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### Title

The Democratization of Technology

### Permalink

<https://escholarship.org/uc/item/68m107pn>

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### Publication Date

2001

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Peer reviewed

# The Democratization of Technology

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## Abstract

*Since the explicit collaboration of biological and physical scientists with archaeologists started in the late 1930s, the discourse on the nature of this collaboration has been intense. The question of the relative roles of the specialist scientist and the archaeologist in the collaboration, and the training and experience of both in the use of scientific techniques of recording and analysis is still not resolved, as we shall indicate by our experience in the Çatalhöyük Archaeological Project in Turkey. In this paper, we shall expand this discourse to examine the more recent collaboration of archaeologists with computer graphics specialists as archaeologists increasingly incorporate cutting-edge and not-so-cutting-edge digital technologies into their practice.*

## 0. Note

It is only appropriate that this 'paper' be embodied in hypermedia. We suggest that the best way to experience this text is in its context, available at <http://www.mactia.berkeley.edu/dot>.

## 1. Collaborations

Since the explicit collaboration of biological and physical scientists with archaeologists started in the late 1930s, the discourse on the nature of this collaboration has been intense. The question of the relative roles of the specialist scientist and the archaeologist in the collaboration, and the training and experience of both in the use of scientific techniques of recording and analysis is still not resolved, as we shall indicate by our experience in the Çatalhöyük Archaeological Project in Turkey [1]. In this paper, we shall expand this discourse to examine the more recent collaboration of archaeologists with computer graphics specialists as archaeologists increasingly incorporate cutting-edge technologies and not-so-cutting-edge digital technologies into their practice.

Our standpoint in this paper is similar to the standpoint that we hold in the collaboration of science and archaeology [2]. As with other specializations, collaboration with computer graphic (hereafter referred to as CG) specialists is necessary. We favor, however, a collaboration in which the archaeologists are not excluded from participation in the creative process of learning, adopting and using the specialized skills and technology of CG. In this collaboration, the archaeologists play an important role in developing technologies that are meaningful and relevant to the field and its practice. This may mean an emphasis on technologies that are affordable, whose learning curve is not too steep and whose implementation can be carried out by archaeologists without the intervention of computer or high tech specialists. In the light of the reality that in most cases a computer graphics specialist cannot be present during archaeological fieldwork, it is fruitful to focus on 21st century technologies that archaeologists can perform themselves. These *conduit* techniques allow the archaeologists to do what they do

best - practice archaeology - while still actively participating in the media creation so that the media products are meaningful beyond the archaeological community. This is a collaboration in which technology is *democratized* rather than mystified. What the archaeologists create in this process may not be perfect or have commercial potential, but it will be relevant to the field of archaeologists, and it will communicate a rich content of what archaeologists do and think to a broad community of stakeholders of cultural heritage.

The collaboration with the CG industry and experts can build on such a democratized basis in two ways. First, the constantly developing CG and immersive technologies can be used by CG practitioners to take the archaeologists' media products and content-rich explorations into realms none of us have ever imagined, but some of which may have commercial application for the heritage industry as well as entertainment (or should we say edutainment?). Secondly, the development of such products and technologies are inspirational for archaeologists, but collaboration with CG industry and experts will help to ensure that the technologies that are developed are relevant to the field of archaeology. "Relevance" in this case means enabling archaeologists themselves to do and think in ways that are related to the job at hand, but that empower them to go beyond what they did before.

Our view is not a fatalist one. On the contrary, the present and future for a high-tech archaeology have never been brighter.

## **2. Recent Developments in the Presentation of Archaeology**

Archaeology, in a sense, is the investigative arm of cultural heritage. This means that we (the stewards) have certain responsibilities to the stakeholders (the public) of the heritage to present our research. The standards by which archaeological research has been presented has changed over time as a result of significant changes in the discipline of archaeology itself and the changing socio-political context of heritage construction. These changes range from the theoretical and methodological developments within archaeology to the growing involvement and interest in archaeology on a global level [3]. The scope of our responsibilities has grown dramatically as the world has shrunk through the information age that we are now in the midst of experiencing.

For the purposes of this paper, we shall focus on the ultimate "product" of archaeological practice – its presentation through paper and digital publication, and through on-site or in museum displays. Incorporated in this focus are the digital technologies through which the huge databases of archaeological practice have been recorded and stored. These become part of the presentation of the research - since what distinguishes archaeology from other observational sciences is that archaeologists must disturb and destroy the context of their data in order to observe the data themselves.

While the vast majority of archaeological projects continue to be presented the "old fashioned way" - on white paper with black ink and the occasional black and white photograph or line art illustration - more and more often we are seeing creative and exciting presentations that incorporate digital (including multimedia) technology make its way into "mainstream" archaeological reporting. An excellent example is the Jerusalem Archaeological Park website, located at <http://www.archpark.org.il> [4].

### **2.1. Computer Graphics and Digital technology in archaeological practice.**

Computer graphics and digital technology are now essential players in every phase of archaeological practice [5]. We would like to list some of the areas where these technologies impact the field:

### **2.1.1. Pre-field Research**

Background Research: Digital databases, from library 'card catalogs' to site reports and online museums.

Funding: The lifeblood of archaeological projects, computer graphics are used to inspire potential donors while a plan for digital archiving is almost always a required component of any grant proposal.

Preparation/Visualization for the field: Packing the *virtual suitcase* with the necessary tools to accomplish the research aims in the field, keeping current on the latest technological possibilities for fieldwork is a full-time job.

Data management and presentation: Web presence and information storage systems must be prepared and manageable remotely.

### **2.1.2. In the Field**

Reconnaissance/exploration: Non-destructive survey techniques, both inter-site and intra-site are essential 'discovery' technologies, employed to locate possible sites and reduce excavation costs.

Recording: Photography, video, mapping, drawing, scanning - digital technologies and CG are changing the traditions of archaeological field recording.

Excavation/Sampling: Digging techniques that move beyond the trowel, frequently include intensive sampling for micromorphology, DNA, soil chemistry.

Conservation: In-situ preservation or extraction, digital imaging is used to document the current and changing state of conserved materials.

Inventory: Recording and management of data (including finds in their context of each depositional event) is one of the more daunting tasks in archaeology, as collections can contain hundreds of thousands of pieces. Digital technology is helping to make the unmanageable tolerable.

Analysis: In-field use of the media record and specialists' analyses of faunal, human, architectural, and paleoethnobotanical remains, including ethnoarchaeological observations.

Presentation: In-field presentations to officials, tourists, other archaeologists, ourselves.

Reporting: Presentation via the internet - webcam and beyond to augmented reality - digital technology and CG can permit the archaeological field experience to be transmitted to potentially thousands of interested stakeholders 'live'.

### **2.1.3. Post-Field**

Data management: Thousands of records and media are produced each season. What do we do with it?

Analysis: Collation of reports from collaborators now scattered across the globe, digital databases and standards hold the potential for reducing the 'Tower of Babel' effect in an age of global communication.

Reporting: Funding agencies, university sponsors, the public interest - the stakeholders expect accurate and timely reporting on our findings.

Presentation: Professional meetings, public interest, museums, media, publication - Meetings such as this one provide a forum for debate and discussion as

well as a showcase for playful or serious expressions of archaeological interpretations in many different forms.

#### **2.1.4. Presentation priorities**

The incorporation of CG and other digital technologies into these different phases of archaeological practice has sometimes been both expensive and highly complex [6], such as precision scanning and 3-dimensional architectural reconstruction. The responsibility for archaeologists to present and archive ever more precise records of their data is tempered not only by the low level of funding for archaeological projects, but also by the subtle introduction of different *priorities* in the presentation of archaeological practice. These different priorities are driven, to a certain extent, by the changing theoretical standpoint of many archaeologists, but also by a changing public (stakeholder) demand for greater participation in the process of interpreting archaeological data.

#### **2.2. Reflexive methods and multivocality**

Within the field of archaeology, archaeologists who have adopted Reflexive Methodology [3] have advocated a documentation of the archaeological process as being an essential step in the interpretation of archaeological data. The *process* of archaeology, therefore, (who is excavating, who they are communicating with, what is their background and experience) becomes as important as the *product* (what they find). The data are regarded essentially as ambiguous and subject to multiple interpretations. In this way, archaeology becomes a multivocal enterprise. Our research in the Çatalhöyük Archaeological Project is an example of this.

This is a constructivist view of (pre)history in which the aim is not to discover the “true” story that is waiting out there, but to construct a story at many different scales of time and place, through the interpretation of archaeological data by many modern agents (steward specialists and public stakeholders), about a past that is inhabited by social agents who have personalities (rather than being “faceless blobs”). Surrealism and fictional narratives are among the different genres of expression that are being experimented in such post-modern presentations of archaeology.

The hypermedia format on the Internet and CD-ROM has been immensely helpful in the presentation of the complex mesh of such multiple interpretations and voices [7], although such presentations are in their infancy. Immersive technologies promise to take the archaeologist further in their ability to present what their imagination sees as the interpretation of real archaeological data. In all these cases, however, our standpoint says that it is the archaeologist who should drive such presentations, even to the point of being able to create them themselves.

### **3. What are the expectations of archaeology by the public?**

Multiple groups have a stake in the cultural heritage that archaeologists steward. At the one end of the broad spectrum of stakeholders is the World Heritage Organization, spearheaded by UNESCO [8]. At Çatalhöyük, stakeholders include the government in Ankara, the financial backers in Istanbul, the local museum and provincial center of Konya, the proud mayor and his neighbors in Çumra, and the villagers at Küçükköy who live nearby, and work there. Other interest groups cross national boundaries, such

as tourists, and Goddess enthusiasts. None of these interest groups are themselves monolithic, and the trend is to recognize and respect their diversity, to listen to their voices, and their ideas about the archaeological process at Çatalhöyük. “Listening” may be done at the site or on the Internet. It is expensive of time and often of labor, but it is part of modern fieldwork.

Traditionally, the diversity and nature of the stakeholders has not been recognized, nor has their participation been invited. The process of archaeological research has tended to be mystified by science journalism and archaeologists so that the results of the research are presented as narratives of “Discovery” in which the end-product (the discovery) is forefronted, while the process of research is hidden. Moreover, the aspects of archaeological research that have been emphasized are monumentality (large buildings), uniqueness (Iceman), good preservation (shipwrecks), obvious visual appeal (Çatalhöyük’s wall paintings), in the belief that this is what will catch the interest of the public. For the most part, the products of archaeological research are quite mundane and not visually attractive, such as our mud-brick (mostly unpainted) buildings at Çatalhöyük. Thus contrary to tradition, we believe that it is the interpretation and the *process of investigation* that will fire the imagination of the public.

We feel, therefore, that by reversing this prioritization in presentation of the archaeological product and focusing on the *process* of investigation - given the challenge of the ambiguity of archaeological data, the creative use of lateral thinking and imagination in interpretation, the surprises and the frustrations - the richness of archaeological research and heritage investigation can be captured and presented to the archaeological community and the various communities of stakeholders. We feel furthermore that hypermedia authoring and immersive technology offers a bounteous potential in this direction, as will be shown by some examples from our research at the 9000-year old Neolithic settlement mound of Çatalhöyük, Turkey and at the Multimedia Authoring Center for Teaching in Anthropology (MACTiA) at U.C. Berkeley [9]:

#### **4. Using computer graphics and immersive technologies to present archaeological practice**

Here are some of the ways in which computer graphics and immersive technologies enable us to present the archaeological process of interpretation in a way that will encourage participation by stakeholders.

##### **4.1. Observations recorded and shared with colleagues and others**

So much of the archaeological world is visual. Digital and immersive technologies allow an almost unlimited visual record of field observations that can be shared over the Internet or through immediate CD-ROM publication. Thus the record of excavated data can be archived and presented by a multitude of different visual images in various media. In the past, image-production and presentation had to be selective because of cost. Recent developments in digital technology have revolutionized our research at Çatalhöyük in just the last three years.

#### **4.2. Memory and experience of research recorded and shared with colleagues and others**

Here we shall draw attention to the intensive recording through video, audio and still digital photography of the experience of field research. Field diaries which have traditionally been a private record written in an archaeologist's notebook are now a vibrant public record of the process of observation and interpretation and knowledge-construction.

#### **4.3. Resonances inspired by the field observations and shared with others (i.e. links to other memories and experiences)**

In this part we shall demonstrate the further demystification of archaeological interpretation at Çatalhöyük by the use of hypermedia authoring to express links to the sources of our imaginations and the process of our lateral thinking. Our interpretations of the archaeological data that include narrative form, imaginary characters, and constructed places are regarded as part of the scientific investigative process, not speculation by which we bring to life the past. These forms are used to explore and follow through multiple interpretations. The surrealism and immersion of our hypermedia constructions of prehistoric Çatalhöyük allows us to express these explorations and share them and receive feedback from colleagues and others. In all of our hypermedia work there is an invitation to our audience to share their reactions to our ideas and to express their own resonances and imaginations and interpretations.

Our ideas and plans for exploring the outer limits of the expression of archaeological and heritage investigation include exploring the power of sound, light, color, motion, avatars, theatrics, performance, operatics, game-playing and interactivity that is possible with immersive technology and hypermedia authoring. Thus one of the key audience/recipients of the democratized technologies is the archaeologists themselves, the products becoming the building blocks for their archaeological imagination. The products are not 'finished goods', complete models; instead they are assets and a set of techniques within the technological grasp of non-cgi specialists. We are one of these audience/participants.

### **5. The Example of Çatalhöyük**

The BACH (Berkeley Archaeologists at Çatalhöyük) team is a multi-national group conducting research at Çatalhöyük, Turkey, directed by Dr. Ruth Tringham, Professor of Anthropology at UC Berkeley, and Dr. Mirjana Stevanovic, research fellow at UC Berkeley. Our team works under the auspices of the Ministry of Culture of Turkey, administered through the British Institute of Archaeology at Ankara (BIAA). We are a unit of the Çatalhöyük Research Team (CHRT) of Cambridge University, under the direction of Dr. Ian Hodder [10]. Dr. Hodder is now Co-Chair of the Cultural and Social Anthropology (CASA) at Stanford [11]. We work closely with the Science Museum of Minnesota and their Learning Technologies division, who are developing a full museum exhibit, scheduled for opening September 2001 [12]. International research teams come to Çatalhöyük each year, including teams from Britain, Greece, the U.S., Turkey and Poland. We have an excellent research facility onsite, including labs, dormitories and an interpretive center.

The site has a thriving tourist interest especially during the excavation season, with visits and tours daily. Each year the project hosts a press day and invites the

international press to tour the site. This year we are expecting longer term visits from Channel 4 TV, England, and National Geographic. This season, starting June 1st and continuing through July 15th, marked our 5th year of fieldwork at Çatalhöyük. This year was especially significant because we planned to complete excavation of our current project, a Neolithic house, in anticipation of a study/analysis season in 2002. We pushed the technological envelope a bit further this year, employing a host of techniques in an attempt to tell the archaeological story of a house at Çatalhöyük.

The imaging technologies that we have incorporated, and plan to incorporate, into our excavation strategy in the 2001 and previous seasons have addressed the aims of the presentation of Reflexive Interpretive Archaeology that we have discussed earlier in this paper. They include:

### **5.1. Digital Photography**

Since 1996, all photography has either been digitized (PhotoCD) or is taken digitally using high-resolution digital cameras. Our image library consists of more than 17,000 items [1]. This season we took over 5,000 images. Such detailed photographic recording of the excavation process using conventional film photography would be prohibitively expensive.

### **5.2. Digital Video**

We shoot lots of video, both as a living diary of the excavation process and for documentary purposes. The Science Museum of Minnesota has over 120 hours of video footage from the last five field seasons that they are drawing from for their exhibit [12]. This year, we shot video specifically to develop experiential tours that can be used in the Science Museum exhibit, as well as document the daily experience of the excavation.

### **5.3. Quicktime VR**

QTVR plays an integral role in the documentation of the site. The entire site, including all excavation areas and labs has been documented over the years with QTVR. This year we used VR in order to document the previously undocumentable, such as the inner walls of burial pits. We used the photographs to produce panoramic image maps that when used in conjunction with traditional illustration techniques, allowed us to much more adequately document these important features. We also shot cubic VRs as part of our daily recording process, an exciting addition that was not feasible with traditional VR technology requiring 15 or more pictures per VR.

### **5.4. Asset Management**

We digitally catalog all of our assets: video, VRs, drawings, and photographs using a combination of relational and image databases. This year we employed the use of Palm handheld computers to enter data in the field. We successfully managed to catalog the majority of the media, saving hundreds of hours of post-excavation data entry. These assets are then immediately available for personal presentations to professionals, funding agencies and the public, as well as publication on the Web. They are available for interpretive webs of ideas and information to be created. The storage of images on



Photo-CDs and other digital storage media is also arguably easier to preserve and certainly takes up less space and raw materials [13].

### **5.5. Digi-Planning and Digitally-Assisted Drawing**

One of the most time-consuming and important tasks on any excavation is field drawing. Traditionally, hand sketches and painstaking illustrations have been employed. As with photography, all fieldwork must stop while illustrations are being prepared. We have developed a system of digi-planning, where photographs are taken, manipulated in the computer and prepared so that much of the illustration can take place off mound and digitally in the lab. This has proved especially useful in recording the complexities of the architectural remains at Çatalhöyük. When necessary, photographs are taken and printed out to scale to assist the field illustrator, a method especially employed for human burials. Unfortunately, a two-dimensional photograph, no matter how well rectified, is not a satisfactory or accurate replacement for a trained illustrator. By combining many photographs with Imagemodeler, we can develop 3D “snapshots” using real texture data. Used in conjunction with the rectified images and QTVR, we will also gain another important method of archaeological documentation.

### **5.6. Aerial Photography**

It is the dream of every archaeologist who excavates an expanse of architectural remains to be able to view the buildings from a bird’s eye view, both for mapping and for recording the whole excavation area. The BACH team works under a tent structure, which provides wonderful shelter from sun and wind, but until now has made it impossible to view our Building 3 from above. This year, however, we took aerial photographs using big wall climbing rigging in order to improve our rectilinear imaging for digi-planning, daily QTVR documentation and time lapse photography. This technique proved invaluable for our recording practice while actually saving time because most photo preparation was accomplished ‘above’ the site.

## **6. Are these techniques a novelty or necessity?**

We think both. Archaeology is an interpretive process, but more often than not it is presented to the public as a finished product with definitive answers to the mysteries of the past. The research methods employed at Çatalhöyük and the researchers who come back every year are dedicated to producing a more complex and ambiguous picture, one that is evocative, innovative and inviting to anyone interested in archaeology or life in prehistory. Hypermedia technology is liberating us to push archaeology, the audience and ourselves into uncharted territory.

## **7. (In)conclusions**

There is no planned end date for the excavations at Çatalhöyük, but projections take us well into the next decade. Meanwhile, the products of the research at the site are being used as a launch point for many different educational projects at the MACTiA, in the Oakland public schools as part of a project in collaboration with the UC Berkeley Archaeological Research Facility as an after-school project funded by the UC Links and Interactive University Programs, and at the Science Museum of Minnesota’s

Learning Technologies Program for kids. Perhaps most important of all, the digital media we produce is a living record, potentially accessed every day by archaeologists, enthusiasts and the public alike.

The aspects of digital technology that we have employed in the Çatalhöyük project are relatively low technology but provide us with a mass of media and other data that can be used to present what we do and have done in our project. They are designed with two aims in mind. One is to provide a basis from which our collaborators in CG industry can build truly beautiful and (perhaps) commercially valid products. The second aim is to allow us - with the techniques that we have in our repertoire - to use the riches of our content to inspire our diverse audiences (which include CG experts) to come up with ever more imaginative ways to interpret our data. The democratization is achieved by diverse communities sharing, on the one hand, the archaeological data and its process and, on the other hand, the digital technologies and their process in the expression of past worlds, as we imagine them.

On our return from Turkey at the end of a season, interested friends often ask us “What was the most interesting thing that you discovered this year?” The digital presentations that we have described in this paper can prevent their disappointment when we answer “There was no one thing that can be described in that way. We find very little on our excavation. For us, the most interesting thing is the process by which we create the history of a house and imagine the people who made it happen”.

## 8. Acknowledgements.

The authors wish to thank all of the many participants at Çatalhöyük. A special thanks to the MADDOG media team - Laura Steele, Jason Quinlan and Adriana Garza - who make the digital process and products in the BACH tent a reality.

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