Inspiring Doctors. Episode 11: Alice Roberts

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Martin
Welcome to Inspiring Doctors, a podcast series brought to you by the British Medical Association. I'm Martin McKee, a professor of public health and the president of the BMA. In this series, I'm joined by people who I see as role models. They've successfully taken their medical knowledge to a wider audience in creative ways. So, what inspired their work? What lessons have they learned? And what advice do they have for young doctors who may want to follow in their footsteps?

There is something magical about the confluence of medicine and communication. My interviewees are only some of the role models who do this work. But they are all people who have inspired me. I hope that our conversations will in turn inspire you.

My guest today is Alice Roberts. Alice qualified at the University of Wales and worked as a junior doctor for 18 months before becoming an anatomy demonstrator at the University of Bristol. She completed a PhD in palaeopathology and became director of anatomy for the NHS in the Severn region. In 2012, she was appointed as the University of Birmingham's first professor of public engagement in science.

Her earliest television appearances were on the archaeology programme *Time Team*, where she applied her expertise to bones. This was followed by *The Incredible Human Journey*, which explained evolution and early human migrations, and then numerous other programmes on archaeology, nutrition and history.

She co-presented the 2018 Royal Institution Christmas Lectures and was one of the organisers of the Cheltenham Science Festival. She's been elected as a fellow of the Royal Society of Biology and is the recipient of numerous awards, including a string of honorary degrees and the 2020 David Attenborough Award from the Royal Society. Welcome, Alice.

Alice
Thank you very much, Martin.

Martin
Well, it was only when I was researching this podcast that I discovered that you'd been a media star for much longer than I'd realised. You won the Blue Peter Young Artist Award when you were 14. Now, we've got a copy of the picture here, and I don't claim to be an expert on art, but it seems technically very complex, with what seem to be a lot of things going on. What stimulated you to submit it and what happened next?

Alice
I've always loved art; I loved art from a very young age and that went along with a love of the sciences. I actually did art all the way through to A-level. And it's always been there in my academic career as well. I use art a lot to learn, myself, but also to teach my students as well. So, I've always illustrated handouts and that sort of thing.

So yeah, going back to that *Blue Peter* design, they put the call out for a cover design and I thought, well that's an entertaining thing. So, it was multimedia. Some of it pencils; some of it gouache, I think, if I can remember – I'm sort of peering at it now.

But it was slightly frustrating because the competition was to design the cover of the *Radio Times*, and so I left a gap at the top for the words 'Radio Times'. And in the end, they decided that they wanted the presenters on the cover as well. So, it ended up being quite a small picture in a photo – we mocked it up as a gallery photo. So yeah, it's another one of those *Blue Peter* competitions which went slightly awry, I think.

Martin
Indeed, as many of them did. Not to mention elephants, for example, one that immediately comes to mind. But I've seen many of your other drawings – the anatomical drawings and others – and they really are amazing. So, I do hope that our listeners will take the opportunity to have a look at some of them.

Alice
I was absolutely delighted this year as well to be made an honorary fellow of the Medical Artists Association, and that just felt like a really lovely recognition. So, I think I can now think of myself as a medical artist and not just kind of dabbling on the side.

Martin
Well, many congratulations for that. Now, you were obviously interested in anatomy because you took an intercalated BSc in it. Now anatomy is not always the most popular subject for medical students. So, what attracted you to the subject?

Alice
I think I've always been interested in anatomy. Again, from a young age, I remember being, you know, fascinated by animals, skeletons. You know, finding animal skeletons out on walks and picking up bird skulls, and just understanding how bodies are put together and how they work.

And then doing anatomy at Cardiff was fantastic. I mean, this was back in the '90s, and anatomy played a very big role in the undergraduate curriculum in the first two years of the course. And we did nine hours of dissection every week, which was… you know, I was totally in my element. I loved taking the body apart and understanding how it was put together.

It seemed to me like… just incredible knowledge. And I remember one moment when I was a medical student and I looked down at my own foot, and I was looking down at my bare foot, and just suddenly went, oh, my goodness, it's all in there. It is all under the skin in my own living body.

I love anatomy. I love the fact that there's a basic plan that we're all built to, but also the variation. And I think that dissection is such an important thing for medical students to do for all sorts of reasons. And unfortunately, it's been compressed so much in our modern curricula. I'd love it to come back to prominence. It's much more prominent in medical training in the United States.

There are lots of reasons to do anatomy in a hands-on way. One of them is to really get the anatomy into your head. It's three-dimensional. You need to handle it, not just look at it. It gives you that kind of understanding of anatomical variation. If you're looking at real, real cadavers.

And also, actually its position in the course. If you're doing a lot of it in the beginning of your medical training, it's doing more than just introducing you to the structure of the body. It's doing things like… for some medical students, when they walk into a dissection room, it's going to be the first time they've ever seen a dead body. They're going to start thinking about mortality – coming to terms with that, coming to terms with the fact that this is going to be a big part of their lives and what they do as a job.

And so I think there's a lot going on, beyond the actual understanding of the structure of the body, that is really valuable, that you get from dissection rather than any other medium. We've got all these fantastic multimedia technologies now, really wonderful three-dimensional anatomy on apps and even virtual reality. But I don't think it replaces the real thing. I think it should be used alongside it.

Martin
And it can be made really interesting. I remember at Belfast where I trained, we had an inspirational Australian anatomist, Jack Pritchard, who really brought it to life in a way, if I can use that phrase. In anatomy – it can be done.

Alice
It is the people, isn't it? I mean, when you look back at your school and then university, very often the subjects that you really fell in love with, it's because of an inspirational teacher. And there were lots of fantastic people at Cardiff. In particular, Richard Newell, who is a retired surgeon who I'm still in touch with. He would bring archaeological human bones into the dissection room to show us what arthritis looked like. I think I can thank him for my enduring fascination with paleo pathology, with, you know, how you diagnose diseases in old bones.

Martin
It's amazing how a contact at an early stage in your career can shape the direction of where you go afterwards. But then after qualifying, you spent 18 months in the ward as a junior doctor. How did you see your career unfolding at that time?

Alice
I was absolutely hell-bent on surgery and in particular, paediatric surgery. My very first house job, you know, straight out the doors of medical school, was with a fantastic consultant in Cardiff in the Heath Hospital, Simon Huddart. He's retired now, but he was just amazing.

And you know, paediatric surgery for me was – I loved working with the children, and I loved the craft of surgery as well, and the very beautiful tiny craft of paediatric surgery.
So that was very much what I had in mind as I started to construct my own surgical training. And of course, back then we didn't have these jobs where you're kind of signed up for years of

training and sent all over within a region. You would apply for individual SHO jobs, and you would construct your own training as you went along.

So, after I'd done my house jobs, I was looking around for, you know, the next step. Having always loved anatomy, I quite fancied doing an anatomy demonstrating job, which is fairly standard fare for young surgeons, spending six months teaching anatomy at Bristol Medical School. Still doing some surgery, so still being an SHO in general surgery as well.

So that was the kind of plan. And then after that SHO job, I was then intending to carry on and do A&E and other surgical SHO jobs, but I got trapped in the university – in a good way I think – although I can see in a parallel life that I went on and did become a surgeon and I think I would have been very happy indeed in that role as well.

But what should have been a six-month job turned into 11 years for me, and a PhD, and a gradual acceptance of the fact… there wasn't a kind of hard line where I suddenly went, 'I've had it with surgery, I'm going off to be an academic.' It was a very kind of gradual acceptance of the fact that I had been absorbed into academia, and I probably wasn't going to go back to the clinical world.

There's a small element of regret there, still, I think. But I've had an amazing career. I'm continuing to have an amazing career. It's probably too late for me to go back to surgery now.

Martin
Yeah, I sympathise to some extent. I moved into public health after three years as a medical registrar. I really enjoyed my time in the wards and in the outpatient clinics. And particularly in Belfast, I had the social determinants of health presenting in my clinics with people with scurvy and beriberi and all those challenges. So, I do miss it. But on the other hand, you know, you make choices and things work out in the end.

Alice
Yeah, and I think I still feel as though I'm very much in touch with that world. You know, I'm still teaching medical students, so I feel kind of one step removed, but I'm still working with surgical colleagues and anaesthetic colleagues occasionally as well on more anatomical bits of research and communication.

Martin
Great. Now I'm getting to the end of the series of podcasts and I'm finding all sorts of connections between my guests. So, in one of the earlier ones we had Guddi Singh, and she told us how she introduced dance onto a paediatric ward. But I gather that you introduced rollerblades.

Alice
I did. I'm not sure whether you'd get away with that now. So, when I was on-call at the Heath Hospital, I was sleeping in the nurse's accommodation and there was a tunnel underground leading from that accommodation into the hospital. And when your bleep went off and you were, you know, trying to catch some sleep – fragments of sleep – you'd then have to race along these corridors to get into the hospital, race along these tunnels.

And I'd already taken up rollerblading. So, it occurred to me that this would be an excellent way of getting through the tunnel quickly into the hospital. And then, actually, why not just keep the rollerblades on? Not if I was attending an emergency, but if I was going to do my last ward round of the evening, I would keep my rollerblades on, and the kids absolutely loved it.

Martin
So, then you spent seven years researching the shoulder. What was it about that choice, that particularly interested you? And what did you learn about the shoulder?

Alice
Well, I knew I wanted to do a PhD on old bones. My head of department at the time really tried to disabuse me of this idea and tried to persuade me to do neurophysiology instead, which was where all the kind of exciting cutting-edge research was happening. And also a lot of the research funding, and I think he knew that there was very little funding for the type of research I wanted to do, but I was absolutely obsessed with it.

So, I stuck to my guns. I did explore opportunities in the department, but I stuck to my guns and I did a PhD under the amazing mentorship of Juliet Rogers, who was a fantastic palaeopathologist and she was a medic turned academic like me, and Kate Robson Brown who is still at Bristol University – amazing forensic and biological anthropologist. And Jonathan Musgrave, who very sadly passed away earlier this year.

So I'd just met these incredible people who were all working in that area. They were prepared to mentor me through a PhD. And I looked around for bits of the body to investigate, and it occurred to me that the shoulder had kind of slipped through somehow.

I was looking at bones in my lab, and I was seeing what clearly looked like rotator cuff disease on these bones. But there was no official palaeopathological diagnosis of rotator cuff disease. People would just note the changes on the bones and quite often just say, 'oh, shoulder osteoarthritis', but it's much more complex than that.

And so, in my PhD, I looked at soft tissue and hard tissue. I was able to use specimens from the dissection room to make sure that the hard tissue changes, the bony changes I was looking at, did actually relate to the kinds of soft tissue changes that you'd expect to see in rotator cuff disease. So, the damage to the tendons around the shoulder, primarily the rotator cuff tendons.

But I was also interested in whether this was a new disease or whether it was something that had always been present in human populations, so there was an archaeological element to it as well. And I was also interested to see whether humans were uniquely affected by rotator cuff disease, because our shoulders are quite different in some ways from those of our closest living relatives, the chimpanzees and the gorillas. So, I also did work looking at other apes – I mean, we are apes – but I did work looking at other apes and looking at their shoulders too.

I think early on in the PhD, I wanted to work out what the clavicle was for, and that proved to be too knotty a problem, so I've left that. I hope somebody's worked it out by now. But I really don't know what it's for. It's a curious bone.

Martin
But let's stick with the clavicle for a minute because you have elsewhere said that it's your favourite bone. What is it that makes the clavicle so special?

Alice
Well, it's my favourite because it's infuriating, because I really – I honestly don't know what it's for. I mean you can come up with easy answers like, 'Oh, it's there to hold your shoulders out to the side.'

Martin
Well, I mean, you would imagine if you didn't have one, you would need something there.

Alice
Yeah, but there are people that are born without clavicles that don't have that much of a problem.

Martin
Ah.

Alice
So, it's a very curious thing. And also, it's unusual. Most mammals don't have clavicles. I think that as humans, we just assume that it's a mammal thing and everyone's got them, but most mammals don't. So, it's obviously something quite peculiar to primates. And so when you spot something like that, you go, 'Right, well, why is it there then? What is it actually doing?'

I think I really wanted to understand how much of the time is loaded in compression versus tension, these kinds of things. And I got to the point where a colleague at Bristol University said, 'In order to really get to the bottom of this, Alice, you're going to have to drill a rosette strain gauge into your own clavicle and go and hang from some bars.' And at that point, I decided I was going to give up on that and do rotator cuff disease instead.

But I mean, it's a fascinating bone. Most of our bones start in the embryo by forming as little cartilage models. And then they ossify, so endochondral ossification. And then there are some bones – predominantly flat bones, like the bones of the skull – that ossify straight out of embryonic connective tissue, mesenchyme.

But the clavicle is very unusual because, amongst all of your limb bones, they all ossify out of cartilage apart from the clavicle. So, the clavicle has this very strange form of ossification, which seems to link it in some way to the skull.

And then you start to look at the evolutionary history of the clavicle, and it once used to be part of an ancient fish's skull. So it has detached itself from the head and kind of sunk down

into our shoulder region. It's just a great example of how you can't really understand something until you go back far enough in time and delve into that evolutionary history.

Martin
I think at this point, any medical students that are listening to the podcast will be thinking, how can I be taught by Alice? Because you clearly bring it to life in a way that I think many other people will struggle to do. That's amazing.

Now, you're probably best known for bridging the gap between medicine and archaeology. What does a doctor bring to the study of archaeology beyond the ability to distinguish, say, a femur from a sternum?

Alice
That is useful. That's a useful skill to have when you're on a dig. It's always useful on digs when you're looking at human bones to have osteologists on-site. And lots of osteologists are extremely well trained, coming from archaeological backgrounds and are very adept at recognising human bones and looking at palaeopathology as well.

But I think coming from a medical background, it's been very useful to approach the subject thinking about the skeleton as not just the skeleton – because obviously, the skeleton is part of the body in the way that it's part of a whole system, it's part of the musculoskeletal system. It's only by dint of the fact that it happens to be hard tissue that it's the thing that remains and everything else is rotted away.

But if you know anatomy, then if you see changes, for instance, on the surfaces of bones, you know what's there. You know what attaches at that particular point, or which vessels or nerves are lying close to the bone at that point. And I think that's really, really helpful to particularly palaeontology where you're trying to diagnose diseases.

I mean, it's a curious thing. When I started doing it with Juliet Rogers, I was pretty amazed actually, as a young doctor that you could diagnose diseases based on just the skeleton. Because coming out of the clinical setting, where you're talking to patients, you're able to ask them where it hurts, and then you're able to do a whole battery of different investigations to try to pinpoint a diagnosis. The idea that actually you could get to a diagnosis by just looking at a skeleton, was quite extraordinary.

And of course, we have some investigations that overlap with the clinical world, particularly radiology. The whole field is being utterly transformed in a really disruptive way right now by this new science of archaeogenomics. And that is incredibly exciting.

So, I'm fascinated by that. I'm working with colleagues in the Crick Institute, which is obviously mostly focused on human disease in the here and now, but there's a whole lab working on archaeogenomics headed up by Pontus Skoglund.

And I'm just fascinated by this collision between… I suppose, biology and history, and genetics and archaeology. And it's happening in a delightfully disruptive way, in that we're able to

answer questions that we never thought we'd be able to even ask before. And it's going to make us ask different questions of the past as well.

One of the most incredible things that's come out in just the last few years – and there's been a very recent publication from my colleagues at the Crick, including Pooja Swali – is that we now know that, for instance, the plague, Yersinia pestis, has a much more ancient history than we'd thought. And that relies on being able to extract DNA from ancient bones, not just human DNA, but the pathogens that people had on board as well.

Martin
I read that and it was absolutely fascinating. Now, let me just link that to the work that you did in 2009 when you presented *The Incredible Human Journey*. At that time, of course, much of the evidence was from archaeology. And as you've mentioned, the whole field has been disrupted by the insights that we're getting from genetics.

There's a rhetoric in academia about the importance of interdisciplinarity, but often it seems that the incentives are to specialise in a very narrow area. So, in my world, where I'm studying the impact of major social, economic, and political change on population health, I need to understand everything from the biological mechanisms through to the political sciences.

And I think you've been showing in the work that you're doing now the need to take the genetics, the archaeology, all of the other bits and bring them together. Has working together in this interdisciplinary way been easy or do you see lots of challenges?

Alice
I think it is easy. It's really fun. I mean, I love the way that when you get disciplines crashing into each other or merging – depending on how dynamic it feels – sparks fly. I mean, it's just incredible how you can kind of shift the questions that you're trying to answer. That's really wonderful.

I think what's evident though, when you do interdisciplinary work, is the language barrier that exists. You know, we're all speaking English, but we're talking technically a lot of the time, and our technical formulations are going to be really different in different disciplines. Even within biology, you'll find people using the same term in different ways.

I'm working on a paper at the moment with a colleague in philosophy at the University of Birmingham and also my colleagues at the Crick. And we're just looking at how we use the word 'migration', because it's an interesting word in that there's a very different definition of it – a different but related definition of it – depending on whether you're using it in a lay context, in a modern political context, in a scientific context…

I think in genetics, what people mean by the term 'migration' is simply that someone has been born in a different place from where their parents were born. That's a kind of very simple definition. When you say migration, I suppose colloquially, and when you're thinking about modern politics, you think of a large movement of people definitely happening within a lifetime. So, you know, it's a large-scale event that's happening quite quickly.

When you use migration in the past, say, for instance, thinking about the palaeolithic colonisation of the world that we were describing in the series *Human Journey*, we're using the same word. But we're talking about an expansion of a population out of Africa and all around the world that's happening over tens of thousands of years.

So, we're talking about very different things, but we don't have any other word for it. And philosophically we're writing this paper and trying to decide whether we can continue using the word. And if you continue using the word in all these different ways, I think the important thing is, for instance, if you're writing a genetics paper and you're talking about ancient migrations, that you really define what you're talking about right at the very beginning. Because otherwise, you can end up with easy misinterpretations of what you're trying to say and what your data mean.

We saw this with the extraordinary genetic revelation about the early Bronze Age in Britain, where it's very clear that when we have this change in culture in the early Bronze Age, which is represented by the Beaker people – I mean, we say the Beaker people as though they're a kind of ethnic group; they're not. So you see these new styles of burials coming in with crouched burials and pots being placed in the graves, you see the birth of metallurgy in Britain.

So there are clearly people coming, with this knowledge and different ideas. And the question has always been in archaeology, how many people are coming then? Is it just a few people? And then the ideas diffuse – so, a cultural diffusion, or is it a large-scale migration into Britain? And the answer, from the genetics that is emerging, is it's a large-scale migration.

Now, this was quite incendiary when it was first published – which I think was five years ago – because the kind of prevailing, favourite theory at the time was that it probably was more cultural diffusion than massive migration. But the genetics, if you look at the genomes of people in the preceding Neolithic, the end of the Stone Age, and then looking at people in the early Bronze Age – their genomes are different enough to say that there's been a 90% population replacement in Britain in the early Bronze Age. So, it's really profound.

So, that's a cat among the pigeons. A lot of archaeologists were very concerned about that and kind of amazed by it. But we need to just pull back and go, right, what does it actually mean? What does it look like on the ground? At the moment, what we can say is that there's a big population change, but the degree of resolution that we've got in terms of the data that we've got at the moment is over about 300 years.

So it may have been within that 300 years that there's a decade where there is a mass migration from the continent to Britain. Or it could be that it's just very gradual and you've got more and more families coming over from the continent and settling in Britain, and maybe their lifestyle is a little bit more successful than the preceding farmers in that they're having more children and so their genes will predominate, we don't know. So, the ball's back in the archaeologists' court now.

But it tells you how important it is to be careful about the term 'migration', because you kind of immediately leap to the conclusion that this is a dynamic change that's happening very quickly and which felt very dynamic to the people that were living through it.

Newspapers get hold of it, and you get horrendous headlines like: ‘Dutch hordes killed off the people who made Stonehenge.’ And you go, ‘You can’t say that – that’s ridiculous.’ But it makes us then say, ‘Right, we need to be very careful about the language that we use.’

Martin
But then you’ve got so many new insights. I’m thinking of the ability to differentiate mitochondrial and nuclear DNA, particularly with the Vikings and others, challenging the traditional ideas about where people came from, which was often based on language.

I do a lot of work in Central and Eastern Europe with the Finno-Ugric people, who came across to become the Hungarians, the Estonians, the Finns and others. Though they share the same language, often they’re genetically quite different, even to the extent of differences in lactose intolerance, for example, between Finns and Estonians. So, we’re having to look afresh at what we thought were established understandings of what was happening but actually, are not so clear at all.

Alice
Yeah. See, when you say that, I think that interdisciplinary work is so important as well, because, you know, archaeologists have been probing that idea of packages of genetics, language, material culture, for a long time. And actually, the idea that a package like that exists goes back to the beginning of the 20th century, where the theoretical framework that archaeologists were working in, we now call the culture-history paradigm.

And it was about these packages. It was about, you know, if you could identify people who were speaking the same language, they’ve probably got the same biology, they’ve probably got the same genetics, and they’re probably doing the same thing in terms of their material culture. And it’s just not true. It just doesn’t exist, because culture is much more fluid than that. So culture doesn’t map well onto genetics at all.

It’s interesting because of course, in the here and now, we construct our identity and our ethnicity based on some biological features, but not others. Some aspects of culture, but not others. So, you know, ethnic identity is a real thing, and it’s about people self-identifying as a particular ethnicity, but we can’t really find it in the past. It becomes impossible. It’s something that somebody feels in themselves about their own culture and where they belong. It’s not something that you can say, ‘Well if you’ve got this set of genes and you make these kinds of beads and you speak this kind of language, this is your ethnic group.’ You just can’t do it.

I mean, this is one of the reasons that we say that race is biologically meaningless. It is. There is no such thing as race, from a purely biological perspective. There is such a thing as race from a political perspective and a social perspective. And it is important, in that way.

Martin
And of course, many people have multiple identities. I think in particular, I do a lot of work with the Roma population in Central Europe. And if you ask someone if you are Roma, the first response from them is, ‘Why do you want to know?’

Alice
What a brilliant response.

Martin
Yeah, because in the past, you know, they were obviously victims of the Holocaust**.** But on the other hand, more recently there have been programmes, the Decade of Roma Inclusion, to support their economic development. And you can understand perfectly rationally why somebody would want to know why they're being asked a question like that.

I think the interaction between microorganisms and humans is absolutely fascinating. One of my favourite examples is the way in which the founder populations of Amerindians that crossed the Bering Strait seem to have been free of Helicobacter but the Helicobacter you find is genetically linked to the Iberian Peninsula. So, you can see that it came later apparently.

Alice
Oh, really? That's fascinating.

Martin
So now, your first appearance on television, if we exclude your artistic excursion with the *Blue Peter* picture, was *Time Team*. I think a lot of people listening to this will want to know, how did you get into television?

Alice
Completely by mistake. So, I moved from surgery to academia by mistake, and then I got into television by mistake. It was just by virtue of the research that I was doing. I was doing research on archaeological human remains and *Time Team* – who used to make these series on Channel 4, very long-running series – had to make reports of everything they did, just like any other archaeological dig.

So, they had to create a report at the end of it, which would involve reporting on the excavation itself but also getting specialist reports on the pottery, the coins, the bones – all of those things. And so, they were looking for somebody to write the bone reports. And I was doing that kind of work alongside my own research in my lab.

And it was my husband's fault. So, he had a friend who'd gone off to work for *Time Team* and I think they were in the pub one evening and she was bemoaning the fact that they had, you know, a backlog of work that needed to be done, including all these boxes of bones that needed to be reported. And he said, 'Well, you know, send it up to Alice at the lab at the University of Bristol, she'll do it.'

So I started doing that for them. I started writing reports for them just as I was writing reports for other archaeological units in the area, sometimes for the police when I got involved with forensic cases. And then in 2001, they said, 'Actually we're going to be doing a site where we'd like you to come along and start analysing the bones, processing the bones' – which always sounds very posh, doesn't it? 'Processing archaeological bones.' It's washing them with a toothbrush in a bowl of water. And starting to compile a bone report.

So I said, 'Well, I'm going to have to shuffle my teaching round a bit to accommodate this. Are you sure there's going to be human bones emerging on this site?' And they said, 'Well, it is a cemetery site, so yes, there will be.' So I went along. And again, I didn't really expect to do any more after that, but they kept on inviting me back to come along and dig when they thought they were going to be human bones.

Sometimes there weren't any. But I know one end of a trowel from the other, having had a boyfriend, and then husband, who was an archaeologist. The only way I could actually spend any time with him in the summer was by volunteering on the digs that he was doing – to which, I thought, why isn't he digging in Santorini? Why is he always digging in Anglesey? But I spent many lovely summers digging in Anglesey. So I was able to use some of the skills I'd picked up on archaeological digs as well.

It was literally one thing that led to another. And I ended up expanding that role on television where I wasn't – I hesitate to say that I wasn't *just* an expert contributor, because expert contributors are absolutely essential to any documentary. You know, *Digging for Britain*, which I present on BBC Two, absolutely depends on the archaeologists; the archaeologists are the expert contributors. They are the programme.

But yeah, I was doing that expert contributor role and then started to interview other people, and then eventually emerged into more of a presenting role where you're actually talking to the camera as well. So it all felt very organic. And I was very pleased that I was doing this television, and getting into that role of being a broadcaster, having had quite a few years by that point of being a teacher under my belt, because I'd learnt an awful lot about communication through teaching undergraduates.

Martin
Well, after that you did a series called *Dr Alice Roberts: Don't Die Young*, and I've been watching some of the clips on YouTube. It was essentially a series of televised anatomy lessons.

Alice
It was, yeah.

Martin
But with some unexpected teaching aids. Could you tell us a little bit about some of the more imaginative teaching aids that you used?

Alice
It was really fun. So, yeah, we did a bit of dissection. We did a bit of radiology. We had some physiology, and I was the guinea pig. And I thought that I had managed this very well by bringing along my wonderful friend Eugene Lloyd, who was a lecturer in physiology at the University of Bristol, to basically design the physiology experiments. But he ended up doing really horrible things to me. I have forgiven him! Like, I think there was one programme where I wanted to test the pH of my stomach acid. Have you ever tried putting a nasogastric tube up your own nose and into your stomach?

Martin

Not knowingly, no.

Alice
It's impossible, honestly. I mean, eventually, I had to give up and get somebody else to do it to me. It's worse than tying someone else's shoelaces, it's just an impossible feat. And then other things… what else did he make me do? Oh, we had things like, what would my blood pressure do if I was taken up in an aeroplane and thrown around and taken to 5G?

And I remember the safety briefing for that where the pilot, who was an ex-Red Arrows pilot, said, 'OK, so the most important thing is, don't be macho about this. When you start to black out, tell me.' And I was like, 'I'm sorry, what? What do you mean when I start to black out?' And he said, 'Don't worry, your eyes go before your brain goes.'

Martin
A useful piece of information.

Alice
My goodness. And then we did quite fun demonstrations of bits of anatomy and physiology. So, I remember mapping out the female reproductive system with white tape on a hill in Ashton Court just outside Bristol. So, we had the uterus and the oviducts and the ovaries, and then I got into a zorbing ball and the zorbing ball was an ovum being ovulated and then passing down the oviduct into the uterus.

So yeah, we thought up lots of fun ways of looking at anatomy.

Martin
There was a particularly memorable demonstration of the male reproductive system.

Alice
Oh, was that the plasticine one?

Martin
That was with a large pump.

Alice
Yes. So, we thought of ways – it was very tricky doing the male reproductive system. So, each programme focussed on an organ or an aspect of the body, a system of the body. And these programmes went out at about 8 o'clock in the evening. So, we were definitely pre-watershed.

And when we came to the male reproductive programme we had hilarious – I thought they were absolutely hilarious – notes from editorial policy, Ed Pol, that man at the BBC. There is no man called Ed Pol; it's editorial policy. I'd just assumed that we were going to be able to show a penis on television, because that's what we were talking about. And I'd actually gone as far as to assume that we'd be able to show an erect penis on television – absolutely not.

So first of all, we were not going to be able to show the penis of a living man on television. So, we had to think of ways to get around that. And I think we got around it brilliantly with me

doing effectively a life drawing class where we blurred out the model in the background. But I drew in quite a lot of detail what it was I wanted to be talking about.

We then had a physiology demonstration which involved, yes, a pump and showing how if you cut off the output – so, in other words, if you're compressing the veins and you carry on pushing, in this case air in, but blood in – you're going to cause an expansion.

And the other thing I did was actually model the whole of the male reproductive system in plasticine in tubes to show how the vas deferens comes up from the testes and passes through the inguinal canal and then enters the urethra and where the urethra goes and all of that, and seminal vesicles, prostate gland, everything.

But I think just in terms of the ease of making this model, I made it about one and a half times the life-size. And the crew I was working with were all male, and they went very quiet while I was making this thing and describing it. And then I think that evening when we were all out for dinner, one of them sort of discreetly said to me, 'That model you made, was that kind of normal, life-sized?'

Martin
Well, going back to your earlier television appearances, I guess that was something that was never going to appear in *Blue Peter*.

Alice
No, exactly. It should do though, shouldn't it? Everyone should know about their anatomy.

Martin
Well, in 2012, you were appointed as the professor of public engagement in science at the University of Birmingham. What does a professor of public engagement in science actually do, beyond what we've just been talking about?

Alice
That's an interesting question, because it was an entirely new role at Birmingham when I arrived there, and it was very different to my job at Bristol. So, my job at Bristol ended up being running anatomy on the medical course, producing or curating a whole series of postgraduate anatomy courses as well.

But I always did lots of public engagement. I liked doing talks. I liked helping fellow academics to engage with the public in all sorts of ways. I've always loved going into schools, and I don't really see a hard line between engaging with adults and engaging with children in terms of science communication. And indeed, I think that, you know, schools are a brilliant way of engaging with the wider community. I was involved with the Cheltenham Science Festival for many years as well.

When I went to Birmingham, the role was there for me to shape. And part of it was definitely as a professor in practice. We have we have lots of these roles in universities now, where you have professors who are engaged professionally in all sorts of outside areas, outside the

university. And that's very beneficial to the universities, that they're still engaging with the wider world, and with a whole range of different professions in that way.

But also, clearly, there was a job to be done inside the university as well, which was looking at how well we were doing public engagement at the University of Birmingham, how we could better support it centrally, and how we could develop it, particularly to reach out to the kinds of communities that wouldn't naturally come along to something like Cheltenham Science Festival.

So I've just had a joyous time, working with many colleagues right across the university. I suppose developing the strategy, and getting to a point now where we've got a central public engagement team at the university.

I hope that the experience for academics is that it's much easier to get involved with public engagement, that there's training available, that there's logistical help available, because, honestly, these things can take a lot of time. And what you don't want is for the academics to be spending a lot of time doing things like booking a venue, marketing, all of that kind of thing. So the university centrally can do that.

And then also looking at interesting projects where we can, for instance, create interdisciplinary public engagement opportunities. And the wonderful thing about that is that sometimes those then sometimes turn back into research.

So yeah, it's been really exciting, and it's come on in leaps and bounds, and we have recently been awarded a Gold Award by the National Co-ordinating Centre for Public Engagement at the university for the Engage Watermark, which is how well public engagement is doing and is embedded in your university. So, I'm absolutely delighted about that. That's a whole team in public engagement but also, it's all the academics who do this stuff.

I think what I'm really happy about is that from where I started in my academic career, where public engagement was considered to be something a bit weird and something you did at weekends or in your spare time – it is now, I think, much more, by most universities, considered to be part of what academics should be doing.

It's part of roles in academia. So alongside teaching, research, the dreaded admin, there's also public engagement as well. It's really important that we stay engaged with the community outside the institution.

Martin
And increasingly recognised in things like the Research Excellence Framework.

Alice
Yeah, absolutely. Well, the REF has been really helpful in that way, making sure that public engagement was recognised and valued. And before that the Research Council building public engagement into every grant application; that's been really important too. The funders have really helped to push that agenda, and the Wellcome Trust as well has been incredibly influential. So I think it's vastly different to where it was at the beginning of this century.

Martin
And of course, it's a key issue that runs all the way through the series of podcasts.

So, Alice, can you tell to our listeners how we met in the first place?

Alice
Yeah. Because this is the first time we've met in the flesh. We're used to seeing each other on a screen, on a grid, on a Friday lunchtime. So, I became involved with Independent SAGE during the pandemic. And I think for me, as somebody who's involved in public engagement with science and a science communicator, it felt like something that I could do usefully during the pandemic.

It was, I think, an incredible model of public engagement in science. It's kind of extraordinary that it wasn't official. It's kind of extraordinary that there wasn't something that was set up by the Government or the Department of Health or something, because we *know* that what people need in a time of crisis is to be able to get trustworthy sources of information, to be able to share their own worries and anxieties.

And I think this concept that was put together by Sir David King, who'd been a chief scientific adviser to the Government, the idea that you would have a panel of scientific and sociological and psychological experts, who would be able to – first of all – communicate what was actually happening, because the public needed to know what was happening on a weekly basis. It was fast moving.

But not just that: to be able to ask questions as well. And for scientists and clinicians to be able to listen to those questions. So I think in terms of both communicating what was happening in a very honest and straightforward way, with no spin, and to then be able to have that dialogue with the public as well, was just extraordinary. And I'm really pleased to have been a small part of it, and to have been able to facilitate those Friday briefings.

And I think, Martin, that what you and your colleagues did during the pandemic was invaluable. And you know that, because so many people have said this over time. But I'd just add my voice to theirs – it was an incredible lifeline, I think, to a lot of people, to have scientists and clinicians and others engaging so openly and honestly in that way.

Martin
Well, thank you very much.

Alice, you co-presented the 2018 Royal Institution Christmas Lectures with Aoife McLysaght. It's a rather different format and audience from what I guess you're used to. So how did you prepare for them?

Alice
It was great fun. I loved doing it. I knew what I wanted to do, which was to basically translate my book, *The Incredible Unlikeliness of Being*, into something which would work as a lecture and a television programme. It was a really, really interesting challenge, because if you were

just making a television programme, you would do something quite different from a live lecture. So you're doing two things at the same time. But I quite enjoyed that challenge.

And the other wonderful thing about it is that you're… as you're thinking up ways of communicating embryology and evolution essentially, to your general audience of teenagers – that's who it's aimed at, although obviously children of all ages watch it – you've also got all the resources of the Royal Institution at your fingertips as well, including their wonderful 'making' team.

So, you know, we came up with some amazing contraptions and ways of talking about natural selection. We brought animals into the studio and had them painted up with their skeletons on the side, including a huge horse, which did actually make it up the spiral staircase to an institution theatre.

Very quickly, I knew that I wanted to bring quite a bit of genetics into it as well. And I'm not a geneticist. So even though, you know, I would feel comfortable in describing genetics to a general audience, I wanted somebody who really knew their stuff, and who better than Aoife McLysaght? She's a very, very good friend of mine, and hilarious as well.

So we had great fun putting together those lectures. And it really is filmed as live; we deliver the lectures in an hour, so what you see when it goes out on television is actually what you have in the live theatre setting. And it was… yeah, it was great fun. I loved doing it. I hope it continues for a very long time. I think it's one of the really wonderful things that the Royal Institution does.

I hope it can get onto a better platform than BBC Four though. Because, you know, I made those programmes, we had very good viewing figures, but necessarily if you put something on BBC Four, there will be fewer viewers than BBC Two or BBC One. And BBC Four doesn't seem like the obvious place for teenagers to go and look at something. The Royal Institution does put them all online as well, but I would love to see those Royal Institution Christmas Lectures on BBC One in the future.

Martin
There's a message for the BBC.

So, in those lectures you looked at what makes us human and specifically our relationship with other hominids. Evolution is a major theme in many aspects of your work; we've already talked about it a bit in the discussion about your PhD, and it features in your book *Anatomical Oddities*. Can you give us a few other examples of why doctors should understand the role of evolutionary perspectives?

Alice
I think because it's just a fundamental part of biology, so… you know that Dobzhansky quote that nothing in biology makes sense unless in the light of evolution. And that evolutionary approach informs so much, in terms of understanding embryology, understanding adult anatomy and anatomical variation, understanding particularly how other organisms evolve, you know, particularly viruses and bacteria.

I think it's such a fundamental biological theory and, you know, theory in the sense that it's like the heliocentric theory of the solar system, that we know the planets go around the sun. We know that all life on this planet has evolved.

It's obviously something now which you start to learn in primary school, and I'm delighted about that. So that was something that was really spearheaded by Humanists UK, that I was recently president of – getting evolution into the primary school curriculum, because it's so fundamental. If you learn a bit about gravity at primary school, you should be learning about evolution as well.

And then if you're going to continue studying biology, it just needs to be in there all the time. It's really important to understand the basic principles, and actually what those mean. And in terms of understanding infectious diseases, it's fundamental, isn't it?

Martin
Absolutely.

Now, you've written so many books and presented so many series that it's really difficult to know what to cover in a single podcast. So I'm going to exploit my position as the host of this series to pick out one that is perhaps my favourite, and that's *Tamed: Ten Species that Changed Our World*, and indeed I have my very well-thumbed copy of it here. In fact, I recently used it as part of the evidence review for the Pan-European Commission on Health and Sustainable Development, a body created by WHO, and in fact your book is cited extensively in that report.

It was a bit different from what you've done before. So what stimulated you to do that book?

Alice
It was this fascination with the collision between genetics and archaeology. And this is an area that I was quite familiar with in terms of one species, homo sapiens, and I started to get really interested in what it was telling us about other species as well.

I think, you know, fundamental questions in biology… one is all about the origin of species, obviously. Somebody wrote a really good book about that once! So I wanted to see what was being discovered, in terms of many other species, once genetics was brought into the frame.

So in *Tamed*, I focus on… essentially it's a book about the Neolithic, it's a book about domesticated animals and plants. But from their perspective rather than ours. So I wanted to see how genetics was changing or challenging, or maybe supporting, our ideas about when particular species had become domesticated and also what that meant. So, how species change once they're domesticated.

Because, I mean, what's happening when humans are domesticating species is that… Darwin would have described what humans are doing as artificial selection. So you're using selective breeding to bring out certain traits in plants and animals. But really I think he needed to use that term in order to then drop his bombshell in *On the Origin of Species* and say, actually, I

think the environment's doing this all the time and other organisms are doing this all the time, and we'll call that natural selection.

But if you really kind of focus on artificial selection, it *is* natural selection. It's just natural selection where the most important agent is another species, and it's humans. So it is still natural selection. So you are still looking at evolution in action.

So, looking at domestication allows you to explore how evolution happens. It also allows you, once you bring in genetics, to see what happens when you take a part of a population away from the parent population and treat it in a certain way. And it also enables us to work with archaeologists to find out, you know, when different species are being domesticated.

One of the really exciting revelations that's come through from that world, again, of archaeogenomics – and this is something that Pontus Skoglund is absolutely fascinated by, and he's got members of his team working on this at the moment – is really understanding how and where and why dogs were domesticated. Because from the evidence we've already got, we know they were domesticated really early, compared with everything else.

Things like cattle, sheep, goats, all of those animals that are going to be livestock in the Neolithic, the earliest glimmers of domestication go back about 11,000 years ago. And it's the same with the crops as well. Things like wheat, rye, oats, millet and rice in East Asia. And I think maize as well – so I think maize, the date's getting pushed further and further back and we seem to be looking at the same kind of timeframe there. That's interesting, isn't it, that you've got three groups of people at around the same latitude, in very different parts of the world, all starting to domesticate crops at same time. I think it's a response to climate change.

But going back to dogs, we've now got evidence that some dogs were domesticated going back 30,000 years ago. It's astonishing. I mean, it pushes it right back into this time when our ancestors were hunter-gatherers. You know, moving around, nomadic in the landscape. And some of them are domesticating European grey wolves. Although maybe the agency is wrong there; maybe it's the European grey wolves domesticating themselves.

Martin
Indeed; that's what I was just thinking, who's doing which. It's a little bit like Douglas Adams' point, that it was the laboratory mice that were actually doing an experiment on humans. Maybe we have it the other way around.

Alice
Yeah, training the humans to look after them very kindly.

Martin
So, another thing that really comes out in many of these podcasts and certainly talking to you, very clearly, is the importance of narrative or storytelling. And you're a very accomplished storyteller. But why is this an important skill for scientists?

Alice

It is an important skill, and I think that it's an important skill because it is quite fundamental to how we understand the world as humans. Language is so fundamental to the human experience, and it is the way that we take one idea from one human mind and put it in another human mind, which is an amazing feat.

And it's something that not many other animals can do, and certainly no other animal can do it in the way that we do. You know, discuss ideas as complex as the ideas that we can – first of all – think up, and then transmit to each other. We're literally doing mind reading, but using, you know, changing soundwaves and then detecting those changes in soundwaves. If I describe a hand axe as a teardrop-shaped object, you've got that shape in your head. Immediately. There's something happening in your brain which is mirroring what's happening in my brain because I've introduced that idea to you.

But the way that we transmit those ideas, I think we learn much more deeply when those ideas are constructed as stories. Now, a scientific hypothesis is a story. It's a story about how the world works. And it may well be the right story or the wrong story, depending on the next bit of evidence that you're going to look for. But in terms of understanding more complex subjects, I suppose then the storytelling, the narrative is really important, and it might be that you're communicating how a subject is relevant to somebody and relatable. Or it might be that you are constructing a story which opens up the wonder of science.

I think it's really important. I think in our education system it's a real shame that we have such a narrow focus by the time we get to A-level that you can do what I did and basically just do science A-levels, where you don't even need to write an essay.

I did do art as well, just to balance it out a bit. But you're kind of losing that practice of creating longform stories and arguments, and I think that's a great shame. And I think it would be, you know, something that would be wonderful to bring back into science A-levels and then into our undergraduate and postgraduate courses as well.

Martin
And maybe it is this ability to paint a picture with words, something that perhaps is having a bit of a renaissance with the increasing interest in podcasts as a way of communicating rather than on the printed page.

Alice
Yeah, I think so. And blogging as well. So I think maybe we're going to see creativity being unleashed in that way.

Martin
Now, you're about to move into a new area. You have a new novel written for children that's very different from what you've done before. Can you tell us something about what it is, why you decided to do this?

Alice
Yeah, it is very different. I'd just dipped my toe in the water of fiction before. So, with the book *Tamed* about the species that are domesticated, I think there's a couple of chapters in there

where I allow myself to go on a little flight of fancy and go, OK, well, here's the evidence – now let's think about how that could have played out. I imagine a wolf wandering into a camp and engaging with a human, and I imagine what it might have been like for the first teenagers to ride horses. I'm sure it was teenagers, they're the ones that take all the risks, aren't they.

So I've done it in short form in some of my factual books. But that's, again, a very different thing from writing a novel. And for a long time I'd wanted to write something which was about what we now know to be true, that modern humans and Neanderthals came into contact with each other. And we know that to be true from a cultural perspective, but we also know it to be true from a genetic perspective.

So we know that modern humans and Neanderthals at various times – not just one time, but at various times in the past – met and had sex with each other. We don't know what that was like; we don't know how violent or loving those interactions were. But we know they happened, because I and you, Martin, have around about 2% Neanderthal DNA tucked away in our genomes.

Martin
And Denisovans as well.

Alice
Yes. I mean, this is the thing, is that the more we find out about the genetics of hominins and other human species, we find that they've all interbred. I mean, it's always happened. And we find that with other species as well, which I cover in *Tamed*. So, just as modern humans and Neanderthals interbred, domesticated apples and crab apples interbred throughout their existence as well.

So I wanted to write something about that scientific knowledge that we have now, that Neanderthals and modern humans came into contact with each other. And I thought, what if it was children that made that first contact? What if it was, you know, a modern human girl catching sight of a Neanderthal boy and becoming friends. How would that have played out?

It allowed me to explore ideas of differences. It allowed me to go back into the Ice Age world and try and recreate that, which I really enjoyed doing. So in the novel, all of the technology – all of the hunting tools and everything that she's using, that her tribe are using – are based on real archaeological evidence. But I've tried to bring that alive in the form of a story, and that is *Wolf Road*.

And I'm absolutely delighted that Philip Pullman has read it, and liked it. And there is a quote on the cover from him, so that makes me feel slightly braver about releasing this into the world, because it does feel much more nerve-wracking than any other book I've written.

Martin
So that should be on everybody's Christmas list. It sounds absolutely fascinating.

I'm going to finish with two personal questions that I ask to everybody. We're talking about doctors as role models. You've already mentioned a number that have been role models for you, but are there one or two you would pick out, especially?

Alice
Yes. I think Simon Huddart, who was the consultant that I did my very, very first house job with, was incredible.

Then actually the other doctor that I worked with as a house officer, John Morris, who I worked with at the hospital in Bridgend. And at that point you could apply to be the house officer of doctors that you'd met in your medical undergraduate training. Which is very different now – it's a lottery, which I think is a shame. It's meant to make it more egalitarian, but it means that if you've met people who you really admire and, you know, would love to learn from, you can't apply to have a job with them.

You could back in the '90s, and I'd seen this doctor at work and I was just blown away by his clinical skills, which were astounding. And he was an amazing diagnostician. But I was particularly blown away by the way he communicated with his patients, and I knew I wanted to work with him and to learn from him. And he was incredibly influential. There's so much about medicine that's about communication.

Martin
And what advice would you give for a new medical graduate listening to this podcast, who would like to follow in your footsteps?

Alice
Well, I suppose I would say to them, don't follow in my footsteps, because that means that you haven't continued with your clinical career! And there are a whole range of amazing clinical careers out there.

But what I would say is, don't worry – you know, don't be overly anxious – if you don't know exactly where you're going to end up in 10 years' time, 20 years' time, because things will happen over the course of your career that will take you off in new and exciting directions. And to be open to those opportunities and those challenges along the way.

Martin
Alice Roberts, thank you very much indeed.

Alice
Thank you, Martin.

This podcast is hosted by Martin McKee, produced and edited by Alex Cauvi. For more information visit bma.org.uk/inspiringdoctors