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Technology brings new insights to ancient language

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New technologies and academic collaborations are helping scholars at the University of Chicago analyze hundreds of ancient documents in Aramaic, one of the Middle East's oldest continuously spoken and written languages.

Members of the West Semitic Research Project at the University of Southern California are helping the University's Oriental Institute make very high-quality electronic images of nearly 700 Aramaic administrative documents. The Aramaic texts were incised in the surfaces of clay tablets with styluses or inked on the tablets with brushes or pens. Some tablets have both incised and inked texts.

Discovered in Iran, these tablets form one of the largest groups of ancient Aramaic records ever found. They are part of the Persepolis Fortification Archive, an immense group of administrative documents written and compiled about 500 B.C. at Persepolis, one of the capitals of the Achaemenid Persian Empire. Archaeologists from the Oriental Institute discovered the archive in 1933, and the Iranian government has loaned it to the Oriental Institute since 1936 for preservation, study, analysis and publication.

The Persepolis texts have started to provide scholars with new knowledge about Imperial Aramaic, the dialect used for international communication and record-keeping in many parts of the Assyrian, Babylonian and Persian empires, including parts of the administration at the imperial court of Persepolis. These texts have even greater value because they are so closely connected with documents written in other ancient languages by the same administration at Persepolis.

"We don't have many archives of this size. A lot of what's in these texts is entirely fresh, but this also changes what we already knew," said Annalisa Azzoni, an assistant professor at the Divinity School of Vanderbilt University. Azzoni is a specialist on ancient Aramaic and is now working with the Persepolis Fortification Archive Project at the Oriental Institute. "There are words I know were used in later dialects, for example, but I didn't know they were used at this time or this place, Persia in 500 B.C. For an Aramaicist, this is quite an important discovery."

Clearer images delivered more quickly

Scholars from the West Semitic Research Project at the University of Southern California helped the Persepolis Fortification Archive Project build and install an advanced electronic imaging laboratory at the Oriental Institute. Together, the two projects are making high-quality images of the Aramaic texts and the seal impressions associated with those texts. They are distributing the new images to the international research community through the Internet.

Inked and incised texts pose different problems that call for different imaging solutions. Making high-resolution scans under polarized and filtered light reveals the ink without interference from stains and glare, and sometimes shows faded characters that cannot be seen in ordinary daylight. Using another advanced imaging technique, called Polynomial Texture Mapping, researchers are able to see surface variations under variable lighting, revealing the marks of styluses and even the traces of pens in places where the ink itself has disappeared.

Distributing the results online will give worldwide communities of philologists and epigraphers images that are almost as good as the original objects—and in some cases actually clearer than the originals—to study everything from vocabulary and grammar to the handwriting habits of individual ancient scribes.

Researcher Marilyn Lundberg and her colleagues from the West Semitic Research Project



Tablets uncovered at Persepolis in Iran are covered with writing in Aramaic. The archive, being studied at the University of Chicago, provides new insights on the language, which has been written and spoken in the Middle East continuously since ancient times. (*Oriental Institute, University of Chicago*)

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built two Polynomial Texture Mapping devices from scratch at the Oriental Institute. They trained Persepolis Fortification Archive Project workers in using them, and also in using filtered light with a camera equipped with a high-resolution scanning device. Now a stream of raw images is uploaded every day to a dedicated server maintained by Humanities Research Computing at Chicago, then uploaded for post-processing at the University of Southern California. Fully processed imagery is available on InscriptiFact, the online application of the West Semitic Research Project, and in the Online Cultural Heritage Research Environment, the online application of the Persepolis Fortification Archive Project.

Seeing the whole picture

The Polynomial Texture Mapping apparatus looks a bit like a small astronomical observatory, with a cylindrical based topped by a hemispherical dome. The camera takes a set of 32 pictures of each side of the tablet, with each shot lit with a different combination of 32 lights set in the dome. After post-processing, the PTM software application knits these images to allow a viewer sitting at a computer to manipulate the apparent direction, angle and intensity of the light on the object, and to introduce various effects to help with visualization of the surface.

“This means that the scholar isn’t completely dependent on the photographer for what he sees anymore,” said Bruce Zuckerman, Director of the West Semitic Research Project and its online presence, InscriptiFact. “The scholar can pull up an image on the screen and relight an object exactly as he wants to see it. He can look at different parts of the image with different lighting, to cast light and shadow across even the faintest, shallowest marks of a stylus or pen on the surface, and across every detail of a seal impression.”

“This is a wonderful way to look at seal impressions,” said Elspeth Dusinberre, another Persepolis Fortification Project collaborator. Dusinberre, an associate professor of classics at the University of Colorado, is studying the imagery and the use of seals impressed on the Aramaic tablets. “Some of the impressions are faint, or incomplete, on curved surfaces or damaged surfaces. Sometimes Aramaic text is written across them. You need to be able to move the light around to highlight every detail, to see the whole picture.”

The Persepolis Fortification Archive also includes about 10,000 to 12,000 other tablets and fragments with cuneiform texts in Elamite—a few hundred of them with short secondary texts in Aramaic. There are also about 4,000 to 5,000 others with impressions of seals, but no texts, and there are a few unique documents in other languages and scripts, including Greek, Old Persian and Phrygian.

“That’s what makes this group of Aramaic texts so extraordinary,” Stolper said. “From one segment of the Persepolis Fortification Archive, the Elamite texts, we know a lot about conditions around Persepolis at about 500 B.C. When we can add a second stream of information, the Aramaic texts, we’ll be able to see things in a whole new light. They add a new dimension of the ancient reality.”

Impacts are far-reaching

The collaboration between the Oriental Institute at Chicago and the West Semitic Research Project at Southern California began with support from a substantial grant from the Andrew W. Mellon Foundation in 2007. To date, the teams have made high-quality images of almost all the monolingual Aramaic Fortification tablets. The next phase of the work, supported by a second Mellon grant that runs through 2010, will make images of the short Aramaic notes written on cuneiform tablets, seal impressions on uninscribed tablets and previously unrecorded Elamite cuneiform texts.

The tablets have been studied since they came to Chicago in 1936, and many of them have been sent back to Iran. Oriental Institute scholar Richard T. Hallock published about 2,100 of the Elamite texts in 1969, and Margaret Cool Root and Persepolis Fortification Archive Project collaborator Mark Garrison are completing a three-volume publication of the impressions made on those documents by about 1,500 distinct seals.

These publications have had far-reaching results. “They have transformed every aspect of modern study of the languages, history, society, institutions, art and religion of the Achaemenid Persian Empire,” Stolper said. “No serious treatment of the empire that Cyrus and Darius built and that Alexander destroyed can ignore the perspectives of the Fortification Archive.”

“If that is the effect of a sample of one component of the archive,” added Garrison, “imagine what will happen when we can have larger samples and other components, and not just the written record, but the imagery, the impressions made by thousands of different seals that administrators and travelers—the men and women who figure in the texts—employed.”

By 2010, the collaborating teams expect to have high-quality images of 5,000 to 6,000

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Persepolis tablets and fragments, and to supplement these with conventional digital images of another 7,000 to 8,000 tablets and fragments. The images will be distributed online as they are processed, along with cataloging and editorial information.

"Thanks to electronic media, we don't have to cut the parts of the archive up and distribute the pieces among academic specialties," said Stolper. "We can combine the work of specialists in a way that lets us see the archive as it really was, in its original complexity, as one big thing with many distinct parts."

Related links:

- [InscriptiFact \(West Semitic Cultural Research Project\)](#)
- [Online Cultural Research Environment](#)
- [Cuneiform Digital Library Initiative \(UCLA\)](#)
- [Musée Achéménide \(Collège de France\)](#)
- [Persepolis Fortification Archive Project at the Oriental Institute](#)
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