**9 Hannah Dee**

Hannah - So the idea is that girls don't feel like they belong in computer science as a discipline. If you don't feel like you belong, then you're less confident when it comes to things like asking questions. And if you don't ask questions, then you don't find out the answers that you need. And that becomes a vicious circle.

Kat - This is the Suffrage Science podcast: How women are changing science, brought to you by the MRC London Institute of Medical Sciences. I’m Kat Arney and over the coming series we’ll be exploring the journeys of women in science - reflecting on progress we’ve made and the challenges still to be addressed - through conversations with an incredible group of women scientific leaders, who have all received one of the Suffrage Science awards over the past ten years.

We’re hearing from inspirational figures from the world of science like former Chief Medical Officer Sally Davies, computing legend Wendy Hall and climate scientist Tamsin Edwards, so make sure you’ve subscribed to the Suffrage Science Podcast through Apple podcasts, Spotify or wherever you get your podcasts so you don’t miss a single episode.

This time I sat down for a chat with Dr Hannah Dee, a senior lecturer in computing science at Aberystwyth University. Her research is all about spatial and temporal modelling in computer vision, and applying this to things like plant science, navigation, medical imaging and even fine art.

Hannah appeared in the Computer Weekly top 50 women in tech list four years running, and was inducted into their "Hall of Fame" in 2018.

Later the same year, Hannah received her Suffrage Science Award being passed on the heirloom brooch from Professor Carron Shankland - who we spoke to earlier in the series. In 2020, Hannah passed the brooch on to Dr Sue Sentance from the Raspberry Pi Foundation and King’s College London.

As with all our Suffrage Scientists, Hannah is driven in her commitment to promote women in STEM. Knowing girls can be put off early, she works with primary and secondary school students to inspire them through the award-winning Aberystwyth Robotics Club. Alongside her teaching schedule, she set up and still oversees the BCSWomen Lovelace Colloquium - an annual conference for women undergraduates in computing science - now regarded as the best of its kind.

Designed by Veronika Fábián, the brooch Hannah received is a delicate golden tape, punched with tiny holes, rolled into a scroll and set with jewels in the suffragette colours of white, green and violet. But this wasn’t just for show - the jewellery hides an important message, as Hannah discovered when she took a closer look.

Hannah - The punch tape, it's a five-bit encoding and as a computer scientist I thought it would be interesting to see if it meant anything, because you see, in coding it's useful to say, well, what could this actually say? And it's all rolled up in a tight scroll, but if you get a little bit of paper, you can feed it around the scroll, which means you can read the pattern of dots. So I copied the pattern of dots onto some paper, and then spent some time going through old punch taping codings to try and find one that fitted. And it turns out it's ITA2, which is a common five-bit encoding. And it says, "courage, constancy, success through thick and thin, we ne'er give in" something like that, "Suffrage Science 2016", because it was a 2016 award. So it does actually say something to do with Suffrage Science, which is pretty cool.

Kat - Because you do see so many kinds of scientific images; my background's in genetics, so you will see DNA used in things. And you're like, does this mean anything? Or you're just using it because it looks cool. So it's lovely to know that it really meant something.

Hannah - Yeah, I was terrified to wear it because you've got to pass it on, right! And it's a really delicate thing and I'm not, I'm not, I'm more of a clumpy person. I'm not a delicate jewellery person. I'm more of a falling off my bike kind of person, the chances of me sitting on it or leaving it on a train were really quite high for the first year of my custodianship, second year of my custodianship obviously nobody went anywhere so it didn't matter.

Kat - I can imagine that, it would terrify me I have to say. But aside from the jewellery, let's look at a bit about the sort of the lineage itself. So who nominated you to receive this? Tell me a bit more about that relationship.

Hannah - So I was nominated by Professor Carron Shankland from Stirling University, who is a proper research professor who does cracking research and interesting things, but she also does quite a lot of women in STEM stuff. So I know her from the British Computer Society, The BCS; the Chartered Institute for IT's women in computing research group, who put on annual talks for computing research, highlighting the work of women researchers. And I've been on the committee for that for a while because of my work on the undergrad conference, I end up on quite a lot of committees around women in tech stuff. Also, a lot of Carron's students come to the conference over the years. And so she'd seen the effect that the undergrad conference, The Lovelace Colloquium can have on the confidence of the undergrads, which is kind of nice. So she knew about that through a couple of different routes.

Kat - And so you've now passed yours on. So tell me about the person that you decided to pass your award on to.

Hannah - I passed my award to Sue Sentance who's Director of Education at the Raspberry Pi Foundation. And again, it carries on the theme of supporting the pipeline I think, because Sue does really interesting work on computer science education, looking at how we teach computing in schools and how a person learns to program. With things like programming and computer science, and also mathematics, a lot of scientific disciplines are kind of hard to learn, and there are ways that you can teach them, which can be more or less engaging and it can put people onto the subject or turn people off of the subject. And I think it's really important for us to think about teaching really carefully, particularly in situations like computer science, where girls are being put off really, really young, right? So, thinking about why girls are being put off computing. It's not a university, they get put off, they get put off when they're sort of seven or eight, right? So having someone who's researching how we learn to do this stuff and how we teach it is really important for me. And I think discipline specific educational research, so thinking about education, not just broad educational theories, but about the specifics of particular disciplines is really particularly important for those of us in minorities, in disciplines, because we need to think about what's happening in schools.

Kat - Yeah. So it's not the same challenge, addressing diversity in biology research, as in computing research or engineering, you know, these are separate things we need to think about them differently?

Hannah - I think it is the case in education to a certain extent. In this country, kids get to choose at 14, roughly 13 or 14, what subjects they're going to choose to specialise in. So when you make your GCSE choices, that's an opening of some doors and a closing of others. And, if at that stage there's a massive gender imbalance, then something has gone wrong before we've even got to that stage, right? And in computing, I think we're about 30% at GCSE and I think we're about 15% at A-level, if that, and we're between 10 and 15% at Uni for most places, some places will say they've got 30% and that's probably true this year, but you're talking about 10 or 15 girls in a year so 30%, if you've got a small department, it's easy to swing it, right? And it's very difficult to fix an imbalance of that size if the pipeline at GCSE is empty, there's nothing as an academic I can do to attract more girls into computer science that isn't effectively attracting girls away from other places unless I work with schools.

Kat - So what does need to happen to change this? What can we do to really get that pipeline full? Because you know, we're all using computers and data and data science is just an ever-increasing part of so many aspects of life. So what is putting girls off and how can we really take steps to actually address that?

Hannah - That's a very, very interesting question. And it's a very, very difficult one to answer. And again, it's one of the reasons that I thought that Sue Sentance would be a good person to take the award, because it's, it's work that she's engaged in doing, or at least engaged in doing some serious scientific approaches to try and uncover what's actually going on. I mean, there's stuff about theory of belonging. So the idea is that girls don't feel like they belong in computer science as a discipline. If you don't feel like you belong, then you're less confident when it comes to things like asking questions, and if you don't ask questions, then you don't find out the answers that you need and that becomes a vicious circle. So a lot of these small differences, so feeling slightly out of place at a computer science classroom, because all of the pictures are of boys, feeling slightly out of place in a computer science classroom, because all the boys have been gaming a lot. And they see that because they play Minecraft a lot then obviously they're going to be good at computer science, not necessarily a correlation, but they have a confidence that sometimes the girls lack and this confidence can make the girls feel less at home and that, in turn, has a knock-on effect. There's also a real image problem, right? So if you do the standard Google image search for computer scientists it doesn't end well, it doesn't end well. And everybody's model of a computer scientist is based on, I don't know, Dilbert, or a person on their own in probably in a cubicle, tapping away and computer science isn't a solo pursuit anymore. If you're building software it's a team effort, you don't get lone bedroom coders making massive hit games, that's the exception, that's not the rule, right? But those are the stories that we hear, those are the stories that you see in the movies, those are the stories that you see online. And that image problem really does put people off.

Kat -I think there's an interesting image perception about what computer science even is, you know, this idea that, Oh, it's just like, you're just coding or you're just making software. I'm very interested in the health data space and there's loads of health, data scientists and computer scientists who are trying to tackle some of the most important questions in human health and wellbeing. And you know, and then you bring it out to all the other aspects of life where we can bring data to bear and it's like these are curiosity driven problems. These, this is not just being a nerd tapping away on your computer, this is solving problems.

Hannah - Yeah. Almost every research discipline at the moment has a computational element. If you look the work that's been going on in the Covid space: the gene sequencing and the matching and the bioinformatics that's going on behind working out what's going on with all these new variants, for example, that is all using cutting edge computer science. I mean we think of computer science as being just programming, but if you think about what programming is, it's solving problems with ideas. When it goes well, you're literally building something out of ideas to solve a problem. And that's quite exciting when you think about it like that, there's nothing that's not touched by it and you can build stuff that really does change the world. You know? So why aren't the girls interested? But because they don't think it's for them and they think it's all boring. And they think it's spreadsheets. I love a spreadsheet.

Kat - Oh you weirdo, very much not for me. That's the thing it's like, I guess all these things in science, you know, people are put off if all you see is like, well, you have to be a scientist in a lab coat if you study biology or you're just going to end up a programmer if you study computer science, it's like, no - this is a tool that you then use to explore and be curious and solve problems.

Hannah - It's just like science, right? The scientific method is a tool that you use to understand the world and computer science is another means of doing that. It kind of gives you like power tools, I guess, for looking at data.

Kat - So would you have any advice for the next generation of girls entering STEM or the kinds of things that you really want to see changing around supporting girls and women in computing science?

Hannah - One of the things you have to realize is that the guys aren't as confident as they think they are, as they pretend to be, let's put it that way. Obviously as a computer science academic, I deal with a lot of computer science guys because we're 85% guys and they're great, right? But they can be a little overconfident at times, and it's easy for people to be put off by bravado, which is just not really necessary. The other advice is to find your tribe. So there are a lot of groups for women in computing and women and gender minorities in computing who are really supportive and put on activities and events and so on. There's a sense in which it might even be easier at the moment to be a woman in computing because of these support groups and these options that are available for you. It's easier to find groups that are interested in things when you're fishing in a smaller pool, I guess... maybe?

Kat - Yeah. I've certainly found it easier to make connections and have conversations while everyone's stuck at home on a Zoom call. It's a lot easier than going "alright, I've got to go to this event and look around and, you know try and talk to people. It's an interesting way that this is this kind of technology where we find ourselves is enabling more connections and people to kind of find each other.

Hannah - Yeah. And of course, it's all computer science, right? We're looking at each other, we're on a Zoom call and talking on, or recording audio separately. And there are signal processing algorithms going on at both ends there, the video processing that compresses it so it fits over our internet connections. There's all sorts of stuff going on just to have a conversation online. And every single part of this is using new computing algorithms that have been improving loads this year.

Kat - So what do you think have been your main contributions to building the next generation of computer scientists?

Hannah - So when it comes to building the next generation of computer scientists, my contributions are pretty easy to define. And that's the Lovelace Colloquium, The BCS women Lovelace Colloquium, which is a one-day conference for women undergrads and MSC students in computing. So, to take students from across the UK and we've got our 14th one, we're in planning stages for our 14th one, we've had a hundred abstracts submitted, we've got a hundred undergrads from across the UK coming to it. In so much as anyone goes anywhere. That means we've got a hundred undergraduates across the UK, sat in their rooms, looking at their computers, but normally we go places. So we'll transport the students across the country and put them up for a night if they need it. And for some of them, it's their first experience of expenses, their first experience of talking to somebody outside their university. It's quite a big thing for the undergraduates that come along. So that's my real contribution. I think it's probably been about... probably over a thousand girls have come through that now. So that's quite a big thing. I think.

Kat - We’ll come back to Hannah soon, but now it’s time to hear a few words of advice from another Suffrage Science awardee, Carron Shankland, who nominated Hannah for her award.

Carron - The best piece of advice I got is to be kind! One of the other reasons that I nominated Hannah for the award was that she set up the 'Scientists are Human' website and, you know, we kind of forget the human side of being a scientist sometimes. So yeah, treat other people like you'd like to be treated yourself. That seems like an entirely obvious thing.

Kat - If you’re enjoying this series of the Suffrage Science podcast, please do rate and review us on Apple podcasts, and make sure you’re following on Apple podcasts, Spotify or wherever you get your pods, so you don’t miss a single episode. Let’s return to our conversation with Hannah Dee, to find out what first got her started on her journey in computer science.

Hannah - When I was at school, I was a proper nerd at school, went to a London comprehensive and was one of the out crowd, very much so, into mathematics and science from the beginning. And just sat in the corner getting on with it, to be honest. And when I was about 14, I read a novel called Neuromancer by William Gibson, which is a science fiction book about artificial intelligence, which is an absolutely great book if you've not read it, absolutely great. Then a couple of years later, I was looking around at possible maths courses at Uni, and I realised that you could do a course in artificial intelligence. And I thought, Oh, you can do a course in that. That sounds mad. That sounds a lot more interesting than maths. So I applied for a bunch of AI and cognitive science, which is kind of AI with psychology and I went to Leeds because of the nightlife. And yes, I did AI and psychology for three years.

Hannah - And then when that finished, I got a job teaching computer science to non-computer science students in the computer science department at Leeds. And that was part-time so I part-time did an MA in philosophy, concentrating on philosophy of AI. So I was sort of brushing up my computing skills at work and my philosophy skills in the evenings, and eventually got a PhD place again at Leeds because by then I had a house and a life and stuff. Then I did a bunch of post-docs, so I had five, four or five postdocs moving around and ended up eventually in Aberystwyth because they gave me a job. But on a positive note, on a very positive note, I've got a submarine.

Kat - You've got a submarine! Tell me about this.

Hannah - So it's a robot submarine. So it's not, I can't climb in it or anything. It's just under two meters long, it's got sonar and cameras and it's completely autonomous and programmable. And I could use it to do surveys and stuff like that. There's a sense in which it's very physical and it exists and I've seen it and it's arrived, it's been delivered. And there's a sense in which it's still quite theoretical because it was delivered during lockdown and it's less than two meters long and it's a two person lift. So obviously we haven't got it out of the box yet. So I've got lots of plans!

Kat - What are you going to do with it? What do you do with a two meter long robot submarine?

Hannah - What do I do with a two-meter long robot submarine? That's a very good question. I've got quite a lot of ideas. I've got to, obviously I've got to write some grant proposals because that's what my research director wants me to do, even though they're horrible. So I shall write some horrible grant proposals to do interesting things, and hopefully someone will look favourably upon one of them, or maybe even more than one. I'd like to work on underwater plants. So I've done quite a lot of work on plants in general. My broad-brush research area is imaging, so I do looking at analysis of images and video, but also sonar and laser scans and stuff to try and detect change and movement and the plant stuff's been very interesting. So understanding how plants grow by looking at pictures of them is quite a difficult thing to do, but underwater, there's a lot of plant life. And at the moment to look at it and measure it, you need to send divers down and divers cost a lot, right? Also they have to come up and breathe and stuff. They don't follow exact paths and so on. And if you want to do a diver survey of, for example, an underground kelp forest, you'll find it very expensive and you'll find there's a limited area you can survey, but with a robot submarine, you could survey much larger areas, possibly even more accurately in terms of distance and so on. So that's one thing. I've been talking to some marine biologists about the damage that is caused by anchors. So a boat drops an anchor and then the tide comes in and the boat gets dragged one way, and then the tide goes out and the boat gets dragged the other way. And this has a pattern on the seafloor, which could be really damaging to certain types of sea life, marine life. So surveying that could be interesting. The nice thing about having the survey vessel, which is effectively what it is, is that you can be sure you're looking at the same thing repeatedly, and then you use sort of standard AI techniques, so it's artificial intelligence still, but instead of looking for faces, you're looking for, I don't know, scallops or the patterns associated with anchoring or kelp forests or something like that.

Kat - So given the recent news that spinach can now send emails. That's a bit of a simplification of the story. You know, one day maybe seaweed sending us emails from the sea floor?

Hannah - There's quite a lot of underwater comms on this submarine. I mean, it's got wi-fi, so it could help!

Kat - See what messages are coming up from the deep.

Hannah - Yeah. I was going to use the wi-fi as a communications device rather than a sensor. But if you think there's something in it, I could give it a go.

Kat - There could be anything down there.

Hannah - The other thing I'd quite like to do is lakes, because it would be quite nice to do some heritage stuff perhaps around drowned villages and reservoirs which is a topic that resonates quite a lot in Wales because of the number of communities which were flooded about a hundred years ago to provide water supplies for cities just across the border. So it'd be interesting to take the submarine up to some of these famous lakes and see what we can see now.

Kat - One of the big parts of the Suffrage Science program is this idea of mentorship, you know, from what we get from the people who came before us, what they pass to us and then what we pass on. Who are some of the people who really have supported you in your career and provided that kind of mentorship guidance, a kick up the arse when you needed it?

Hannah - It's interesting because I've been assigned mentors at various stages of my career, because you quite often get assigned a mentor when you start a new job, and some of those have been great and they have not always been women. In fact, I can't remember the last time I had a formal mentor who was a woman. People think that you have to identify with role models that look exactly like yourself and I don't think that's true necessarily. I think it's useful to be able to see people, seeing successful women is a useful thing to be able to do, but you can also be inspired by the actions of other people and you can also take advice from other people. And so I think that's important to say, I think that we talk a lot about women being good mentors to each other, but it doesn't have to be the case at all. Apart from anything else, if all the women scientists are mentoring people all the time, they'll never get any science done.

Kat - Yeah. I guess if you're like 85% men in your department, there's only so many women mentors to go round. And I did spot an article that you wrote a few years ago now about tips for men in tech to make things more inclusive and to be supportive for women. You know, what do you think are the most important things that men can do to support women, particularly in this field of science, whether it's still so much imbalance

Hannah - Where I work now, we're quite lucky in that I've got a very supportive head of department and have had a supportive head of department for the last couple of bosses, the last couple of direct bosses have been absolutely great. So the equality work is now part of my workload. When I started it wasn't, it was what I did in my weekends. But now, for example, I'm on committees to do with equalities, but that's actually counted as my job rather than the thing I do for fun. So up until maybe eight years ago, all of the conference stuff was stuff I was doing in the evenings and weekends. Now I'm allowed to do it during office hours, right? Isn't that nice! Very kind of them. But if the equalities committees that I'm on are fairly mixed. So there are guys taking on work in this field, which is great. And I think that's really important. I also think there's a real kind of consciousness raising effort that's been happening over the last couple of years.that's made a huge difference. So the idea, for example, that men might repeat a woman's idea in a meeting and then take credit for it, is an idea which is quite pervasive. And I think everybody's now heard of that idea and because everybody's now heard of that idea, it happens a lot less. And if you see a woman in a meeting, make a good suggestion and then a guy repeat it, that guy's going to get some dirty looks. And that does seem to have been a cultural change in the last five or ten years in my view. More of that please guys. That's what I'd like. Find out, read Invisible Women, read the books about how women are treated, understand that there is a problem here and quite often the guys are part of it and actually try and do something to rectify that.

Kat - And what would you like to see change over the next 10 years? You know, we're looking back now on 10 years of Suffrage Science, what really do you want to see changing in the next 10 years for maybe women in science in general or women, particularly in your field? What would you like the next shift to be?

Hannah - Do you know, I'd just like a different ratio. I don't know how we get there because there's a sense in which I've been a woman in science now, since I started my first degree in the early nineties, right, 30 years I've been bashing my head against this. And obviously I haven't got all the answers because if I had all the answers, we wouldn't be in this situation still. I think it would be nice to have more women in computing. It would be nice to have women in STEM valued more. Whilst I, it's not a problem that has affected me personally, I think childcare is just still a massive problem that the UK has not solved at all. And it falls on women. You get situations where women scientists are taking time out because it's cheaper for them not to work than it is to work and have their kids in nursery. That's just absurd. That is absolutely absurd. Think of all the years of work we're losing because of that situation. So I think there are a lot of structural unsolved problems that aren't necessarily to do with science. I think that's still the case. But it just be nice to see a different ratio. It would be nice for my incoming first year girls not to feel quite so odd. It's just weird being the only woman in the room, right? I'm used to it, but it still is, definitely now and then... Particularly if it's a big room, every now and then, it just feels really odd. My first ever research conference presentation, a PhD student, 2004, Prague, European Conference on Computer Vision; halfway through my talk I realised I'm the only woman in the room. And it's really ornate, with carved breasts dangling from the ceiling and naked women engraved in part of the room. And I'm sat there, stood there, giving my talk. And I suddenly realise that everybody else in the room is a guy. It was a workshop, so there's probably only about a hundred of them, but it's still a bit, it's just disconcerting. I'd like it not to be the case that that happens anymore.

Kat: Thanks very much to Hannah Dee.

Next time it’s the last episode of the series, and I’ll be speaking with leading X-ray crystallographer Professor Elspeth Garman about her unorthodox route from the world of physics into the life sciences.

Elspeth - I didn't know at that stage what a protein was. I didn't know what an amino acid was. And the very first day I started the job. I had a big argument with one of the graduate students who came upstairs from the microscope room and said, “Oh, I've just seen a nucleus”. And I'm like, “no, I've spent the last 11 years looking at nuclei, I never saw one, that's amazing.” You know? And then after a bit of an argy bargy, we realised that he was talking about the nucleus of a cell and I was talking about the nucleus of an atom.

And before we go, here’s Suffrage Science awardee Sue Sentance, who Hannah passed her secret code scroll on to, on her hopes for the future.

Sue - So in the future, I'd like to see my field, computer science education become more diverse by which I mean more representative of gender, ethnicity, disability, et cetera, because we cannot expect to bring more diversity into the it workplace or computing related careers until we can achieve that first in computing classrooms and with computer science teachers and computer science education research, I think that's really important, particularly in the UK,

The Suffrage Science Podcast: How Women Are Changing Science is presented by me, Kat Arney, with audio production by Georgia Mills. It is produced by First Create The Media for the MRC London Institute of Medical Sciences Suffrage Science scheme. Find out more and read profiles of previous awardees at [suffragescience.org](https://www.suffragescience.org/) and follow @MRC\_LMS on Twitter and the hashtag #SuffrageScience for all the latest news. Until next time, goodbye.