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Restoration of Joan Planella's huge painting of revolting commoners was helped by an 1887 photograph

Zapatero recalled as the initial response. However, the phone call prompted interest in a rescue plan. If Castilla and Leon was willing to take on the restoration, the Prado would cede the work for exhibition in a space that gave meaning to its subject.

The deal was struck and *The Comuneros of Castilla* arrived without fanfare in the city of Valladolid which it depicts last June, where it had to acclimatise for several months.

Ana González Obeso, chief of the restoration team, said: "The scale of the work was the biggest challenge; it is unprecedented."

With the clock counting down to its official presentation, the restorers are recovering details last seen in a different Spain: the ring on the hand of the main figure confirms the haughty knight as the warrior bishop of Zamora, Antonio Acuña, who was executed for his role in the uprising. On the horizon, women wave red cloths as their menfolk ride out to battle.

## Masterpiece redefines slice of Spain's history

**F**or almost four decades a once-lauded 19th-century Spanish painting larger than Picasso's *Guernica* languished in a basement, exposed to damp and rot (David Sharrock writes).

*Los Comuneros de Castilla* (*The Commoners of Castilla*), rare in its size and its depiction of Castilian nationalists not in defeat but on a war footing in revolt against King Carlos I, was hidden away at the outbreak of the Spanish Civil War and remained lost until the 1980s.

Now it has become

the subject of the largest restoration of a painting owned by the Prado art gallery in Madrid.

The work is so big that the restoration has had to be carried out in its future exhibition space, the lobby of the Cortes de Castilla y Leon, the local parliament.

The journey from when it last hung on a gallery wall to its revival began in 1936. As Spain descended into war the artwork, measuring almost 40sq m, by the Catalan painter Joan Planella, was rolled up and put in the basement of the Catalonia Museum of Art to save it from damage.

The painting had won

an award in the 1887 National Exhibition of Fine Arts before it was bought by royal decree for the state for 4,000 pesetas. It was sent to Barcelona and displayed at the School of Fine Arts, then the City Hall before being secreted in the damp basement.

In 1986 the Prado recovered it and did what it could to prevent further deterioration of the canvas before sending it to a storage warehouse with a third of its artworks. In 2020 an accident led to its rediscovery and the restoration began.

Juan Zapatero, director of the Castilla and Leon Foundation, was preparing for the 500th anniversary of the Revolt of the Comuneros, the citizen's uprising against Carlos that nearly changed the course of Spanish history. He chanced

upon a black-and-white photograph of the painting taken in 1887 — the only remaining evidence of its existence — and put in a request to the Prado for it to be lent for the commemoration.

"You have no idea what you've asked for,"

# 3D printing? It's a piece of (cheese) cake

A milestone has been reached in digital food creation. But what does the result taste like? **Will Pavia** finds out

About tea time on a drizzly afternoon, Jonathan Blutinger began printing a slice of cheesecake.

"We just have to upload the recipe file," he said, punching commands into his computer. He told everyone to cross their fingers. "As soon as we upload this, it will just start printing right away."

There was a moment's silence, akin to the quiet in the control centre at Houston, before a rocket launch. A research assistant, Evan Omo, counted down: "Three, two, one."

Then there was a mechanical hum, as the arm of a 3D printer slid forward and picked, from a bracket of cartridges, a tube full of biscuit paste. This was lowered into position and began to squirt a line of brown thread, drawing a triangular shape on a grey plate.

The researchers have described in a newly published paper how they managed to "print and laser-cook a seven-ingredient slice of cake". Seven ingredients was, by all accounts, a

landmark in the still-early history of food printing: the most ever used.

What did it taste like? "Everybody asks that question," Blutinger said. Their paper is silent on this detail.

The truth was that it had taken them about two months of intense tinkering from late 2019, involving a series of collapsing prototypes. Then, on February 11, 2020, they managed one that resembled a slice of cheesecake. There was intense jubilation, though not for too long, as everyone was still vaguely worried that the thing might fall over.

"We took a lot of pictures," Blutinger said. "We said: 'All right! Nobody breathe.' Then I immediately put it in the freezer so we could cut it in half and show the interior."

So they did not actually eat it. It was frozen, like a piece of wedding cake. This week, more than three years later, their paper, along with the photographs of the untasted prototype cake, were published in the journal *npj Science of Food*. Blutinger said he would have felt unable, as the scientist behind the paper, to offer an unbiased opinion on the cheesecake if he had tried it. "Would you have taken my word?" he asked.

Hod Lipson, the head of the Creative Machines Lab at Columbia University in New York, where the cheesecake-making took place, advised them that



The machine squeezes out layers of crackers, peanut butter, jam and icing

### How it took shape

In 1945 the American sci-fi writer Murray Leinster described a strange machine with a drawing arm producing plastic (Max Kendix writes). "This thing will start at one end of a ship or a house and build it complete to the other end, following drawings only," he said.

Forty years later the first "additive manufacturing equipment" was invented and the new millennium heralded the first 3D-printed kidney, then, in 2004, 3D printers that could replicate themselves.

Since then inventors have made 3D printed prosthetics, cars, houses and even stem cell Wagyu beef.

The machines can also produce guns — a concern for the police as criminals download easily accessible blueprints for rifles and ammunition from the United States.

"you are like Beethoven, you can't listen to your own symphony".

But after some back and forth, he agreed to attempt a sequel, which I could eat.

The newest version of the food printer was in a small kitchen in the corner of the laboratory. "The old machine only had seven ingredients. This one can do 18," Blutinger said. "Right now I'm measuring the toner levels."

He has to get this right because the machine cannot sense when it has squirted out too much, he said. If you give it too much butter, it will still use all of it.

A drawback of food printing is that you have to use pastes. An advantage is that you can make things with extraordinary precision. "The other cool thing is the shareability," Blutinger said.

In *Charlie and the Chocolate Factory*, Roald Dahl imagines a new type of television that broadcasts not only pictures but actual chocolate bars viewers at home can pluck from their TV set.

Digital food manufacturers could offer something similar during commercial breaks. "A QR code pops up on the screen, it says: 'Check out this,'" Blutinger said. "You take a picture of it, send it to your machine, it prints it for you."

He moved to his computer, and pulled up a model on the screen. "Here is our cheesecake," he said. This would be run through "slicer software", that would break it down into layers.

He also had to determine something called the "extrusion multiplier" — the force with which the machine would squirt the food paste, depending on its viscosity. Biscuit paste requires more of a shove than strawberry jam.

He was almost ready to print now, but

for some computer code. He had contacted a software engineer to write the code for the cheesecake, but she was busy giving a class, he said. Gordon Ramsay would probably have started swearing, at this point, but Blutinger remained calm.

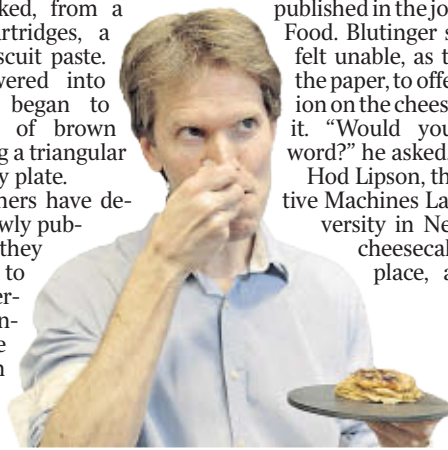
After the code was provided, the cake began to print. The biscuit paste formed a triangular base, but then parts of it rolled and swelled beneath the nozzle, forming little walls that were not part of the design. The calculations were slightly off, he said. "It's extruding more graham cracker than we need right now."

But the printer kept at it, adding layers of peanut butter and little internal reservoirs of jam and chocolate. After about half an hour, it had nearly reached the final layer of pink frosting when the arm failed to release a cartridge and began reaching for another. Omo, the research assistant, hit the stop button.

Blutinger removed the cheesecake and handed it to me. It had sagged slightly at the sides but the top was still fretted with a pattern of thread-like lines, as if the cake had been spun like a jumper. It had the texture of mousse, and tasted greatly of biscuit and peanut butter.

"We are not Michelin-starred chefs, we are engineers," Blutinger said. He took a spoonful himself. "Too much graham cracker," he said. "We just need to change a couple of things and we'd totally change the flavour of this."

Science, unlike cheesecake, is never finished. Perhaps, if everyone could spare another half an hour or so, he could print off another one, Blutinger said. "I think this could be improved."



Will Pavia trying some of the cheesecake printed at Columbia University