co-authors have addressed image modifications in at least 16 papers, providing original data for several more and apologizing for mistakes. He has also requested image corrections at various journals; most editors have accepted them, although some deemed them unnecessary, according to screenshots of e-mails posted on the lab website. Only one image has been retracted.

Hetz tells *Nature* he plans to make changes to his lab, aimed at ensuring his science is "bullet proof". One measure is to reduce his lab from 21 people to 18 by March next year. The university has put in place an external team of researchers that will review the lab's results and make sure they're consistent with the raw data before permitting the team to submit them for publication. The university's school of medicine, with which Hetz is affiliated, will institute scientific-integrity training for its researchers and students.

A time of transformation

But some Chilean researchers are upset about the outcome. They say Hetz's actions go against scientific practice and ethics, and that the consequences are not harsh enough. "I think he should receive an exemplary sanction" such as temporarily being barred from mentoring new students, says Ximena Báez, a biotechnologist at the Federico Santa María Technical University in Valparaíso, Chile, who is also president of the National Association of Postgraduate Researchers in the country.

For Adriana Bastías, a plant geneticist at the Autonomous University of Chile in Santiago who is also the president of the Chilean Network of Women Researchers, the fact that Hetz was investigated twice and not punished in any significant way, in her view, "means that when you have power, publications, and you are a great scientist, you are not investigated or sanctioned in the same way" as early-career scientists or less prestigious researchers might be. She thinks these people would probably be expelled or suspended.

Flavio Salazar, an immunologist and vice-rector for research and development at the University of Chile, who co-commissioned the investigation, acknowledges that the case has caused a fierce debate. He condemns Hetz's actions. But he says the committee's findings must be upheld, and thinks that having made the report public "generates a kind of moral sanction, which is not minor".

Others think the case sets a poor precedent, particularly at a time when journal publishers are trying to rein in the growing problem of image manipulation by issuing guidelines on how to deal with incidents ranging from data "beautification" to fabrication with an intent to mislead. C. K. Gunsalus, a research-integrity specialist at the University of Illinois at Urbana-Champaign, thinks Hetz's actions damage the education of early-career scientists and undermine trust and accountability in the scientific process. "When someone persists with a pattern of behaviour over a long period of time that results in untrustworthy work, even after an intervention, it is hard from a distance to see that as other than a deliberate set of choices or a reckless disregard for scientific integrity," says Gunsalus, who read a translated version of the 2021 committee findings at *Nature*'s request.

"I think these are very unfair opinions," Hetz says. "I actively take action to improve Chilean science." He says that his lab probably has some of the highest quality standards in the country, and adds that as director of the Biomedical Neuroscience Institute, he has promoted initiatives to improve the use of logbooks and create systems to back up data.

Some scientists worry that the case is emblematic of Chile's current struggles. "What [Hetz] did is absolutely questionable," says Mercedes López Nitsche, a clinical immunologist at the University of Chile. "But we must not forget that this was enabled because, in Chile, we built a society and a culture where ethics is no longer the rule."

For now, Hetz says he's ready to move on. "I'm really tired," he says. "I consider this a closed chapter; now comes a process of learning and improvement."

BURNT SEEDS SHOW PEOPLE USED TOBACCO 12,000 YEARS AGO

Earliest evidence that hunter-gatherers chewed or smoked the plant has been found at a Stone Age site.

By Tosin Thompson

Archaeologists have uncovered evidence that hunter-gatherers in North America were using tobacco around 12,300 years ago — 9,000 years earlier than was previously documented.

Tobacco use spread worldwide after contact between European explorers and Indigenous people in North America in the fifteenth century. But researchers debate precisely how and when tobacco plants (*Nicotiana* spp.) were first domesticated.

Now, Daron Duke and his colleagues at the Far Western Anthropological Research Group in Davis, California, have discovered the oldest direct evidence of tobacco use at a hunter-gatherer camp in Utah's West Desert. They published the findings on 11 October in

D. DUKE *ET AL.*/*NATURE HUM. BEHAV.*

Excavations at the site in Utah, where tobacco seeds were found in a 12,300-year-old hearth.

Nature Human Behaviour (D. Duke *et al. Nature Hum. Behav.* https://doi.org/g2kw; 2021).

The site lies alongside the now-dry channel of a prehistoric river called the Old River Bed, where people camped 13,000 to 9,500 years ago. While excavating a historical site located within the US Air Force's Utah Test and Training Range, the team found an ancient hearth containing four burnt tobacco-plant seeds.

The researchers used radiocarbon dating to determine how old the hearth and its contents were. The tobacco seeds themselves were too small and fragile to be dated, but the team determined that other burnt woody material in the hearth was around 12,300 years old. The charred seeds were presumed to be of a similar age.

Although the team cannot say for certain how the tobacco was used, the fact that only seeds remain implies that the leaves and stems of the tobacco plant — the parts with the intoxicant effect — were consumed. The seeds, which are small and easily caught in the sticky hairs of the plant, could have been picked up when the plants were harvested. "People in the Pleistocene likely smoked tobacco or chewed tobacco in a similar fashion to how it's used today," says Jaime Kennedy, an archaeologist at the University of Oregon in Eugene.

Duck bones

Artefacts found in and around the hearth provide context for the find. These include fragments of a Haskett, a spear tip commonly used by roaming hunter-gatherers in North America during the Pleistocene. In this case, the researchers say, it seems to have been used to hunt various species of duck: a large number of waterfowl bones were uncovered at the site.

Duke's team also found charred seeds from other plants traditionally eaten by Native American communities: goosefoot (*Chenopodium* spp.), red maids (*Calandrina* spp.) and hairgrass (*Deschampsia* spp.).

The tobacco seeds were unlikely to have been deposited into the hearth naturally, the researchers say, but they investigated this possibility. The seeds could have come from the hunted ducks' stomachs, or from plants growing in the vicinity of the hearth. But tobacco grows on higher ground — away from wetlands and typical waterfowl foods. "The birds would have to be away from their natural habitat and eating something that is basically toxic and not palatable," says Duke. He and his team examined sediments from the area around the time of human occupation. "We found only common wetland plants, not tobacco," he says.

It is especially interesting that tobacco was found along with seeds from edible plants such as goosefoot, says Kennedy. "This discovery highlights the ancient symbiotic relationship between people and plants like tobacco that flourish in anthropogenically disturbed soils," she says.

A woman receives a dose of Sinovac's CoronaVac COVID-19 vaccine in Brazil.

TARSO SARRAF/AFP VIA GETTY

CHINA'S COVID VACCINES HAVE BEEN CRUCIAL: NOW IMMUNITY IS WANING

Billions of shots have been given globally, but studies question the length of protection they offer.

By Smriti Mallapaty

China's CoronaVac and Sinopharm vaccines account for almost half of the 7.3 billion COVID-19 vaccine doses delivered globally, and have been enormously important in fighting the pandemic, particularly in less wealthy nations (see 'The race to vaccinate').

But as the doses have mounted, so have the data, with studies suggesting that the immunity from two doses of either vaccine wanes rapidly. Last week, the World Health Organization (WHO) announced advice from its Strategic Advisory Group of Experts on Immunization (SAGE) that people over 60 should receive a third dose to ensure sufficient protection. The recommendation is "sensible and necessary", says Manoel Barral-Netto, an immunologist at the Oswaldo Cruz Foundation in Salvador, Brazil.

A number of countries are already offering third doses to all adults or are trying mix-and-match approaches. Some experts are even questioning whether China's jabs — based on inactivated virus — should continue to be used at all when other options are available.

But others say that the vaccines are still important. "These are not bad vaccines. They're just vaccines that haven't been optimized yet," says Gagandeep Kang, a virologist at the Christian Medical College in Vellore, India.

CoronaVac, produced by Beijing company Sinovac, is the world's most used COVID-19 vaccine. Not far behind is the vaccine developed in Beijing by state-owned Sinopharm.

In mid-2021, the WHO approved the shots for emergency use, on the basis of limited clinical-trial data suggesting that CoronaVac was 51% and Sinopharm 79% effective at preventing symptomatic disease. This was on a par with the 63% efficacy reported for the University of Oxford–AstraZeneca's viral-vector vaccine at the time of its WHO listing, but lower than the 90% and higher efficacies of the mRNA vaccines developed by Pfizer–BioNTech and Moderna.

Both the Chinese vaccines are 'inactivated vaccines', which use killed SARS-CoV-2 virus. Researchers say this type of vaccine seems to be less potent because it triggers an immune