

# MYSTERIOUS SCROLLS

*Technology is helping experts to read papyri safely, says Robert Fowler, and as such, we stand on the edge of a new age of discovery.*

The largest library to survive intact from the Greco-Roman world was discovered in 1752 in the Villa of the Papyri, a luxury country residence that almost certainly belonged to Lucius Calpurnius Piso Caesoninus, father-in-law of Julius Caesar. It had been buried at Herculaneum by the eruption of Vesuvius in AD 79. When the workers, tunnelling underground, first came across the burnt papyrus scrolls, they thought they were charcoal, and used them for fuel, until one fell apart and revealed writing in the interior. From that moment on the quest began to read the books.

It was no easy task. The volcano had miraculously preserved the scrolls by a combination of carbonisation in the pyroclastic flow and burial in airless mud, which blocked all agents of decay. But the rolls were crushed and distorted; many had suffered water damage before carbonisation; the slightest touch can reduce the crusty chunks to powder; exposed layers are still ferociously difficult to read.

The story of early, catastrophically destructive efforts to prise the rolls apart makes for dismal reading, but they did succeed in identifying the contents of many books as Epicurean texts in Greek, particularly by the first-century BC philosopher Philodemus, whose patron was Piso. The texts link directly to great names: Horace and Virgil were part of Piso's circle, and there are strong echoes of Philodemus' philosophical themes in Virgil's *Aeneid* and Horace's *Ars Poetica*. They also raise the possibility that more remains to be found in the parts of the Villa the 18th-century diggers could not get at—the rest of the Greek books, and the Latin library.

Be that as it may, the efforts of scholars in recent decades have been focused on improving readings of texts we already have rather than on discovering more. Physical interference



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## **Unravelling a scroll is no easy feat**

with the unopened scrolls has stopped. In the past decade, multi-spectral imaging (MSI) has dramatically improved the readings. Black ink on charred papyrus is nearly impossible to read with the naked eye, but MSI scans the text through a range of invisible light frequencies until one is found where the ink reflects back, but the papyrus does not. The computer enhances the contrast, and the images are as fresh as yesterday's newspaper.

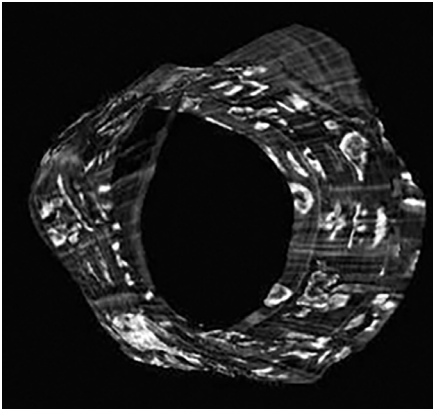
This technique has revolutionised the publication of the unrolled Herculaneum papyri. For the hundreds of unopened papyri, however, the Holy Grail is to find a non-invasive method of reading without physical contact.

There are two aspects to this. One is mapping the interior of the papyrus; the other is identifying the ink. Professor Brent Seales of the Department of Computing Science, University of Kentucky, has been working on the first

problem since 2003, originally in contexts far removed from papyrology.

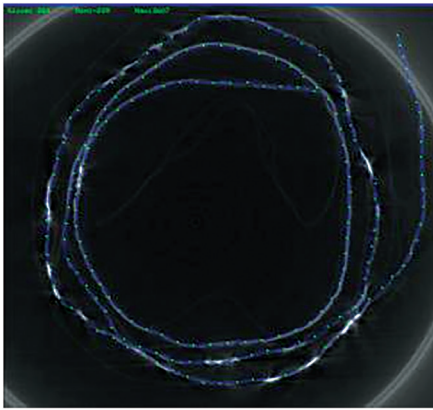
Professor Daniel Delattre of the Sorbonne in Paris is a leading papyrologist, and in 2009 he and Professor Seales teamed up to scan two Herculaneum rolls preserved in Paris. They used X-ray computed tomography (CT), exactly like medical scanning, except that for this purpose a finer resolution is needed. CT detects differences in density, and the data reveals the structure of the interior. Hopes were high that CT would also be able to distinguish between ink and papyrus. A mock-up with modern ink and papyrus worked a dream: each salami slice clearly showed the spots of ink on the whorl; Professor Seales's programme then combined the slices, joined the dots of ink, and unrolled the image virtually from three dimensions to two. Unfortunately, ancient ink, being made of lampblack and gum, is carbon-

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*Each salami slice clearly showed the spots of ink on the whorl*

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*Cross-section showing dots of ink*

based, and the metallic composition of modern ink is what makes it stand out. The ink on the Paris rolls remained hidden.

Further work will enable detailed navigation of the interior of Herculaneum papyri, where mangled layers intersect with each other, and bits from one or more layers stick to their neighbours. The near-molecular level of analysis involves enormous quantities of data, and not coincidentally, given Google's day-to-day business, Professor Seales has been joined in the latest phase of research by Steve Crossan of the Google Cultural Institute, Paris. Meanwhile, the second aspect of the problem, distinguishing the ink, formed the subject of other experiments in which Professor Delattre was involved, leading to a spectacular announcement in Nature Communications last January.

Scientists at the European Synchrotron Radiation Facility in Grenoble subjected one of the Paris rolls to X-ray phase-contrast tomography, looking for disruptions in the X-rays caused by the tiny differences in elevation between the ink and the underlying surface. The technicalities (well beyond the comprehension of the current writer) may be omitted here, but the interested can most easily consult the Nature article through the website of

the Herculaneum Society. Professor Delattre was able to reconstruct the scribe's complete alphabet (except for the relatively uncommon letters xi and psi), and identify peculiarities in the hand that resemble those in another Herculaneum Papyrus (no. 1471), enough to date the roll to the first century BC and suggest that it may be another Philodeman work.

The concept has been proved, but much work remains to be done. The letters are still very indistinct, and finding strings of connected letters depends on knowing, or making a shrewd guess, that the traces come from the same layer of papyrus. Future experiments, already in planning, will test variables in the beamline (energy levels, band-width, and resolution). Once these two prongs of the attack—the mapping, and the reading—have been sharpened to precision, they then need to be forged into one incisive weapon, enabling the transcription of hitherto inaccessible scrolls containing who knows what riches.

Beyond the Herculaneum scrolls beckon the many crates of papyrus mummy cartonnage in the storerooms of museums, for whose inner layers ancient texts, no longer wanted by their owners but precious to us, often provided the stuff. We stand on the edge of a new age of discovery.

# WRITERS ON GREECE

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*The late Patrick Leigh Fermor's house, Kardamyli, Greece*