THIS WEEK

EDITORIALS

Use and abuse of ancient DNA

Researchers in several complementary disciplines need to tread carefully over the shared landscapes of the past.

History might, as historian Arnold Toynbee allegedly said, be one damned thing after another, but historians and archaeologists spend a lot of their time trying to put those things into the right order. Assistance from science over the decades has been transformative, but not without difficulty: it took years for some archaeologists to be won over by radiocarbon dating.

Now, historians and archaeologists are grappling with a new scientific technique. As we discuss in a News Feature on page 573, the genetic study of ancient DNA is exploding, and the findings are posing several problems. One is a need for geneticists, archaeologists, historians and anthropologists to understand exactly how their skills and insights complement each other's. It is clear, for example, that although genetics has useful things to say about the sweep of population history, the more conventional disciplines provide essential context.

Another problem is fear that simplistic takes on ancient DNA will mirror damaging uses of the idea of 'culture history'. Culture history views the discovery of old artefacts as a proxy for the movement of the people who made them. According to this idea, a particular floral design on a pot that spread from south to north over a few centuries, for example, would indicate that the specific group of people that painted it was on the move — and carried the design with it.

These fears are not just about scholarship. Simplistic readings of culture history have encouraged people with political agendas to falsely draw clear boundaries between the behaviour and the claimed territory of some ancient (and not-so-ancient) populations — and to infer similarities with their claimed modern equivalents. For example, they often refer to the work of early-twentieth-century German archaeologist Gustaf Kossinna, who used culture history to trace the supposed origins of modern Germany to the spread of Corded Ware, a type of ceramic found throughout central Europe in the Bronze Age. Kossinna's ideas, although influential, have proved to be scientifically simplistic. They became notorious following their use by the Nazi party to legitimize its territorial goals and beliefs about the racial superiority of German-speaking peoples.

Scholars are anxious because extremists are scrutinizing the results of ancient-DNA studies and trying to use them for similar misleading ends. Ancient DNA, for example, offers evidence of large migrations that coincide with cultural changes in the archaeological record, including the emergence of Corded Ware. Some archaeologists have expressed fears that the extremists will wrongly present such conclusions as backing for Kossinna's theories.

Another problem for archaeologists and historians relates to the potential for abuse of the results of ancient-DNA studies looking at more recent times, such as the Migration Period around the fall of the Roman Empire or the era covered by the Viking sagas. They worry that DNA studies of groups described as Franks or Anglo-Saxons or Vikings will reify them by attaching misleading genetic profiles to categories that were devised by historians, and are not representative of how individuals viewed themselves at the time. Already, some people have picked up on such studies as a way to try to trace their roots to such supposed populations, to justify claims they have a right to some territory or other (L.-J. Richardson and T. Booth *Papers Inst. Archaeol.* **27**, 25; 2017).

On the contrary, genetic and historical evidence suggests that there was widespread mixing during these periods, across populations and geography. Indeed, presented correctly alongside insights from other disciplines, ancient-DNA research can be a powerful weapon against bigotry. Studies documenting migrations can drive home the point that present-day peoples in one area often share few genetic links with ancient peoples who lived in the same place. And when they do focus on relatively recent times, DNA projects can highlight the diversity of past peoples who otherwise might be seen as homogenous. A 2016 study of Anglo-Saxon burials, for example, found a mix of ancestry, with some people related to earlier inhabitants of England and others tracing their ancestry across the Channel (S. Schiffels *et al. Nature Commun.* **7**, 10408; 2016).

"Presented correctly, ancient-DNA research can be a powerful weapon against bigotry."

Two recommendations can be made for the public behaviour of scientists and other scholars. The first: give ample credit to the insights of complementary disciplines. The second: refute statements that misconstrue what your insights actually reveal and that can be used politically to justify disrespect, or worse, to groups of people. ■

Digital trust

A scandal over an academic's use of Facebook data highlights the need for research scrutiny.

Revelations keep emerging in the Cambridge Analytica personal-data scandal, which has captured global public attention for more than a week. But when the dust settles, researchers harvesting data online will face greater scrutiny. And so they should.

At the centre of the controversy is Aleksandr Kogan, a psychologist and neuroscientist at the University of Cambridge, UK. In 2014, he recruited people to complete a number of surveys and sign up to an app that handed over Facebook information on themselves — and tens of millions of Facebook friends. Kogan passed the data to SCL, a UK firm that later founded controversial political-consultancy firm Cambridge Analytica in London. (All those involved deny any wrongdoing.)

Last week, Facebook announced restrictions on data harvesting by third parties, including drastically reducing the kinds of information

that app developers can access. (It had already changed its rules in 2014 to stop developers gleaning data from users' friends through their apps.) But damage has been done: the public has good reason to be angry about the way in which researchers and companies have seemingly used personal data without consumers' full understanding or consent.

Where do academic researchers fit in? Handled correctly, online data can be a major boon to research, and the world would benefit from companies such as Facebook making their data more open. Ethical safeguards for research that intervenes in human lives were largely set up for medical and psychological studies, and are often written with definitions that exclude Internet research. In the United States, for example, unless data collected are both private and identifiable, informed consent is usually not deemed necessary, and research requires minimal, if any, oversight by an institutional review board. This would include data from Twitter, which are by default public. Models built on anonymized Facebook data would also tend to be exempt.

Kogan's study was unusual, both in that it was done by a university academic for a private company he operated, and in that the data were passed to a third party. Yet there is a common theme behind this controversy and ones that preceded it — such as a study warning that someone's sexual orientation could be determined from their online presence (Y. Wang and M. Kosinski *J. Personality Soc. Psychol.* **114,** 246–257; 2018). Data were used in ways well beyond what users expected or intended. Bundled together and trawled by algorithms, innocuous data points can reveal information that users might reasonably expect to stay private and that might be used in ways they are not happy with.

Guidance does exist. A number of projects are grappling with the ethical challenges of big data. US and European funders have supported efforts in this area, and have issued recommendations such as rethinking what counts as 'public' data and the need to consider a study's potential harm to society, as well as to individuals. (The University of Cambridge is among the institutions writing guidelines for Internet-mediated research, after the UK Research Integrity Office issued non-binding recommendations on the topic in 2016.) Funders should further support such efforts, and make them better known to researchers.

"Innocuous data points can reveal personal information."

Sticking points remain, a major one being that consent is often not practical when retrospectively accessing data from millions of individuals. But as outlined for biomedical scientists in the 1978 Belmont Report, the principle of beneficence applies: researchers should put the good of research participants first and, with that in mind, perform their own assessment of risks versus benefits. Studies should not be done just because the data are there. In studies that are too large to ask participants for consent, researchers should poll the views of samples of subjects and of any population that could be affected by the outcomes. Ethics training on research should be extended to computer scientists who have not conventionally worked with human study participants.

Academics across many fields know well how technology can outpace its regulation. All researchers have a duty to consider the ethics of their work beyond the strict limits of law or today's regulations. If they don't, they will face serious and continued loss of public trust. ■

Burger *al funghi*

Mushroom–beef blends can tackle expanding waistlines and carbon footprints.

Big burgers and petrol-guzzling vehicles: it's a match made in the United States. But last month, the US fast-food chain Sonic Drive-In tweaked its menu to introduce something different: a burger with some of its beef replaced with mushrooms. The Signature Slinger cheeseburger, Sonic promises, will deliver drive-through customers "all of the flavor with none of the guilt".

The claimed conscience-easing credentials of the Slinger are twofold: reduced calories and a smaller carbon footprint. It's targeted at those who wouldn't switch to a non-meat alternative, such as soya. And the burger does not come alone. It's merely the latest offering from a movement that has united chefs, scientists and health and environmental advocates. Led by the Culinary Institute of America in Hyde Park, New York, with predictable support from mushroom producers, the initiative seeks to promote both public health and environmental sustainability, by replacing 100% ground beef in some foods with a blend that contains up to half mushrooms. It's the biggest new foodie trend that you haven't heard of. Harvard University in Cambridge, Massachusetts, and the University of Southern California in Los Angeles are among the institutions that have started to cook with it routinely.

Does the science support the claims?

Beef has an outsize environmental footprint. Per gram of protein, beef requires on average 50 times more land and produces 100 times more greenhouse gases than do beans and other plant-based proteins. Replacing 30% of the beef with mushrooms in the roughly 10 billion burgers that Americans eat each year would reduce emissions equivalent to taking 2 million cars off the road, according to the World Resources Institute, an environmental think tank in Washington DC.

Still, mushroom cultivation is not a green panacea. Mushrooms are fussy about temperature and are usually grown inside energy-hungry climate-controlled sheds. A 2012 analysis reported that mushrooms have a greenhouse-gas impact almost ten times that of vegetables such as onions, carrots and cabbages (M. Berners-Lee *et al. Energy Policy* **43,** 184–190; 2012).

Although individual consumers who choose a mushroom substitute might feel less guilty, demand for beef continues to rise alongside incomes around the world. As such, scientists and governments must continue to look for ways to reduce the impact of beef farming itself. Expanding cattle pasture is the main driver of deforestation in the Brazilian Amazon, and one-third of the world's cropland goes to feeding animals — usually cattle. Research is needed to raise pasture productivity, improve feed and reduce methane emissions. So, too, is a renewed effort to combat deforestation.

On the health front, research has shown that substituting one-quarter of the beef in meals with mushrooms decreases caloric intake by about one-third. Saturated fats also drop, and chefs can often make do with less salt. Tests across US school dinners suggest that these benefits seem to come without a negative impact, such as leaving pupils hungry.

In an era of expanding waistlines, this is potentially good news. Earlier this month, health authorities in the United Kingdom called on food manufacturers to voluntarily reduce the calories in processed products by 20% by 2024. Doing so would save nearly £9 billion (US$12.7 billion) and prevent more than 35,000 premature deaths due to obesity-related illness over 25 years, Public Health England estimated. Sonic's blended burger is substantially smaller than its regular cheeseburger and would more than deliver on that goal, starting at around 340 calories compared with 580 calories for the chain's standard.

Will it and other mushroom-blended meats succeed where health and environmental advocates have failed, and persuade people to eat less beef? Certainly, it seems a better approach than simply asking people to change their ways by pointing out the cost.

But, as with zero-alcohol wine and sugar-free soft drinks, taste will ultimately determine consumer choice. So how does the Signature Slinger score? In a blind taste comparison, two *Nature* reporters were both able to correctly identify the mushroom blend. Setting aside the fact that both patties had the distinct taste and texture of fast food, one person preferred the pure beefburger, and the other the mushroom blend. Both agreed that if the blended burger was the future, then the future was better with (guilt-inducing) bacon. ■