

# Ancient world's multicultural secrets revealed by handwriting analysis of scrolls

October 18 2022, by Ethan Bilby

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Credit: AI-generated image ([disclaimer](#))

Advanced techniques to analyze the Dead Sea Scrolls and Eastern papyri are revealing vibrant secrets about daily life in the ancient world.

Around 2,100 years ago, a Judaeen scribe deftly swirled a stylus to dab the final strokes of black ink onto a piece of parchment.

His work, a copy of the biblical Book of Isaiah from the Old Testament, would soon be complete in the form of a seven-meter-long scroll. But was he finishing his own work—or someone else's?

Though the Dead Sea Scrolls were discovered more than 70 years ago, sophisticated computing techniques are now revealing the invisible hands that wrote the famous texts and Professor Mladen Popović at the University of Groningen thinks he knows the answer.

"My simple idea was to use paleography—their handwriting," he said.

Paleography is the scientific study of ancient handwritten texts. The goal of the paleographer is to identify the location and time of writing. Texts come on parchment but also pottery, metal, cloth and even casual graffiti as discovered on the walls of Pompeii.

## **Muscle movements**

"The way you write, the way I write, is very person-specific," Prof Popović said. "It is your muscle movements and it is very individual."

Working with Artificial Intelligence (AI) expert Prof Lambert Schomaker and other team members as part of the HandsandBible project, he developed new machine learning computing methods to analyze ancient handwriting digitally.

"The beauty of the technology we have now is that you can make high spectral images and go down to the pixel level, and then make all sorts of calculations which you can boil down to movement," Prof Popović said. "Through their handwriting, we can, as it were, shake hands with them."

Researchers spent many long hours painstakingly tracing Hebrew letters to teach a computer model what was ink and what was not. The results

were 3D models of manuscript texts that include more than 5,000 dimensions of calculations.

## **Isaiah scroll**

Back in a lab in the Netherlands, Maruf Dhali, one of the team members, was puzzled by the results the computer model was producing.

It showed that, roughly halfway through the text of the Isaiah scroll, the handwriting changed enough to indicate another scribe took over. While statistically significant, it was barely perceptible visually.

The researchers considered other options. Could he have changed his pen? Or had he perhaps stopped writing and picked up again much later?

"They write so alike, but the most likely explanation really is that there are two different scribes," said Prof Popović. "One scribe is so good at imitating the other that, with the naked human eye, you can't really see that."

While scholars had previously debated whether or not there were multiple writers of the Isaiah scroll, this was the first robust evidence that two scribes had produced it.

Could the AI be wrong? Less likely, according to Prof Popović.

"The human paleographer, the expert, is much more of a black box," he said. "We don't really know what goes on in our minds. Of course, we have this expertise, but we cannot explain all of our paleographic reasoning."

By using a trained computer, he says, paleographers are challenged to better explain the observations they make with human eyes.

## Time machine

The ability to drill down to the handwriting of individual scribes and connect them with various works opens up a whole new way for researchers to look at texts, as well as understand their scribal culture.

For instance, there is evidence that some Dead Sea Scroll scribes were just learning how to write. A scribe was discovered who wrote both Hebrew manuscripts and Aramaic (an [ancient language](#) which was the lingua franca of the Middle East 2-3 000 years ago) ones, giving researchers new insights into their language abilities.

"Another example is how we look at those scribes—is there also some individuality or space for them to maneuver?" said Prof Popović. "We see there is variation there, so they were not just slavish robots copying what they were told to copy."

With this paleographic approach, these scrolls even act like a sort of time machine.

"We can see a little part of what was the cultural evolution that became the Bible," he said. "It's the same sort of scribal culture. The way they write here was also how they worked two to three centuries before."

## Ancient writers

Prof Maria Chiara Scappaticcio has also been using texts to reveal new details from the lives of ancient people.

Stemming from the era when Rome controlled Egypt between 30 BCE and 641 AD, she and her team have been traveling from Berkeley to Berlin to catalog fragmentary papyrus rolls that contain Latin as part of

the PLATINUM project.

They have been combing through the papyri using techniques like ultraviolet photography. In this way, they have been able to discover new texts, as well as better understand the meaning of existing ones.

The fragments are revealing much about the daily lives of ordinary people, according to Prof Scappaticcio.

The team has been working on "documents between private people who were lending things, letters between soldiers asking for new shoes, etc.," she said.

## **Ancient multiculturalism**

But the texts also gave the team a chance to better understand the lives of Roman Egyptians and how their identity mixed with Roman culture of the time.

"Multiculturalism and multilingualism are key words of our reality," said Prof Scappaticcio. "It was actually almost the same thinking about antiquity, with the necessary caveat due to the chronologic distance."

Researchers found texts of the Aeneid, the Latin epic verse penned by Virgil glorifying the foundation of Rome, being used in local language instruction.

"In the peripheral areas of the Empire, Latin was the language of power," she said. "Rome imposed its power, and literature was one of the instruments through which to do that."

Through their research, her team was even able to uncover the first text showing Arabic transliterated as Latin, as well a literary work by Seneca

the Elder (father of the better known Roman philosopher by the same name) thought to have been completely lost.

The team has assembled an exceptional number of texts in this new study. "In 2023, we will publish a corpus of roughly 1,500 Latin texts on papyri," Prof Scappaticcio said.

A previous collection, from 1958, contained a mere 300 texts. The goal is to allow a broader range of scholars to access Latin works written and circulating from the fringes of the Roman Empire.

"I hope it will be a point of departure, using this corpus as a tool to investigate Roman orientalism," she said. "It was an open society and a lot of aspects flowed from one culture to another. It was not so much different from today."

**More information:** HansandProject:  
[cordis.europa.eu/project/id/640497](https://cordis.europa.eu/project/id/640497)

PLATINUM Project: [cordis.europa.eu/project/id/636983](https://cordis.europa.eu/project/id/636983)

Provided by Horizon: The EU Research & Innovation Magazine

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