

Nature Podcast

Introduction

This is a transcript of the 1st February 2018 edition of the weekly *Nature Podcast*. Audio files for the current show and archive episodes can be accessed from the *Nature Podcast* index page (<http://www.nature.com/nature/podcast>), which also contains details on how to subscribe to the *Nature Podcast* for FREE, and has troubleshooting top-tips. Send us your feedback to podcast@nature.com.

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Interviewer: Shamini Bundell

Welcome to this week's *Nature Podcast*. This week in the show, piecing together hominin history from stone tools, and growing peril for the world's coral reefs.

Interviewer: Benjamin Thompson

Plus: whale song out of the water and foetal workouts. This is the *Nature Podcast* for the 1st February 2018. I'm Benjamin Thompson.

Interviewer: Shamini Bundell

And I'm Shamini Bundell.

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Interviewer: Benjamin Thompson

Almost two million years ago, our ancient ancestor, *homo erectus*, is estimated to have first migrated out of Africa. This is a time known to archaeologists as the Lower Palaeolithic. These hominins took with them the most cutting-edge technology available including teardrop shaped stone tools known as Acheulian hand axes. As time progressed and hominins evolved, the world transitioned into the Middle Palaeolithic, a period marked by a decline in Acheulian technologies and the development of more advanced specialised tools. Because of the scarcity of hominin fossilized remains, there's a lot we don't know about the Middle Palaeolithic. This means that studying stone tools is a good way of working out the movements of ancient populations and knowledge.

Interviewee: Shanti Pappu

This is one of the criteria when you have a lot of debate going on about the puzzles of hominin species, also modern humans as well as other species.

Interviewer: Benjamin Thompson

This is Shanti Pappu from the Sharma Centre for Heritage Education in India.

Interviewee: Shanti Pappu

One of the key questions which everyone is looking at is how and where and when they go and what was happening in terms of interaction with local culture which were already there in various places. So this is one of the things which we are looking at.

Interviewer: Benjamin Thompson

Shanti has got a paper out in *Nature* this week that's been using the transition between tool types to make a new estimate of when Middle Palaeolithic culture began in India. Her results suggest this time period might have been a lot earlier than previously thought. The historical evidence for this work comes from an archaeological site called Attirampakkam on the banks of a stream in the south east of India. The site was discovered by the British geologist Robert Bruce Foot in 1863. Shanti has been working there since 1999.

Interviewee: Shanti Pappu

So when we started excavating – it's a huge site and we dug a number of trenches across the site and very, very slow, meticulous excavation with a huge number of scientists from different disciplines from all over the world. And we have been trying to look at the archaeology, the changes, the environment, the vegetation, the monsoon climate change, and of course the dates at this site through time.

Interviewer: Benjamin Thompson

Shanti's new paper focuses on three of the trenches dug up to nine metres deep in the site's soil. The different layers of sediment give snapshots of individual time periods, a bit like looking at the rings of the tree. From just one of the trenches, Shanti and her colleagues uncovered over 7000 stone tools of various types. By linking the depths that these tools were found with the technology used to create them, the team were able to chart what sort of culture was at the site at particular times.

Interviewee: Shanti Pappu

Right at the bottom you have the earliest cultures called the Acheulian of the Lower Palaeolithic, and we dated that to one to 1.7 million years old. And then we get a break in occupation midway. We don't know why.

Interviewer: Benjamin Thompson

Following this mysterious break in occupation, hominins returned to the site around 385,000 years ago, when the makeup of the tools changed. While Acheulian tools made of large flakes of stone were still present, they were gradually phased out as time went on, and replaced by more advanced, Middle Palaeolithic instruments.

Interviewee: Shanti Pappu

At this point in time you have a few of the old Acheulian elements still continuing and you have a predominant shift away from some of the Acheulian technologies to this new system, this new way of flaking stone which is showing up here. So in the very beginning there are still elements of the Acheulian, there are still some of these hand axes, but the large flake tools completely drop out and you have this beautiful technology called the Levallois which is quite sophisticated and then you have points and blades and lots of small flake tools and these evolve in different ways through time at the site.

Interviewer: Benjamin Thompson

Previous estimates pegged the beginning of the Middle Palaeolithic in India as only 125,000 years ago. This is the time that *Homo sapiens* are thought to have first migrated out of Africa. Now, the stone tools in this period are often associated with *Homo sapiens*, so pushing this date back to 385,000 years ago raises several questions. Who brought these

tools or the techniques used to make them to the region? If it was indeed *Homo sapiens*, does this mean we've got the date when humans first migrated from Africa, way off? To better understand who went where and when, we can't just rely on tools. We need bones. Indeed, just last week, a paper in *Science* described a newly discovered fragment of fossilised jawbone from Israel, suggesting that *Homo sapiens* may have migrated out of Africa 50,000 years earlier than previously thought. So why have no bones been discovered at the Attirampakkam site? Given that thousands of tools have been discovered it seems odd that none of their owners have been found. Sadly, as Shanti explains, the local tropical environment just isn't conducive to skeleton preservation.

Interviewee: Shanti Pappu

In this type of tropical environment bones are very, very quickly destroyed, and in fact at Attirampakkam we were very lucky to get these fossils of animal fauna. Apart from that, preservation conditions are very poor for bones.

Interviewer: Benjamin Thompson

Until such bones are found, the question of who made the tools that took India into the Middle Palaeolithic will remain unanswered. What this work does show though is that there is still a lot to discover about the history of hominins. You heard from Shanti Pappu there, joining us on the phone from the Sharma Centre for Heritage Education. You can read her paper over at [Nature.com/nature](https://www.nature.com/nature) and we'll put some pictures up of the amazing stone tools that she uncovered on our Twitter account @NaturePodcast.

Interviewer: Shamini Bundell

Still to come, an update on the uncertain future for the world's coral reefs, but first, it's the Research Highlights, read by Emily Banham.

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Interviewer: Emily Banham

Expectant mothers getting foetal kicks right through the night may have a bone to pick with their boisterous babies, however the fidgeting foetus is just flexing its muscles and building healthy bones. MRI scans of wriggling human foetuses in the second half of pregnancy have enabled the first ever estimates of muscle forces and stresses on the baby's skeleton. Foetal kicks got much stronger between twenty and thirty weeks but weakened again towards labour. Stresses on the baby's skeleton remained high as wriggling room became restricted. These early embryonic exercises likely helped joint formation. This window into the womb is in the *Journal of the Royal Society Interface*.

[Jingle]

Interviewer: Emily Banham

The sounds of the sea could soon be sampled by using a material that lets noise pass from water to air. Usually, sound waves travelling through water are almost entirely reflected at the boundary with air. Engineers have made a material less than half a centimetre thick filled with tiny structures that make incoming sound waves bounce around. This reduced reflection and let 30% of the sound pass from water to air. Marine biologists could use the

material in microphones to eavesdrop on ocean life from the comfort of their own boats. Sound out the paper over at *Physical Review Letters*.

[Jingle]

Interviewer: Shamini Bundell

In a moment Adam Levy has a report about some of the problems facing the world's coral reefs, but first, cast your minds back, if you can, to our holiday special episode from the end of 2017. Remember this...

Interviewee: Alistair Reynolds

Very little science fiction literature written before the 80s came anywhere close to predicting the internet and instant communication as well. Very few science fiction books predicted anything like the cell phone.

Interviewer: Shamini Bundell

That was from an interview I did with Alistair Reynolds about the relevance of science fiction in the modern world. Well, one of our listeners, John Le Page, got in touch with a counter example. He cited a device called the Phototelesme' which was introduced in *The Black Box*, a novel by E. Phillips Oppenheim published way back in 1915. We read through John's example and indeed the Photoelesme does appear to be an early imagining of a proto-smartphone, albeit one which uses a lot more mirrors than the modern-day equivalent. Thanks, John Le Page, for letting us know!

Interviewer: Benjamin Thompson

And now, from a 20th century prediction of the future, to something altogether more pressing – Adam Levy has been investigating the uncertain future of some of the most bio diverse places on Earth: coral reefs.

[Music]

Interviewer: Adam Levy

Graduate student Nathaniel Mollica is fascinated by coral. His work has taken him to reefs around the world and while every reef is unique they almost all have one thing in common.

Interviewee: Nathaniel Mollica

The first thing that strikes you about almost any reef is the complete abundance of life. They're almost like oases in the ocean.

Interviewer: Adam Levy

Much like rainforests, coral reefs are complex ecosystems that we're still a long way from understanding fully, but also like rainforests, reefs aren't just valuable for their ecological importance. They're integral to the lives of huge numbers of people around the world.

Interviewee: Nathaniel Mollica

Over 500 million people in the world make their livelihood and depend on coral reefs.

Interviewer: Adam Levy

It's not just tourism and fisheries that make reefs so important. They also provide coastal communities with vital protection from storms and typhoons. But it's becoming increasingly clear that coral reefs themselves need vital protection, from us. Perhaps the most obvious threat comes from climate change. Warmer seas spell bad news for corals. In 2016 and 2017 the Great Barrier Reef was hit by mass bleaching. This saw huge numbers of corals expel their colourful symbiotic algae which can ultimately lead to their death. But our carbon dioxide emissions aren't just creating a warmer world. They are also creating more acidic oceans.

Interviewee: Nathaniel Mollica

You could easily say that it's fairly obvious how ocean acidification would affect an organism that builds its skeleton out of calcium carbonate.

Interviewer: Adam Levy

That's because ocean acidification would lead to fewer carbonate ions available for the coral. But measuring the rate that corals build up calcium carbonate hasn't revealed the obvious relationship that theory predicts. To clear up this picture, Nathan and his team measured sea water chemistry and coral cores at many different reef sites. Their research, published in *The Proceedings of the National Academy of Sciences* this week, couldn't find a link between the vertical upward growth of coral, and ocean acidification.

Interviewee: Nathaniel Mollica

However, what we did see was that the acidification negatively impacted the density of the coral's skeleton in locations where low PH conditions existed. It does bring worry to the future of coral reefs because it affects the entire structural integrity of those reefs that are built out of both living and dead corals.

Interviewer: Adam Levy

But acidification is far from the only worry for coral reefs. Corals also have to endure an inundation of plastic pollution. Ocean plastics harms go far beyond floating rubbish that might be munched by unsuspecting animals. That's because plastic can also become tangled up on the sea floor, and on reefs. Here's Drew Harvell who's been investigating the damage that plastic could cause reefs.

Interviewee: Drew Harvell

Plastic entangled is a triple whammy for coral infections. First, it degrades and cuts open the skin of the coral, and then the plastic is dirty and can convey pathogenic microorganisms that can cause disease and then finally it can shade the light that these solar power animals need and cut off water flow.

Interviewer: Adam Levy

A lot of research on ocean trash has focused on floating plastics. But Drew's study published last week in *Science*, quantified the impact of plastic entangled around coral.

Interviewee: Drew Harvell

We individually noted the health of over 124,000 corals from 159 reefs and our study estimates that about 11.1 billion plastic items are entangled in these coral reefs. The likelihood of disease increases if a coral is in contact with a plastic from about 4% to 89%, so a very substantial increase.

Interviewer: Adam Levy

These findings indicate coral is 20 times more likely to be infected if it's contaminated with plastic.

Interviewee: Drew Harvell

What does it say about us sending in trash that in its second life takes down these living cathedrals of living biodiversity in our oceans?

Interviewer: Adam Levy

Of course, coral reefs aren't facing plastics and ocean acidification separately. Warming, acidification and pollution work in tandem to threaten these delicate ecosystems.

Interviewee: Drew Harvell

We're just fighting for the life of coral reefs over the next 50 years.

Interviewee: Nathaniel Mollica

For a lot of reefs there's a dire threat. Many of these stressors will potentially compound on each other.

Interviewer: Adam Levy

But although all these changes to the ocean are affecting corals, the fights to tackle them may look very different. Ocean acidification, Nathan explains, is a truly global problem.

Interviewee: Nathaniel Mollica

You can't really put a wall around a reef and protect it from ocean acidification. A lot of these large scale problems have to be dealt with as a global community.

Interviewer: Adam Levy

Global problems require global solutions and there's no sign that the world is poised to halt the trend in ocean acidification or warming any time soon. But Drew is hopeful that the fight against plastics might be somewhat easier to win.

Interviewee: Drew Harvell

This is a much simpler problem, I think, because it can be handled on a local scale. So we can immediately turn this around by clearing up the coastal near shore trash and stop inputting it. People are asking me, 'what research do we need?' Do we need to know more about what kinds of microorganisms are on plastic? It might surprise you but my own view is we don't need anymore. We just need to fix this. There's just no reason to not clean this up and enact policies to do that.

[Music]

Interviewer: Shamini Bundell

That was Drew Harvell who's at Cornell University talking to Adam Levy. Before her you heard Nathaniel Mollica, who's in the MIT Woods Hole Oceanographic Institution joint program. To find out more about their coral studies, have a look over at *Science* and *PNAS*, respectively.

Interviewer: Benjamin Thompson

Last up this week it's the News Chat and joining me in the studio is Alison Goddard, *Nature's* European Bureau Chief. Alison, how are you doing today?

Interviewee: Alison Goddard

I'm very well, thank you.

Interviewer: Benjamin Thompson

Right, I think we should do our first story and we are going to head to Turkey and we've got something in *Nature* about a physicist who has recently been released from prison. Maybe you could tell us a bit about that?

Interviewee: Alison Goddard

So this is a physicist called Ali Kaya and he's a theoretical physicist but he's just one of several thousand academics who were rounded up by the Turkish government following the attempted coup against President Erdoğan. That was back in July 2016 and these academics have been charged either with terrorist offences or for plotting the coup. He was then jailed and he's now been released from jail and he's published three academic papers that he wrote whilst he was imprisoned.

Interviewer: Benjamin Thompson

He's written these papers then. What sort of pressures was he under? Where was he at the time?

Interviewee: Alison Goddard

So he was jailed in a Turkish prison a few miles outside Istanbul and he had to share his cell normally with about 20 prisoners, some of whom though were academically inclined, so he said that he shared with some teachers, there was another associate professor there and a medic, so some of their conversation would have been around academic subjects. He worked by himself with a pen and paper, several hours a day. He said that science kept him sane. But he had very little access to external materials. So, there was no internet, not even a hand held calculator. At one point he tried to get papers and a former student of his translated some papers into Turkish because he wasn't allowed to take in any materials that were written in a foreign language and even those were denied him because they contained equations and the prison guards were concerned that those equations might contain some sort of codes.

Interviewer: Benjamin Thompson

Oh my goodness, so he really has gone back to first principles then and done all of his equations by hand?

Interviewee: Alison Goddard

Yes he had to derive everything from first principles.

Interviewer: Benjamin Thompson

What has he been deriving then? What has he been working on?

Interviewee: Alison Goddard

Well he's a theoretical physicist so he was working on theoretical physics. His speciality is cosmology. So in particular he studies cosmological perturbation theory.

Interviewer: Benjamin Thompson

So he has been doing this research then under pressure that most academics don't encounter. What's happened to the research now that he's been released?

Interviewee: Alison Goddard

Well, the research was published on an online archive and he's hoping to turn it into some solid academic papers. He's continuing to work but he's not able to return to his university.

Interviewer: Benjamin Thompson

Oh really, and why is that?

Interviewee: Alison Goddard

Well he was suspended from his academic position and when his conviction was upheld the university now has to decide whether to allow him to return or whether to fire him and that's something that he's awaiting at present.

Interviewer: Benjamin Thompson

Well, thanks Alison, I'm sure we'll cover news of that when we get it. Next today then, let's talk about chimps in the US. We've got a story hear about the NIH, the National Institute of Health, are looking to retire the chimps involved in research.

Interviewee: Alison Goddard

So the NIH has got almost 300 chimps that it's seeking to retire and it's now investigating how best to go about this. The options are to retire the chimps while leaving them in the labs they are currently living in or the alternative would be to send them to a sanctuary.

Interviewer: Benjamin Thompson

Who's making this decision and why does it need to be made?

Interviewee: Alison Goddard

The NIH has set up a working group to examine whether moving the chimps is in their best interests and one of the problems that's occurred in the past is that after chimps have been moved they have a higher than expected death rate and part of the reason why that might be is because the chimps are elderly, they're not always in good health and when they move they have to reform social groups and that can be very stressful.

Interviewer: Benjamin Thompson

So it sounds then that careful decisions need to be made about where to send these chimps? What options do we have? Where can they go?

Interviewee: Alison Goddard

The options are actually very limited. There's only one facility and it's a federally funded sanctuary and it's called Chimp Haven.

Interviewer: Benjamin Thompson

So what's stopping the NIH getting on with it then, and sending all the chimps to Chimp Haven?

Interviewee: Alison Goddard

There are two limiting factors here. The first is the size of Chimp Haven. It's pretty much at capacity already and it doesn't have the space for another 300 chimps. The second is the NIH still needs to identify whether this is in the best interests of the chimps, whether it might be best to keep them in the social groups that they are currently in within the laboratory and that might be a happier outcome for the chimps than moving them to a more natural environment.

Interviewer: Benjamin Thompson

When will this happen? What can we expect next?

Interviewee: Alison Goddard

It will happen relatively quickly. We're hoping that the working group will be able to make its recommendations by May.

Interviewer: Benjamin Thompson

Thank you Alison. For more on these stories, and the latest science news, head over to Nature.com/news

Interviewer: Shamini Bundell

That's it for this week, but before we leave you, one quick shout out to Stephen Lee who got in touch to say he's been enjoying the podcast. In his words: 'serious science news presented with a nice entertaining style'. Well, I don't think I could argue with that. Thanks Stephen.

Interviewer: Benjamin Thompson

And if you'd like to get in touch, we would love to hear from you. Tweet us @Naturepodcast or send us an email on podcast@nature.com. Otherwise, it'd be great if you could leave us a nice review or some stars over on iTunes, or wherever you get your podcasts. I'm Benjamin Thompson.

Interviewer: Shamini Bundell

And I'm Shamini Bundell. Thanks for listening.

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