

COMPUTERS REBUILD THE PAST

► Sophie Boukhari

Three-dimensional imaging is increasingly used to recapture the appearance of ancient sites and legendary figures. But not everybody is happy about seeing the past through 3-D spectacles

“Come back from the land of the dead!” is the startling exhortation made at the beginning of a new television film about Ramses II using digitally-engineered images. The film, not yet complete, brings history’s best-known pharaoh back to life from among his fellow mummies.

In one sequence, Ramses is puzzled when he finds that his temple of Abu Simbel no longer stands on the site where he built it. It was moved by UNESCO in the 1960s to save it from flooding caused by construction of the Aswan Dam. But he goes inside it when asked to do so by the god Amon. Today, the images engraved on the inner walls of the temple have lost their original colouring, but they appear in the film in all their former splendour. Thanks to French archaeologist Cécile Breton, their brilliant colours have been digitally restored.

“I worked from traces of colouring left on the walls,” she says. “Egyptian art was highly codified. We know a certain god’s crown should be red and his hat should be blue, and that Isis’s robe is either red or green. In the latter case we solve the problem by looking at other temples where the colours haven’t disappeared and choosing the more likely colour.”

Portraits in the round

The film, which is scheduled to be shown in September 2000, continues with an account by Michel Evenot, an official of the Paris Court of Appeal who for years compiled identikit portraits for legal use. Evenot, who died in July 1999, was pleased to be involved in the first attempt to make a three-dimensional reconstitution from a mummy.

“We were used to producing full-face and profile pictures,” he says, which in two dimensions (2-D), cannot be 100 per cent

compatible. Further research had to be done so that the two images were perfectly consistent. In 3-D, no “cheating” is possible. There is no room for approximations in digital models constructed from real data.

The Ramses II film, which is expected to cost around \$1.5 million, is a spectacular example of the extraordinary potential of new imaging technology for presenting the world’s cultural and monumental heritage.

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Initially developed for use in industry, digitization and animation techniques can be used to recreate the appearance of famous historical figures and sites that have crumbled away or disappeared beneath the waves. They also make for more effective restoration of fragile or badly damaged artworks and provide useful tools for archaeologists and curators of museums and sites.

“These technologies can be used in two ways with heritage,” says Benoît Coignard, a French “info-sculptor”. “You can reconstitute and preserve the shape of something and use it scientifically in various ways, and you can recreate a world and an environment for people to marvel at.”

Experimentation in 3-D imaging has proliferated since the late 1980s. Many places, from Egyptian heritage sites to ancient Indian villages in Ohio, prehistoric grottoes and jewels of Antiquity, have been made into 3-

D models for use in films, on the Internet or on interactive CD-Roms. The user can move around freely, whether just taking a casual look or carefully scrutinizing the image from every angle. Specialists note that the technique is only in its infancy.

“There are still only a few centres where this kind of work is underway at a sophisticated level,” says John Hancock, of the Center for the Electronic Reconstruction of Historical and Archaeological Sites, at the University of Cincinnati (U.S.). “Hardly anyone is pursuing the level of architectural and visual detail that is really required to bring ancient worlds to life.”

The obstacles are financial as well as technical. Synthesis imaging, which has made tremendous progress in the past decade, still cannot produce total realism. Heritage experts and engineers also sometimes have trouble understanding each other and working together. The equipment is still very expensive, even though prices are steadily falling. A 3-D scanner costs more than \$150,000, and making a computer model of a two-metre-high statue costs about \$30,000. This is not counting the cost of research, which makes the bill even bigger. “If you want to work scientifically,” says Breton, “it can take a week of research to pin down the exact position of a door or a detail of a piece of clothing.”

University projects are funded by governments or philanthropists. Many firms have become involved as a way of testing their new technology and getting publicity for themselves. Television stations and museums also invest in producing educational or entertainment programmes and along the way pay for archaeological research. But overall, says Richard Lapointe of Quebec’s Laval University, these technologies, under-used because they are so expensive, are far from being generally avail-

lable. "The world powers in heritage, archaeology and technology are Europe, North America, Japan and Australia," he says. In these rich parts of the world, the new imaging technologies are starting to be added to the archaeologist's toolkit. They make it possible to "document" objects without touching or spoiling them, says Philippe Martinez, an Egyptologist at the French National Centre for Scientific Research (CNRS).

In 1993, for example, a "virtual" archaeological investigation reconstituted the cargo scattered around an inaccessible wreck that has been lying in more than 660 metres of water since the first century AD. Three sets of photos were taken from a submarine that glided over the site. The

reconstruction of the church, which should be complete in 2003. The computer model was also used in a televised appeal to Germans that raised money for the project.

The advantages of imaging in heritage restoration have also been seen in Alexandria, in Egypt. Coignard tells how he reconstituted the city's colossus in 1998 using huge blocks of stone fished out of the sea. "We carried out a virtual reconstruction by digitizing bits of the sculpture with a 3-D scanner, moving them around the screen to see if they fitted together and then simulating the reassembly of the whole statue."

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Computer imaging recreates the face of pharaoh Ramses II (right) from his mummified body (left).

pictures were then processed by a computer to make a digital 3-D model.

In Thailand, the ancient capital of the kingdom of Siam, Ayutthaya, has been "reassembled" on a CD-Rom from vestiges scattered around the modern city. The church of Cluny in France was once the biggest edifice of medieval Christianity. Little is left of it today, but its appearance has been reconstituted thanks to synthesized images.

Using 3-D scanners and digital cameras, archaeologists report they can build models from drawings with unprecedented accuracy. These models can help them to refine their interpretation of historical evidence. "Hypotheses can be investigated and tested in new ways," says Hancock.

"We won't be able to say what's true, but we'll be able to say what isn't true," says Martinez. "In 2-D, if part of the structure gets in the way, you pick a new angle where it doesn't show and you get round the problem. In 3-D, every part has to fit perfectly with the others."

Computerized simulation of archaeological hypotheses has often led to the disapproval of theories and even to the acquisi-

tion of new knowledge. At a prehistoric site in the Ohio Valley, "the surrounding landscape context was restored to its original condition in order to test astronomical alignments," says Hancock. In Greece, advanced equipment belonging to France's state-owned utility Electricité de France and designed for testing nuclear power stations, produced a far clearer impression of the *tholos* (circular temple) at Delphi.

With the increasing threats to world heritage from wars, pollution, urban expansion and theft, back-up digital images of monuments and objects could be extremely useful. In Afghanistan, for example, where the statues of Buddha in the Bamyán Valley have been looted by the Taliban, Coignard says such imaging would have enabled the shape

of these remarkable objects to be recorded so they could be reproduced in the future. But the cost of such work is currently so prohibitive that only a few projects are underway. One of them, the ECHO project run by the University of California at Berkeley (U.S.) and sponsored by a group of big companies, seeks to record the shape of about 100 endangered Egyptian monuments.

These virtual clones can be used in restoration work. Here, the German city of Dresden has played a pioneering role. After German reunification, the government decided to rebuild this "Florence on the Elba" which had been bombed by the Allies in the Second World War. The city began by ordering a computer model of one of Dresden's architectural jewels, the Church of Our Lady (the Frauenkirche), an 18th-century church which had been reduced to rubble.

"When I presented the synthesized images for the first time in 1993, there was an extraordinary silence," remembers Luc Génévriez, who made them. "People were weeping." The virtual reconstitution, which drew on a mass of historical documents and photographs, was used as a guide in the real-life

advantage. "The best thing," says Coignard, "was being able to test the equilibrium of the statue. With the colossus, whose fragments were very worn, we managed to come up with a stable structure and a base which fitted perfectly and in theory enabled the statue to resist even earthquakes."

The new virtual images have "enormous potential" for visitors to museums, says Cliff Ogleby, of Melbourne University, in Australia. More and more museums are installing multimedia facilities and commissioning interactive products which both educate and entertain visitors. They can also display and sell them on their websites.

The museum next to the site of the huge Roman amphitheatre at El Djem, in Tunisia, today echoes as of old to the sound of gladiatorial combat. In France, the inaccessible underwater prehistoric site of the Cosquer Grotto has been turned into a film of digital images which will be presented at the Marseilles Museum in April 2000. In many places, major exhibitions of world heritage are enriched by interactive features that help fund the museums where they are held.

Like television and the film industry, ►

► “video games make wide use of 3-D modelling of heritage sites to flesh out their adventures,” says Lapointe. “This is the information age and archaeology is being popularized wherever there’s money to be made.”

Some historians and archaeologists are uncomfortable with this mingling of different worlds. Génévriez recalls the fuss the scientific community made in the early 1990s when he was asked, as part of IBM’s communication policy, to make synthesis images of the Cluny church and the Roman baths in Paris.

Beware of bogus images

“There were tremendous battles among the experts over the site, to the point where I had to work out my own ideas about it and finish the job by myself. The resulting film stirred up a dreadful row. I was accused of having distorted ‘the truth’ even though nobody knew what the truth was. Scientists are scared of pictures.” Often, he says, new technology upsets them because it makes them question their practices and familiar ideas and forces them to make choices. “Archaeologists spend their time dealing with uncertainty and think that when you don’t know something, you have to leave dotted lines in the drawings,” says Breton. “But 3-D images force you to come down off the fence.”

A lot of “bogus images” made from unreliable material are in circulation, says Martinez. Archaeologists also resent the fact that people make no distinction between images based on a massive amount of scientific work and images in video games.” From this perspective, the dangers of the virtual world are real. The general public is presented with reconstitutions of ancient sites but has neither the means nor the desire to question their scientific quality now that technology can produce images almost as good as photographs.

But despite these reservations, more and more scientists, especially in the English-speaking countries, are moving into 3-D modelling. “Any means of representation involves conjectures, distortions and the possibility of misreadings,” admits Hancock. But these drawbacks are outweighed, he believes, by the advantages of increasing public awareness of world heritage and the importance of protecting it. ■



● **Website of the International Festival of Multimedia in Archaeology, Archeovirtua:**
perso.cybercable.fr/platypus/inscrit.html

Other websites:

- www.cdv.berkeley.edu/ECHO/
- www.learningsites.com
- www.cerhas.uc.edu
- www.sli.unimelb.edu.au



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In 1945, the church of Our Lady in Dresden (Germany) was reduced to rubble by bombing (top). The edifice is now being rebuilt (middle photo). To help the builders, the city authorities commissioned a virtual reconstruction of the monument (above).