

# In Plato's words

## How AI is helping to reveal the secrets of ancient scrolls

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Science editor

**M**ore than 2,000 years after he died, Plato, the towering figure of classical antiquity and founder of the Academy, still makes the news.

Researchers this week claimed to have found the final resting place of the Greek philosopher - a patch in the garden of his Athens Academy - after scanning an ancient papyrus scroll recovered from the library of a Herculaneum villa that was buried when Mount Vesuvius erupted in AD79.

The project belongs to a new wave of efforts to read, restore and translate ancient and even lost languages with cutting-edge technology. Armed with modern tools, many powered by artificial intelligence, scholars are reading the unreadable.

"It's going to have a huge impact," says Dr Kilian Fleischer, a papyrologist who worked on *The History of the Academy*, the scroll that revealed details of Plato's life. "There will be scrolls that will be read with these new techniques that contribute to our knowledge of antiquity, and to literature in general. This might be a second Renaissance."

The *History of the Academy*, written by the philosopher Philodemus, has been studied for many years. The researchers' goal was to produce a more comprehensive edition - no easy task when the scroll is in pieces from being unrolled and the papyrus is as black as the ink used on it. Substantial portions of text are faded, missing or illegible.

Prof Graziano Ranocchia, project leader at the University of Pisa, used hyperspectral imaging to illuminate the scroll fragments with broad-band infrared light. The images reveal letters that are invisible to the naked eye, giving scholars crucial clues to the missing words. Fleischer likens it to completing a crossword: sometimes it takes only a single letter to be confident of an answer.

"It's a wonderful feeling, this moment of reading something new

► *Plato's place of burial, previously unknown, is now thought to be in the garden of his Athens Academy, near where his statue still stands*

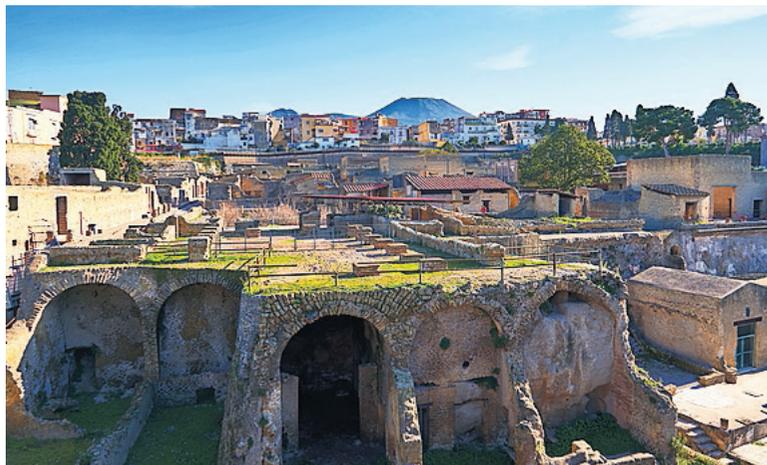
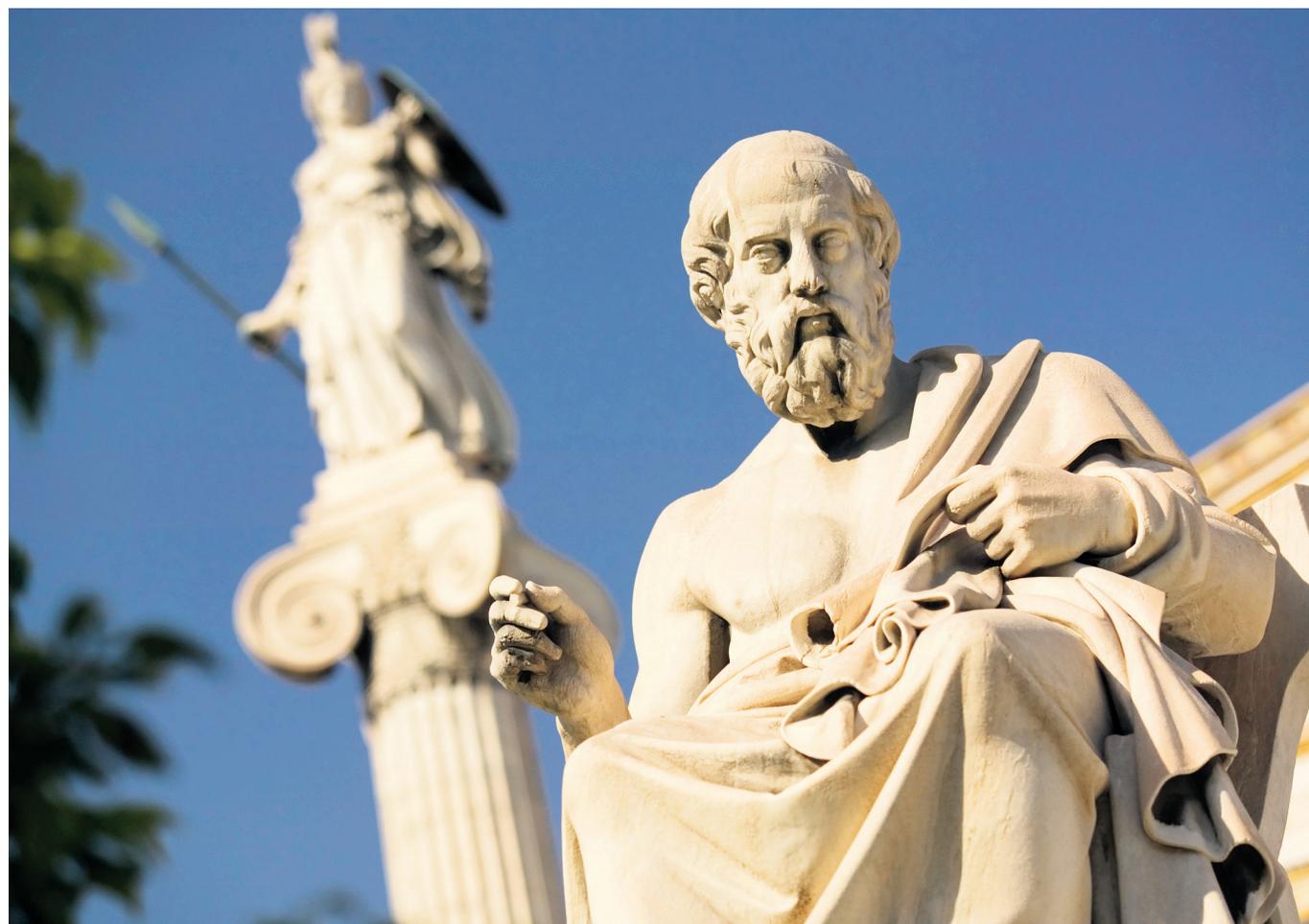
and knowing this was information other researchers have wanted for decades or centuries," Fleischer said. "We are travelling back and seeing text which hasn't been read for 2,000 years."

Armed with the scans, the team reconstructed 20% to 30% more text, with the additional words slotted into place amounting to 1,000 extra letters. The words for "buried" and "garden" do not appear - they are surmised from other characters and context.

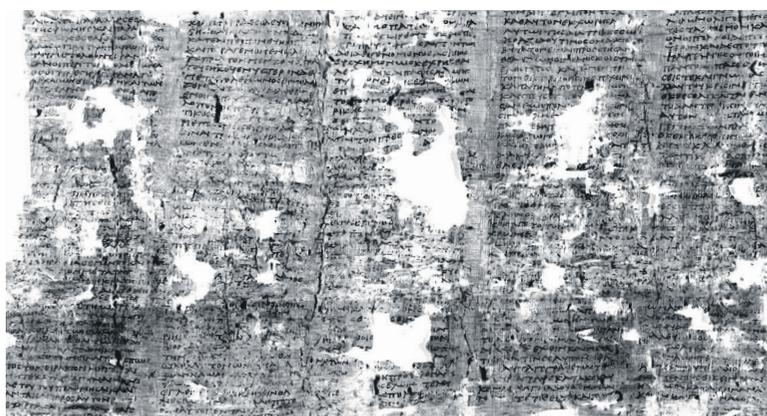
Seeing the manuscript emerge was "a marvel", Ranocchia said. One exciting passage is where Philodemus mentions as yet unknown books on the Megarians and the Cynics that may be among the hundreds of charred and unopened scrolls in the National Library in Naples, or are perhaps still buried at the doomed villa.

For many scholars, the prospect of reading the unopened Herculaneum scrolls is profoundly exciting. Carbonised in the blast that overwhelmed Herculaneum, the scrolls are too fragile to physically unroll. But researchers led by Brent Seales, a computer scientist at the University of Kentucky, showed there is no need to. The team developed techniques to virtually unwrap CT scans of the scrolls, and trained machine learning algorithms to detect ink on the warped, blackened pages, often by spotting subtle changes in the patterns of the papyrus fibres.

The work led to the Vesuvius Challenge, a competition backed by Silicon Valley entrepreneurs with lucrative prizes for the team that deciphered the most text from scans of scroll fragments. In February, three students shared the \$700,000 (£557,000) grand prize after reading hundreds of Greek words across 15 columns of the scroll. Dr Federica Nicolardi,



PHOTOGRAPHS: JON HIGGS/GETTY; SEBASTIAN GONDREA/GETTY, NRI



▲ *One of the scrolls found in Herculaneum, top, whose secrets were revealed by*

*AI-assisted interpretation - which can assist when scrolls cannot be unrolled, below*



a papyrologist at the University of Naples Federico II, is studying one of the columns in which Philodemus discusses how perception begets knowledge.

The contents of the remaining scrolls are up for debate. Some are stuck together, potentially indicating how ancient libraries were organised.

Nat Friedman, founding sponsor of the challenge, has announced a further set of prizes to spur researchers on to read 90% of a scroll by the end of this year. A major bottleneck is the tedious process of "segmentation", which

involves manually tracing layers of the digital scroll so the text-reading algorithm doesn't confuse layers. Work is under way to automate the process. "That should unlock gobs and gobs of text," Friedman said. In anticipation, he has booked beam time on the Diamond Light Source in Oxfordshire to scan dozens of Herculaneum scrolls.

These technologies could also be used to read papyrus wrapped around Egyptian mummies, with sheets that range from letters to laundry lists. There are boxes of such stuff in the back rooms of museums.

Dr Thea Sommerschild, a historian and epigrapher at the University of Nottingham and Yannis Assael at Google DeepMind are co-leads on a project called Ithaca. Using state-of-the-art AI, it can predict missing characters in Greek inscriptions and propose times and places where they may have been produced, promising to shed fresh light on the ancient world. Inscriptions in stone, ceramics and metals preserve writing from around the globe and from a cross-section of society, not just emperors and the elite. "They give us information about thought, language, society, and politics of the ancient world at large," said Sommerschild.

So far, the best results have come from multi-disciplinary teams with computer engineers working with scholars. Such mixed teams are vital, said Sommerschild, as are efforts to build clean and well curated datasets that cover other popular languages and writings from around the world.

"If we have that kind of interaction then we will earn the trust and interest and engagement of computer scientists, the general public and the scholarly communities."