualise and test hypotheses in four dimensions.

The Digital Model of the Inca Sanctuary of the Sun at Lake Titicaca, Bolivia. In this screenshot, we see the solar markings at the winter solstice, providing a "virtual empirical" test of a hypothesis of temple alignment.

Many of the book's essays mention the current limitations of Virtual Reality technologies. Although models can be easily created, displayed, and shared via the Internet, up until now, once a model has left the developer environment there is little opportunity to carry out the type of detailed research often necessary on a virtual site, such as using measuring tools to undertake detailed analysis. The availability of intuitive, user-friendly specialist software to enable complex analysis and interrogation of virtual cultural and heritage artefacts is as important as the availability of low cost and robust data acquisition and modelling techniques to create them. Ozmen and Balcisoy's paper, "A software system to work with 3D models in cultural heritage research" provides an overview of why such tools are necessary for archaeologists, and introduces their simple, freely available extensible measurement tools system, CH Toolbox (<http://graphics.sabanciuniv.edu/chtoolbox/>), that was designed exclusively for cultural heritage research. By providing virtual tape measures, callipers, and rim charts, the Open Source software has provided a platform for interactive computer-aided cultural heritage tasks. Although further development and testing of the toolbox is necessary, this paper points to the prospect that peer reviewed 3D models of cultural heritage materials will soon become available, along with the means to handle, test, measure, and interrogate them, allowing empirical research on virtual models.

Figure 3: Screenshot demonstrating how a toolset for the analysis of Virtual Models (The CH Toolbox) can allow those navigating models to conduct measurements, and

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therefore novel research, on cultural and heritage objects. This screenshot shows the calliper tool in action, allowing detailed measurement to be undertaken.

Like many books dealing with emergent technology, this collection suffers a little from delays in publication. It is understood from the introduction that many of these essays were prepared in 2004, and the rate of technological change means that there has been many developments in the area of computational reconstruction, networking, and the holistic use of archaeological data from collection to visualisation and publication since then. There is no mention, for example, of the work of the London Charter for the computer based visualisation of heritage, which aims to establish internationally-recognised principles for the use of computer-based visualisation by researchers, educators and cultural heritage organisations (<http://www.londoncharter.org/>). Likewise, there is no mention of the VERA (Virtual Environments for Research in Archaeology) project (<http://vera.rdg.ac.uk/>), which has done pioneering work in testing digital capture of information in the trench; using an integrated archaeological database to store the vast data set pertaining to the dig at Roman Silchester, allowed publications which directly link deep into the database to facilitate understanding and use of primary evidence (Clarke et al 2007), and experimented with visualisations of the 3D dig data, generated from the underlying database as and when required. However, *Beyond Illustration* points to a future where cultural scholars will be able to access fully-stocked analytical toolkits which will enable them to create and interrogate highly detailed 3D models of the spaces excavated by modern archaeologists, enabling virtual archaeology which moves away from producing pretty pictures, to robust, methodological, empirical, grounded research.

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