Nature Podcast

Introduction

This is a transcript of the 11th January 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: Benjamin Thompson
Welcome back to the *Nature Podcast*. This week we'll be investigating the shape of memories, plus the tabletop physicists looking for cracks in prevailing theory.

Interviewer: Adam Levy
We'll also be finding out about the effects that armed conflict has on wildlife. I'm Adam Levy.

Interviewer: Benjamin Thompson
And I'm Benjamin Thompson.

[Jingle]

Interviewer: Benjamin Thompson
Right then, wow. Here we are, the first show of 2018 and I'm very excited to be here. Adam, how are you doing?

Interviewer: Adam Levy
I feel a bit like I'm living in the future. Every New Year, another number. It should be something I'm used to now. It's happened to me 29 times but every single time I feel like I've been transported into a distant time.

Interviewer: Benjamin Thompson
Well Adam, you and I are actually both time travelers but sadly ours is in a linear direction at a uniform speed.

Interviewer: Adam Levy
Well I suppose it changes slightly as our altitude and velocity relative to the earth changes.

Interviewer: Benjamin Thompson
Oh, here we go. Right, anyway, happy New Year listeners. I hope you're having a good time. There's only 355 days of science left. Let's get started.

Interviewer: Adam Levy
First up then this year, we have a story all about…

Interviewer: Benjamin Thompson
Go on…

Interviewer: Adam Levy
Errr, well I don't think I can remember.

Interviewer: Benjamin Thompson
I mean, I've got nothing.

Interviewer: Adam Levy
No, I seem to have forgotten. I know it's being presented by Shamini Bundell. So, hopefully she can shed some light on it…

Interviewer: Shamini Bundell
So there's a feature out in *Nature* this week about memory. It asks what does a single memory look like? Where is it stored in the brain? Which cells are involved? And what determines its particular shape? I got in touch with a neuroscientist who's working to answer these questions, Sheena Josselyn. I first asked her how scientists define a memory.

Interviewee: Sheena Josselyn
Everybody has their colloquial definition. I think we can probably all agree that it's some sort of representation in the brain of a past event or some sort of past learning that we can recall at a later point.

Interviewer: Shamini Bundell
And when people first were studying memory, they were like, right, where's the memory section of the brain? That must be where the memories are stored. But we've since come to understand that memories are more distributed across different brain areas.

Interviewee: Sheena Josselyn
We're certainly not saying that there's one specific cell that stores a memory, the grandmother cell. You know, you stimulate this cell and there's an image of your grandmother. We, now, as a field, I think appreciate that memories are widely distributed in groups or ensembles of neurons that come together and for whatever reason these cells seem to be chosen, and not other cells, and they form a memory.

Interviewer: Shamini Bundell
And if there's no one cell, we can't identify the cell for a memory, how would we go about finding out which multiple cells or multiple areas are involved in any given memory?

Interviewee: Sheena Josselyn
We are still at the inference game. We infer that a cell or a brain region is important in a memory if we get someone to recall this memory and we see this brain area very active. So if you're looking at human memory, you put someone in an FMR scanner and you ask them to recall a memory and those places that are more active, they have stronger blood flow, those are thought to be the ones that are really important in retrieving this memory and

probably really important in housing this memory. We do the same kind of experiments on experimental animals in the lab.

Interviewer: Shamini Bundell
So you have this vague idea that there is an association there with this memory and these particular cells but how can you actually sort of test whether you're right about that?

Interviewee: Sheena Josselyn
So we can ask what happens if we manipulate the activities of these cells when we ask mice to recall a memory and what happens if we decrease an activity? Can they still recall a memory? So we go in and we can kill just these cells we think are really important in the memory and we ask the mouse to recall the memory. The mouse shows us no evidence of recall. It's as if the memory has been erased.

Interviewer: Shamini Bundell
How do you know if a mouse is remembering something or not?

Interviewee: Sheena Josselyn
Yes that's a question that we spend a lot of time in the lab discussing and the only thing that we can do is we look at their behaviour. So, when a mouse is afraid, it shows this fear response. So it adapts this crouched, motionless posture. So what we do in the lab is we pair an innocuous stimulus such as a tone or a place with a tiny electric foot shock. Now it's not enough to cause the animals any damage but it's enough for the mouse to say, what the 'huh', and the cool thing is we can test memory by saying, well the next time that you hear this tone that we previously paired with the shock, do you show fear responses?

Interviewer: Shamini Bundell
And then the next step is to see if you can stop them remembering the association?

Interviewee: Sheena Josselyn
Absolutely. So, what happens if we perturb the function of this small population of cells? Do mice show us this freezing response? Do they remember? And it turns out that no they don't so it's like we're sort of turning off the memory and the cool thing is, it has to be these cells we perturb the function of. If we perturb the function of a bunch of other cells, we don't see this. So it's really specific.

Interviewer: Shamini Bundell
So, getting rid of the memory is one way to prove that you've kind of got the right cells, you've found the cells for that memory, but then there are also experiments on activating recall of an existing memory?

Interviewee: Sheena Josselyn
I mean you can always argue that there's multiple ways of decreasing a memory, but to actually bring a memory out of the air, to have the animal bring to mind a memory without giving it an external retrieval cue, so in this case the tone, what we can do is just give it an internal retrieval cue. We artificially activate these cells. It's like we're bring to mind this memory because the mouse freezes. So it's like we're cutting out the middle man, going

directly to those areas of the brain we think are important in the memory, we cause the mouse to remember this memory and they show us this by freezing. It's amazing that this experiment worked and that it's been replicated so many different times.

Interviewer: Shamini Bundell
I mean it's just really cool that you're able to manipulate memories like that, but is manipulating memories either activating it or getting rid of it, is that actually the point of the research?

Interviewee: Sheena Josselyn
I don't think that anyone is in this business to sort of cosmetically change memories. What we really want to do is understand how memories are formed in the brain for two reasons. One: it's a really cool question. Our brains are sort of like the final frontier of science. It really tells us who we are and how we process information, how we encode information, is really looking at understanding the brain at a really fundamental level. But it's also really important because there's an epidemic of memory disorders in the world. Everything from Alzheimer's to autism which you can sort of phrase as being an information processing disorder. But the treatments are really lacking because we don't understand how memories are normally made.

Interviewer: Shamini Bundell
So your work is mainly on mice but the research that's going on in humans is actually kind of backing up a lot of what you've found?

Interviewee: Sheena Josselyn
The fundamental things about how memory is encoded is really similar between mice and humans in the lab and to me if we get really converging evidence from two very different species doing very different tasks, yet the same answers still keep coming up, that is really exciting to me. It tells me that we're really onto something here.

Interviewer: Benjamin Thompson
That was Sheena Josselyn from the Hospital for Sick Children in Toronto, talking to Shamini Bundell. A lot of the work that Sheena mentioned, both from her lab and others, is described in a feature over at nature.com/news so go over there to give it a read, if you remember.

Interviewer: Adam Levy
Still to come in the Research Highlights: how a digestive discovery has identified a new lizard, and how demographics affect carbon dioxide emissions.

Interviewer: Benjamin Thompson
Many animals across the globe are under threat from manmade causes: climate change or habitat destruction, to name just two. This week in *Nature* there's a new paper that looks at the threat to wildlife that's not so well understood, entitled, 'Warfare and wildlife declines in Africa's protected areas'. This looks at how conflict has affected populations of large mammals like zebras, wildebeest or elephants. I spoke to Josh Daskin from Yale University,

one of the authors of the paper, and began by asking him why he focused on African mammals and why this research area in particular.

Interviewee: Josh Daskin
Africa has really the last standing, intact, assemblages of large wildlife, particularly large mammals, and they have large roles to play in the ecosystems where they exist. In addition there are large benefits for local communities through tourism and other revenue that comes in due to wildlife. So that's why they're important. We focused on the impact of war because war has been unfortunately common and there are a number of pathways by which conflict can impact upon wildlife populations.

Interviewer: Benjamin Thompson
When I looked at your paper and looked at the title, I kind of assumed, perhaps rather naively, that armed conflicts would of course have a negative impact on local wildlife but you suggest that there isn't or wasn't a consensus about the relationship between wildlife and warfare and its effects on biodiversity and it could have actually been positive or negative in different areas.

Interviewee: Josh Daskin
Intuitively, yeah, you would think that war is not necessarily a good thing for the environment in general or wildlife in particular and there are good examples of this from Africa where there are cases of militias or other armed organisations funding some of their activities through the sale of ivory poached from elephants but there are also cases in Africa and elsewhere where the onset of conflict can create a de facto refuge for wildlife and for biodiversity in general. The classic example of this outside of Africa would be the demilitarized zone in Korea which for several decades has acted as, really, a park and protected quite a bit of wildlife there. You could also have things like the closing down of bush meat trade routes or the reduction in extractive industries like logging that would otherwise harm wildlife populations during times of conflict if it becomes too dangerous for companies or traders to operate.

Interviewer: Benjamin Thompson
So maybe this is where your work comes in then, trying to better understand this relationship and you've gone back kind of a fair way back in history, all the way back from 1946, to data from 2010.

Interviewee: Josh Daskin
We collected data from about 500 existing published estimates of mammal populations and then paired these in order to calculate population trajectories. And once we had these population trajectories for each species in each protected area we could map these onto an existing database of where each of the conflicts have occurred throughout time in Africa. And we can suss out what exactly the impact of conflict is on these mammal populations.

Interviewer: Benjamin Thompson
So, what impact does conflict have then?

Interviewee: Josh Daskin

The result was really quite striking and clear, that as the frequency of conflict increases, the performance of mammal population declines. So at peaceful sites, the average population trajectory was replacement. Populations were neither increasing nor decreasing, but with the onset of just a little bit of conflict, the average population was declining. At the sites with the highest conflict frequencies there were really no populations that we found data for where mammal populations were increasing. I would also say though the news is not all bad. We did find that there were very few outright extinctions in the data set, so although populations declined in areas where war has been common, there's quite a bit of potential for recovery and restoration of these populations because they're not completely blinking out.

Interviewer: Benjamin Thompson
So the word that maybe stuck out here to me was, I think you mentioned, it's the frequency of conflicts, not necessarily the intensity of conflict that makes so much of a difference.

Interviewee: Josh Daskin
Exactly, so we included a number of predictors, including both the frequency and intensity of conflict to see which of these would affect wildlife populations and how. As you said, the frequency of conflict was the best predictor, whereas the intensity of conflict, the number of human deaths, did not predict wildlife population trajectories. We might infer from this that it's actually just the onset of conflict that has the greatest impact on wildlife and one possible reason for this is that wars of course come with lots of correlates of their own, so increased human poverty, decreased ability of governments to perform non-military functions either because their abilities actually decline or because their priorities lie elsewhere. So it may simply be that the onset of conflict, regardless of how intense it is in a military sense or in a human sense is enough to impact wildlife.

Interviewer: Benjamin Thompson
And if we throw it back to our earlier chat then, say, if there wasn't a consensus one way or the other about how warfare or conflict affects biodiversity, it sounds like here you've begun to shine a light on how it may affect it. How do you hope that this research is used in the future?

Interviewee: Josh Daskin
One of the motivations for conducting this study was that there was very little synthetic information on how conflict affects any aspect of biodiversity and yet conservation organisations including big funders like the Word Wildlife Fund, Wildlife Conservation Society, foreign aided organisations like the US Agency for International Development, all of these groups need concrete evidence for where to invest their funds.

Interviewer: Benjamin Thompson
Well, finally then Josh, if there is the potential for populations to recover in areas after conflicts, do you have any examples of where they have? Or where good practices have been put into place?

Interviewee: Josh Daskin

Maybe the best example today is the place where I've been doing fieldwork since 2012. It's called Gorongosa National Park and it's the flagship National Park in Mozambique which is in South East Africa and Mozambique suffered through an intense civil war from 1977 to 1992 during which time the park, Gorongosa, was the headquarters at different times for both the rebel army and the government soldiers. And the wildlife populations in the park suffered immensely. So, whereas before the war the park was home to tens of thousands of all the iconic African wildlife species that you normally think of, well over 95% of the individual animals were killed during the war. So they were down to single digit zebra, elephants were down to about 200 individuals from several thousands. Across the board everything declined. However, an intensive restoration effort has been founded since 2004 and there's been an incredible population recovery. Wildlife populations are back near their levels from before the conflict. That was Josh Daskin. You can read his paper over at nature.com/nature.

Interviewer: Adam Levy
To kick start the New Year we've got a special news chat this week. We'll be gazing into a crystal ball to predict some of the big science stories that you may be able to expect from 2018. That's at the end of the show, but right now we're joined again by Shamini for this week's Research Highlights.

[Jingle]

Interviewee: Shamini Bundell
Paleontologists have made a dazzling discovery in a dinosaur's dinner. A chicken-sized dino dug up in the 19th century was known for some time to contain a small reptile in its gut. Researchers have taken a closer look at this unlucky lizard and found that its skull anatomy doesn't match any other specimens, suggesting that this creature within a creature is a brand new species. The lizard has been named *Schoenesmahl dyspepsia* which roughly translates to, 'beautiful meal that is difficult to digest'. Chew over that research in the *Zoological Journal of the Linnean Society*.

[Jingle]

Interviewee: Shamini Bundell
How does getting married affect your carbon footprint? Any big life transition changes how you spend your time which in turn affects how much energy you use but it's proven rather tricky to put a number on these impacts. Now researchers have studied the effects of two big shifts in Chinese society: the increase in one or two person households and the increase in people over 65 years old. In Szechuan, a province with over 80 million people, these demographic shifts may lead to an extra 35 million tons of carbon dioxide in 2030. Have a peep at that paper in *Nature Energy*.

[Jingle]

Interviewer: Adam Levy
The standard model is one of the crowning achievements of modern physics. From its description of the fundamental properties of matter, to its prediction of new particles like

the Higgs Boson, it's hard to think of a theory that has been so thoroughly demonstrated to be correct. Except, it isn't correct, because for all its accuracy there are some little things that it misses out.

Interviewee: Gerald Gabrielse
So, you know, most of the energy and mass of the universe it can't explain. Inflation, it can't explain, or why the universe is made out of matter rather than antimatter it can't explain. These are not little things.

Interviewer: Adam Levy
This is Gerald Gabrielse. Physicists like Gerald are on the hunt for theories beyond the standard model that could explain these not-little-things. But where to look? One approach is to search for exotic new particles not predicted by the standard model. This is what huge experiments like the Large Hadron Collider are doing. But another approach is to make painstakingly careful measurements of the properties of everyday particles like electrons. Any deviation from the standard model's predictions could help physicists pick between the many proposed theories that aim to 'fix' the standard model. Well, there's a feature out this week about this second approach which has been getting more and more attention in recent years. Gerald has long been working on these precise measurements, so I called him up to find out more about physicists' hunt for cracks in the standard model.

Interviewee: Gerald Gabrielse
The thing that gets the most publicity these days is the Large Hadron Collider at CERN. That's certainly one way to do it. There you take two particles, you smash them together with as much energy as you can and you see what bits fly out and you analyze the bits. There's another approach which I more represent to say what does the standard model predict precisely? And then let's make a measurement to see if indeed the prediction is correct. So in my group we've done that. We took the most precise prediction of the standard model which is the size of the magnetism of an electron, a single particle, and we made a measurement, the most precise measurement ever made of a property of an elementary particle and by George, the standard model was right to 12 significant figures. If the standard model and proposed fixes to the standard model make very different predictions then it's a great place for experimenters like me to go and look and decide what the truth is because after all, nature always has the last word.

Interviewer: Adam Levy
They sound like very different ways of searching for things beyond the standard model. One smashing particles together, the other very precisely measuring properties of a particle. In terms of what the experiments actually physically look like, do thy look very different as well?

Interviewee: Gerald Gabrielse
They look tremendously different. If you've ever been in the LHC tunnel at CERN, it's spectacular. It's this big, round tunnel that if you stand in it, it looks kind of straight because its circumference is so enormous and my new centre is called the new Centre for Fundamental Physics with tabletop experiments. So, tabletop is a bit of an idealization

because sometimes the table is a little bit big but the scale is something that can fit in a university laboratory, so it's just a smaller scale experiment. Tabletop versus industrial scale.

Interviewer: Adam Levy
Has more attention started being paid to these kinds of tabletop experiments in recent years since the LHC hasn't really been finding anything unexpected?

Interviewee: Gerald Gabrielse
Even if the LHC finds things, the scale of these accelerator projects and the budgets are so enormous that it takes decades to make a new machine, so I think, increasingly, people who are working at the LHC or their type are going to start using more tabletop approaches, substituting precision for energy but one type of experiment I would say is not a direct substitute for the other. I regard us as being part of the same enterprise, having similar goals and taking different approaches and what we learn compliments each other.

Interviewer: Adam Levy
What's it like to really try and study one aspect of, say, an electron, incredibly precisely? Is it laborious?

Interviewee: Gerald Gabrielse
Well, every job is partly laborious. Every experiment is. But I would say mostly it's just fun. I mean, just imagine, we can take one electron and we can suspend it by itself for months at a time while we play with it. You know, you get kind of fond of it after a while. For me I still get excited by seeing that.

Interviewer: Adam Levy
What's the longest you've managed to keep an electron in place? What's your current record?

Interviewee: Gerald Gabrielse
Well we did it once for 10 months until one of my associates made a mistake and clicked the frequency synthesizer knob one click too far.

Interviewer: Adam Levy
Were you sorry to see that 10 month electron go?

Interviewee: Gerald Gabrielse
Yeah, I was sorry, I was looking forward to having a one year birthday party for it.

Interviewer: Adam Levy
For quite some time everyone has been hunting for some gap in the standard model, some chink in its armour. Do you think there's any possibility that we just won't find anything?

Interviewee: Gerald Gabrielse
Well I suppose there's always that possibility. That's not the possibility that motivates us. I guess if I were a sea captain years ago there would be a possibility I could sail into the ocean

and never find anything but I might have tried it anyway. I think many of us take that same approach here. That's what we'd like to do.

Interviewer: Adam Levy
That was Gerald Gabrielse who's at Northwestern University in the United States. For more on the quest to find new physics with tabletop experiments check out the feature. That's at nature.com/news. And to hear from more physicists who are making minute measurements to look for errors in the Standard Model, give our piece on antimatter a listen. That was in the show from the 3 August 2017.

Interviewer: Benjamin Thompson
So it's time now then for the first News Chat of 2018 and I'm joined here in the studio by Lizzie Gibney, a senior reporter here at *Nature*. For the past few years, Lizzie has been collating and maybe looking forward to the year in science and this year is no different. Lizzy, welcome.

Interviewee: Lizzie Gibney
Hi, hello.

Interviewer: Benjamin Thompson
My first question to you then is, how can you possibly pick out some of the highlights and things that might happen this year?

Interviewee: Lizzie Gibney
So the way that I tend to do this story every year, and can I just say this is a really fun task to do and why it's so enjoyable is that we have, at Nature, lots of different great reporters and we have the journal editors and what we do really is we mine their brains really, and we look for general research trends. We've got a lot of our reporters who are out and about at conferences so there may be something they have up their sleeve that they've heard about that they think might happen in the coming year. And with some topics it's a lot easier if it's, for instance, a space launch or something then that's down on a schedule. So, barring something going wrong, they do usually happen. So some of it is tracking what we are already paying attention to and some of it is looking at what we think might emerge in the following year.

Interviewer: Benjamin Thompson
Well, speaking of space there, and space launches, I think the moon got quite a lot of coverage in this year's predictions list. Maybe let's start with the Google Lunar X Competition which I believe the deadline for is March 31st. Maybe you could tell us a bit about that?

Interviewee: Lizzie Gibney
That's right, so these teams are competing to be the first privately funded rover on the moon. And they don't just have to just go to the moon. They have to land, travel for 500 hundred meters and then beam back some images and as you might imagine, to date, that's only been done by National Space Agencies. So this would be quite an achievement. Now they've had a number of extensions but according to the enterprise, this really is the last

one. The deadline is the 31st of March. So, I think definitely 4 out of 5 have committed to launches so we will see how many of them will make it, how many of them get partial prizes for getting some mini milestones along the way and if any of them actually manage to achieve it.

Interviewer: Benjamin Thompson
So if that's then a private competition, what are governments themselves doing in the lunar-sphere?

Interviewee: Lizzie Gibney
Well, yeah, the moon is hot again which is great. I think that's a brilliant thing. So, NASA is going to have to respond to President Trump's order to send astronauts to the moon which came late last year. And then there are two other space agencies that are sending rovers. India will send Chandrayaan-2 which is a follow up to Chandrayaan-1 and that will be the first time it's actually going to try a controlled landing so it will have a rover that works once it gets there and then China will also send, actually two probes, one of which is going to be an orbiter and the other one is going to land, hopefully, first time on the far side of the moon which would be very exciting because it's a very unexplored area.

Interviewer: Benjamin Thompson
Alright, well let's look further out into space then and I understand that Canadian researchers are chiming in on mysterious fast radio bursts.

Interviewee: Lizzie Gibney
Yes, lovely pun there. So this is a radio telescope based in Canada and originally it was supposed to be looking just at the very early universe, looking for very faint radio signals, but in the interim, these fast radio bursts have been discovered which are very short and often just one off blasts that we see and have been very, very difficult to explain. But it's been rejigged a little bit so now hopefully we should be able to see perhaps dozens of these fast radio bursts a day. To date we've only seen about 20 or 30 in total so this will make a huge difference.

Interviewer: Benjamin Thompson
Okay, so if they are so kind of few and far between, what will they actually tell us?

Interviewee: Lizzie Gibney
Well, as you can imagine, if we've only seen such a small sample size so far, it's very difficult to know what the characteristics are of these bursts and knowing more should tell us about the general population. At the moment we don't know if we are just seeing particular ends of a spectrum or where they're coming from. They look like they're coming from all over the sky but perhaps there is some concentration in some areas versus others. But this is going to blow the whole thing out of the water. We're going to ramp up the numbers we've got by an enormous extent and just that sheer amount of data should be able to show us some patterns that will maybe stop them being quite so mysterious.

Interviewer: Benjamin Thompson

So let's maybe some back down to earth then for a little bit. 2017 was quite the tumultuous year for climate change science. How is 2018 looking?

Interviewee: Lizzie Gibney
Well, so 2018 will be in part about working towards 2020 which is going to be the next big UN climate meeting. So countries at the moment, those who that have signed on to the 2015 Paris Climate Agreement, are going to be looking at their progress towards commitments, and looking towards how they might update their commitments in 2020. And of course what they've committed to doing is keeping the world's average temperature to below 2 degrees and if possible 1.5 degrees. What's also going to happen this year is that there'll be a special report on exactly what the consequences will be of such as a 1.5 degree temperature increase so keep your eyes peeled for that. And then another particularly interesting thing that we pulled out is that there's going to be a big climate meeting in the states which is kind of interesting because of course, President Trump has committed to pulling the US out of the all-important Paris Agreement. But this is Jerry Brown, the Governor of California, who has in some ways taken up the mantle of climate leadership over there and is having this huge conference that is supporting the Paris Agreement and saying the US isn't going to be out entirely because there are lots of states and lots of scientists and people who are well behind it.

Interviewer: Benjamin Thompson
Okay then Lizzie. So, what about health then? What stories have you picked out as maybe being important this year?

Interviewee: Lizzie Gibney
Well CRISPR, the gene-editing tool, which I'm sure everyone knows about, is going to be very hot this year and in particular the first human study that uses CRISPR, in this case to edit immune cells in order to tackle lung cancer is set to conclude in April, so eyes peeled for that. And there's going to be a lot of work towards engineering viruses that are called bacteriophages which use CRISPR to kill or potentially, hopefully, kill antibiotic resistant bacteria. And there's also going to be a trial using induced pluripotent stem cells to treat Parkinson's Disease, so there's going to be quite a few exciting clinical trials that should hopefully wrap up by the end of the year so look out for those.

Interviewer: Benjamin Thompson
So if they're all clinical based studies, do we have anything more fundamental coming up?

Interviewee: Lizzie Gibney
Absolutely, yes, so in particular in genomics, we're hoping that this year when we have the first large scale multiple-cancer sequencing genome studied, so these are big efforts that have been going on for many years. That's going to bring some insights into the genes that control cancer and the evolution of cancer and in particular there's also going to be the final results of an effort from the Cancer Genome Atlas that will look at the protein coding regions which is the exome across a whole host of different tumours. I think it's going to be 32. So these are really big multiple cancer sequencing efforts that we hope will reveal some really important insights.

Interviewer: Benjamin Thompson
What about you yourself Lizzie? Anything that stood out to you? What excites you the most about this year?

Interviewee: Lizzie Gibney
Well, I mean, there are so many things built I would say what I would like to pull out, because it is dear to my heart, is an advance in accelerator physics, so as you will definitely know, colliders are massive, usually. The Large Hadron Collider is 27 kilometres in circumference but there's a really intriguing way to possibly accelerate particles across much shorter distances that they're trialing at the moment at many places but including CERN which is trying a particular technique and what they are attempting to do is essentially surf electrons on a wave of plasma. It's quite out there but last year they managed to show that the principle does work and this year they're actually going to put electrons into the machine and see if it does work as hoped.

Interviewer: Benjamin Thompson
So if we can get electrons to hang ten and surf then what does that mean for physics?

Interviewee: Lizzie Gibney
Well that means that we should hopefully be able to keep increasing the energy of our colliders whilst not increasing the price because we can make them in shorter spaces.

Interviewer: Benjamin Thompson
Wow, we have covered a lot of ground there. Listeners, you can find the full list over at nature.com/news and Lizzie we'll need to get you back in the studio in about a year I guess to find out how your predictions went.

Interviewee: Lizzie Gibney
Yes, I hope so. Looking forward to it.

Interviewer: Adam Levy
Well that's it for this week. But before we go there's just time to tell you about the *Nature Middle East Podcast*. This month, host, Pakinam Amer, goes on a journey through the lush mangrove forests of the Arab world, and meets a painter who is trying to save these natural carbon sinks through her art. Find the *Nature Middle East Podcast* wherever you get your pods.

Interviewer: Benjamin Thompson
And while you're subscribing to that, don't forget to follow us on Twitter, we're @Naturepodcast. We've also got a great YouTube channel. We've just published an animation on 'artificial photosynthesis' and how it could help in the fight climate change. I'm Benjamin Thompson.

Interviewer: Adam Levy
And I'm Adam Levy. Thanks for listening.

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