University of Oxford Disability Lecture 2025

Professor Sam Howison

Building an environment for all

Greeting by Jordelle Akinola, University of Oxford Disability Advisor

Good evening, everyone. My name is Jordelle Akinola, and I'm the Staff Disability Advisor within the Equality and Diversity Unit at the University of Oxford. And it's my honour to welcome you to the 11th annual Disability Lecture.

It's wonderful to see so many of you here in person and to have so many people online, and to be here at the Blavatnik School of Government. Thank you for hosting us; it's great to be here.

It's wonderful to know that we have registrations from as far away as Canada and New Zealand. We hope you have a wonderful experience tonight, and it really is a great opportunity to hear about what advancements are happening within the sector of disability, and to engage in some awareness-raising and some heartfelt discussions.

Before we get started, there are some housekeeping notes on accessibility and participation for today's session to make you aware of.

Firstly, for our online attendees, we have spotlighted the British Sign Language interpreters for the video feed, so they should remain clearly visible on your screen throughout the session without you needing to do any adjustments. So hopefully everybody can see them online, but please let us know if there are any technical glitches and we can get our moderators to help. And we also have live captioning available. You can turn these on by clicking CC, and the 'live transcript', or 'show captions' button, typically found in your Zoom control bar. Once captions are active, if you need to adjust the appearance, such as the text size or the colour, just click the small upward arrow next to the CC button and look for 'subtitle settings' or 'caption settings'. If there are any problems, again, please do let us know online and one of our moderators will be able to help. For those joining us here in the

room, you will see the BSL interpreters are displayed on the screen, and we also have an induction loop system for audio assistance for those who may require it.

We are not expecting any fire drills. If you do hear any alarms, the fire exits are highlighted to the left and to the right, but we will be able to help anybody who has any assistance needs. Toilets are located outside again. Please just signal to myself or any of my colleagues, and we will provide assistance and direction.

Please note that today's session is being recorded, and the podcast details will be circulated after the session.

I now have the privilege of handing over to our Vice Chancellor, Professor Irene Tracey. Thank you.

Introduction by Professor Irene Tracey, University of Oxford Vice Chancellor

Well thank you so much, and a very good evening, everybody, to this, the 2025 Disability Lecture, 'Building an environment for all'. As just mentioned, this is the eleventh one in the series at the University, and the third to feature British Sign Language interpretation. And I will try and speak slowly in order to help this wonderful woman on my right [BSL interpreter], because I speak very quickly normally. The event is organised by the Disability Advisory Group and the Equality and Diversity Unit, and I'm very grateful for all the work they do in this hugely important area for the University, so thank you to them; and thank you also for the gracious hosting by the Blavatnik School of Government for the second consecutive year, the really wonderful environment to do this in.

I probably don't need to tell you, but it's important for us to be reminded of just where things are at, in this space of our work, to make sure we build an environment for all. 24% of the UK population are disabled. So, as a microcosm of society, here in the University, we expect that the percentage of disabled colleagues, students and visitors here will likely be similar. This means at any given time, disabled people will be working and studying in our buildings, or indeed visiting them to learn more about their world. If our spaces are going to be inclusive and accessible, disabled colleagues will be better able to focus on their research, teaching, their tasks, their learning, rather than on the impact of a disability. As you know, the Equality Act of 2010 states that we have a duty to anticipate the needs of

disabled people and to be inclusive in all areas of our work, to remove or minimise disadvantages, and to meet the needs of those with protected characteristics. A visible strand of this work is the accessibility of our buildings.

Now as you know, our estate is very large: over 260 buildings, 67 of them listed. And it includes some of the most iconic spaces in the city. Unsurprisingly, the idea of accessibility has been evolving, since the early 1400s: the Bodleian Library, through to the 1800s: the Natural History Museum, and in the 1900s: the Dyson Perrins Laboratory. Estates Services work to ensure our legal compliance with accessibility regulations, both in refurbishment of historical buildings, and in new projects such as the Life and Mind Building and the Schwarzman Centre just behind here. Alongside the features of the building itself, operations and procedures must support independent access and use for all occupants, including visitors.

The challenges are not insignificant: I know that well, having been Head of a 13th-century College when I was Warden of Merton. But we remain committed to the University's Equality Policy of non-discrimination and the advancement of equality. The University does not consider compliance with regulations as sufficient. Oxford's Accessibility Design Philosophy Document goes beyond Government regulations, aiming for an inclusive environment where all can independently access and use facilities. The key word here is 'independently'. Maximising independent access for disabled people is at the heart of inclusive design.

Now, how independent access can be made to work in the complex environment of Oxford is the theme of this year's speaker, Professor Sam Howison, a dear colleague and, I hope I may say, friend. Sam's research interests are in mathematical modelling and applications of differential equations in a wide variety of topics. Recent projects include models of heat transfer in electrochemical furnaces, melting of Arctic sea ice and the microstructure of Bitcoin markets. More recently, he has served magnificently and as a good citizen as Head of the Oxford Mathematical, Physical and Life Sciences Division, a very active Member of Council, and a great mentor to many in this institution and at his College of Christ Church. He is also active in several national organisations, including the new Academy of Mathematical Sciences. But perhaps less well known is his role in the Oxford Mathematics

YouTube channel, in the Mathematical Toy Stories and other videos, which demonstrates his deep interest in using mathematics to help everyone understand the world around them.

Sam is currently enjoying a return to teaching at Christ Church and at the Mathematical Institute. However, it is notable that he was Head of the Mathematical Institute during the construction of its current beautiful home, the new Andrew Wiles Building, here in the very Radcliffe Observatory Quarter where we're having tonight's lecture. This and his own lived experience at Oxford gives him particular insights into what makes a building accessible and user-friendly. Sam, thank you for everything you have done for this collegiate University, and thank you so much for your contributions to teaching and research, but thank you especially for coming to speak and share your thoughts with us tonight. Please give a round of applause and welcome him.

(Applause)

Building an environment for all, by Professor Sam Howison

Irene, thank you so much for that introduction, which has sort of said everything I was going to say, so… maybe we could all go to the pub, perhaps!

It is a great honour to give this lecture. It's a subject which I have personal connections with, as people will know. But it's also a subject that I feel very strongly about for many, many reasons, all of which I think Irene has just outlined so very eloquently that I won't repeat them.

Well, first I just want to thank the organisers also for inviting me, because Catherine and Teresa and their team have done a tremendous job in organising, bringing this lecture together, and in getting the whole thing going.

Background

So let me go to my first slide. I want to mention some people at the beginning of this, because I want to pay some tributes. I want to pay a tribute to two people who have exemplified in many ways things that have been very important for me personally and generally. The first is Professor Ian Shipsey, who you will see on the left on the slide. Ian was

the Head of the Physics Department when I was Head of MPLS, so I worked with him quite closely. He was a passionate and dedicated physicist, a very larger than life character who very sadly died suddenly last November. But I mention him particularly here because in midlife he lost all his hearing, suddenly, through illness. And that is a very traumatic thing indeed to happen to somebody, at that or any stage of their life, as that may be in midcareer with a young child and so on.

He was not daunted. He went in due course and got himself cochlear implants (and we'll come to those in a moment), and went on to have a career as a highly successful physicist, and FRS and so on. He is someone that we miss a lot. On the right on this slide is another Ian, another Professor Ian. This is Ian Galway Taylor, known as Professor Taylor in my family. He was on the faculty in Manchester, into the Department of Audiology, where I was born, in that great city a very long time ago, and he was, I think, a real pioneer in the education of Deaf children, in particular. I was born with congenital deafness verging on profound deafness. So I think if I had been born anywhere other than Manchester in the UK at that time, I might have sunk without a trace. Even in London. But it was an immense stroke of good fortune that I was able to have access to their early research. And one of the things that he particularly insisted on was that children should be fitted with hearing aids from as early as feasible.

Figure 1: Sam's Philips body-worn transistor hearing aid from the 1960s

I believe the object here is my first ever hearing aid. Online tells me that it dates back to 1960, which is consistent – you see I'm quite old. It's a lovely retro object in chrome. It was cutting edge technology at the time, with transistors which were relatively new at that date. There's a wire which went and plugged into your ear: not unlike the devices you see today, actually. My reaction at the time was to go and bury it in the garden. And as you know, a world of noises and sounds when you are not used to them is probably quite a difficult thing for a two-year-old to get hold of.

But anyway, thank you to Philips Eindhoven for making that. And above all, I want to dedicate this lecture to my parents, because without their love and support at that very early stage in my life, and indeed throughout it, of course, but at that very early stage, things would have been very different. I hope they would be proud to see me here today because I certainly am proud to be speaking.

Right, that is enough of the touchy-feely stuff. Let's go on and do some science. Because I am sort of an existential mathematical scientist, applied mathematical scientist. And it's everywhere.

As Irene mentioned, I have been making these little videos. My latest one is about how to sum the geometric theories using your compost heap. And you can go and see it on the Maths Instagram or YouTube or TikTok or whatever.

The human ear

Here is a diagram of the human ear, the inside of the human ear. And here is the same diagram but with the colours inverted, because I find it much easier to work with inverted colours.

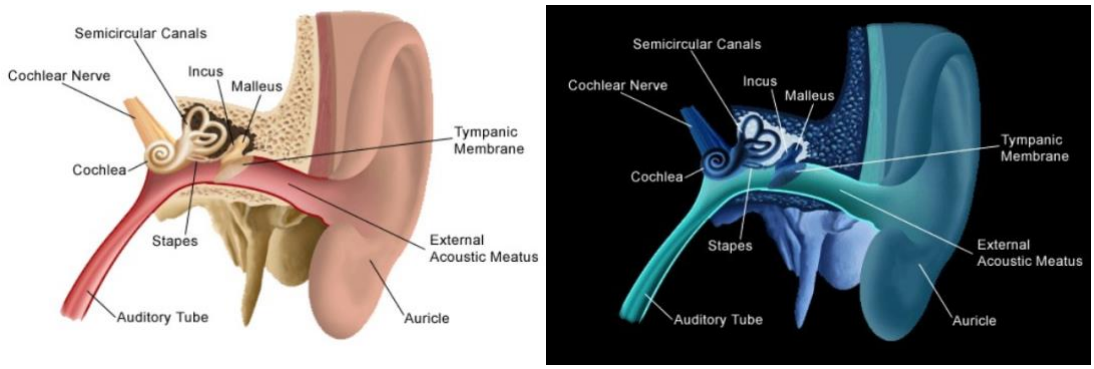

Figure 2: A diagram of the human ear, in both original (left) and inverted (right) colours.

I was hoping – I'm sorry about this – I was hoping that there would not be these lights in the front, which might make it a little difficult to see that diagram. Why don't I come over here, where I will not be in the way of that screen?

Our ears are miraculous pieces of biology, of evolution, and of function. So just to take you through this very quickly – this is basic biology. We all have ears. On the right is the outer ear, the bit that you always see. And that has its own function in helping to guide sound waves into the channel that leads inside your head. The one that you are not supposed to put your fingers into or anything smaller than your elbow. The sound then reaches the ear drum, or the tympanum, which is a membrane in the middle of the ear, and the sound waves make that vibrate.

Behind that, going further into the ear still, so go further to the left on the picture, you have three minute little bones which form a really ingenious linkage that takes the vibration of the eardrum and focuses it down to a much smaller vibration at the beginning of what's called the cochlea. And the cochlea is that little spiral structure which you might just be able to see on the left-hand side of the picture two thirds of the way up. A spiral which contains all the sort of business end of it. That is where the nerve cells are, that detect the sound that's coming in and has been amplified by, or focused by, the three little bones. And finally above that there is a set of three semi-circular canals which help with our sense of balance and motion, and work with our eyes to help us know where we are.

This is an exquisitely sensitive mechanism. It can detect frequencies that run from the rumble of the earthquake up to the squeak of a bat over the range of 10,000 Hertz or so, 10,000 cycles a second. It can detect pressure waves in the atmosphere, the sound that's

going from me to you. It's making the molecules in the atmosphere vibrate by a few nanometres. Now a nanometre. What's a nanometre? It's a short distance, right? If you take a paper clip and imagine taking the shaft of the paper clip that's about a millimetre thick, divide that by 1 million, that's a nanometre. And vibrations. This sound vibrations in the air are a few nanometres. So it really is detecting something that is almost vanishingly small.

So, that is the inside of the ear. Now I'm showing you the two pictures side-by-side, and sort of repeating what I've just said. But I think the key point about this mechanism is that its output if you like, varies incredibly widely between people. So it's quite a familiar sensation, I guess, that if your ears are full of water, you don't hear so well. Or if you are all blocked up from a cold or something, then you don't hear so well.

There are other ways in which the ear can vary, so that you simply don't hear so well due to the outer and middle ear, and then, of course, there is what can happen inside the cochlea, where the nerve cells are. And again, that can affect your ability to hear different frequencies, in good ways as well as bad, because there are people who have absolutely fantastically sensitive hearing and there are people who don't. The range is enormous. I should say, incidentally, that the cochlea is a practical solution to a very interesting mathematical problem. The sound comes into your ear and makes what is called the oval window, at the end of it, vibrate, and then the sound travels on up the cochlea. There’s a set of nerves that sits along on the membrane, wrapped around like that. The short wavelengths, the high frequencies, are all sensed at the beginning, and the low frequencies are sensed at the far end of the cochlea.

And this is because of a very clever kind of resonance between the membrane and the fluid, so that each frequency finds its own little echo chamber, and it goes along and sort of grinds to a halt and stimulates the nerve cell at exactly the right place, so that you can distinguish between these frequencies. It's a really, very ingenious mechanism for sorting out frequencies.

The human eye

So that's our ears, and as I say, their performance does vary extremely widely. Equally astonishing is what our eyes can do.

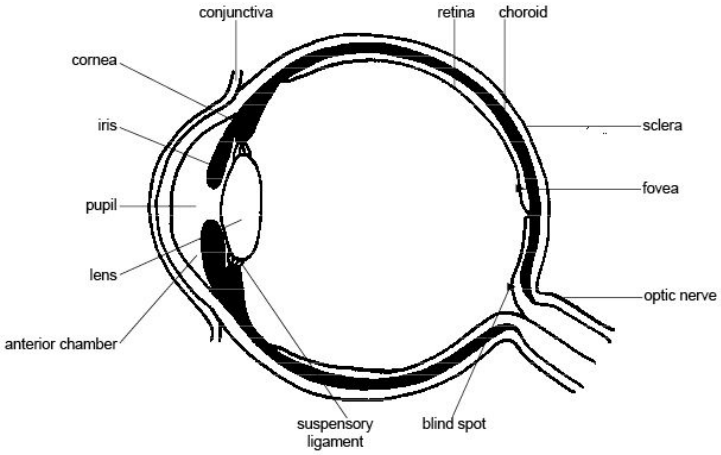

Figure 3: A diagram of the human eye.

Here is a cross-section through an eye, a human eye. And we are all familiar, I think, probably, with the sort of the general way it works. Going from left to right, you have the cornea, which is the translucent bit at the front covering up a little gap, which is full of a fairly runny liquid called aqueous humour. ('Humour' is a very ancient word for 'liquid' or for 'substance'). Then you have the lens, which does the business, the focusing object controlled by sets of muscles and with an aperture, like a camera, which is the iris, and the gap in the middle is your pupil.

The light goes through the lens to the back of the eye, where it is focused on the retina, which is the line of light-sensitive cells on the membrane that sit on the back of the eye. And then it goes down the optic nerve into the brain. So again, there is a wide variety of things that can happen with that, that can happen very slightly and will happen to pretty much everybody in this room over their lifetime.

Because eyesight certainly does change – as does hearing, but eyesight certainly does change. For example, the cornea at the front of the eye may not be as translucent as it could be. The lens can become opaque as you grow older, and this condition is known as cataracts, where it becomes sort of milky and doesn't let the light through, and then you have terrible problems with glare, that light coming from over here gets refracted into the particles in the lens and ends up somewhere where it shouldn't be. The lens becomes stiff as it gets older, so it won't move and adapt to focus the light from different places, as it should do. You can get floaters and things in the two layers of fluid; and many things can

happen in the retina. That's before you even get to the optic nerve. So, once again, there is a very wide variety of performance, if you like, or outcomes from the eye.

The idea of 'disability'

Now this is the Disability Lecture and both the eye and the ear are key focuses of certain kinds of things we label as disabilities.

But the real point I want to make here is that these disabilities are really just part of a much wider variation. And I'm going to come back to this throughout the lecture. There is such a wide variation, both between people and in individuals as they go through life, or as they get a cold and can't hear, or as they get an eye infection and they can't see so well, or whatever might be.

There's a much greater variety than 'There's this lot of people over here who aren't disabled, and there's this lot over there who are.' So my approach to this whole question is very much dictated by that thought: that we are talking about pretty much everybody. There will be the odd person with perfect eyesight and perfect hearing and all the rest of it, but we are talking about pretty much everybody in what I'm going to talk about for the rest of this lecture.

A digression: colour

Before we do that, though, I want to take one digression because I'm a mathematician and I did want to work on the mathematical theory of colour. Now the mathematical theory of colour is very interesting. It goes back to the 19th century. Maxwell, the great Maxwell, was involved, and Helmholtz. It works something like this: we all know light that comes from a light source, the sun, these lights, wherever, consists of photons of light which come into the eye, and they come into the eye in enormous numbers. They come in at the rate of, as on the previous slide, I think it was 10 trillion photons a second in ordinary daylight. And in those, the eyes can respond to his few as half a dozen at once: again, a mechanism of quite extraordinary sensitivity. But you have this notion that we all learn at school, that light has wavelengths, and the wavelengths tells you the colour of the light. But our eyes and our brain between them take that complicated set of information, that the amount of light at

this frequency is that, and the amount of light at this frequency is that and so on, and synthesise all of that and they turn it into three numbers: just three numbers.

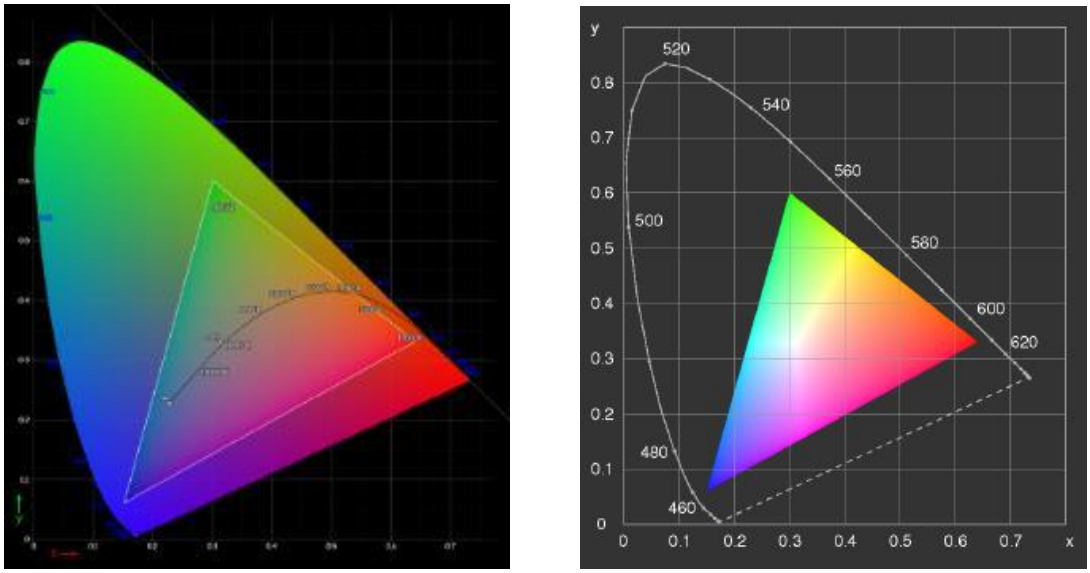

Figure 4: Two colour diagrams, side by side. Caption: The CIE1931 chromaticity diagram; RGB as in LED displays. (RGB image ©Dietrich Zawiska)

The picture on the left of the slide is what's known of the CIE Chromaticity Diagram. CIE is something in French, I think to do it ‘couleur’, I’ll bet you, for the C, but that, then the I and the E... And what this is, is a representation of all the colours that we can see. Round the curved bit, the curved boundary of that shape, you have the pure colours, the monochromatic light, light of a single frequency going from red at the bottom left-hand corner to blue at the bottom right-hand corner, through what is it, ‘Richard of York gave battle in vain’ – red, orange, yellow, green, blue, indigo, violet. So those are the monochromatic lights.

And then you have a straight line across the bottom, which is red joining up to purple to violet. Everything else is a combination of those colours. And it's what we call in mathematics a convex combination, which means the shape on the screen is convex, in the sense that if you draw a little line in it, you stay inside the coloured region, you never go outside it. It's not shaped like a figure of eight or anything like that. It's a nice convex shape. And it has three dimensions. The third one goes, as it were, into the screen, and that measures the brightness, the amplitude. But the key is in this picture. On the right is how a

television screen works, so an LCD screen. You have three different phosphors, red, blue and green and they – or liquid crystals or LED these days – shine at their different powers. And they meld together if you look at them from far enough away. If you look at them really close up with a magnifying glass or the magnifier on your phone or something, you can see the individual pixels all red, blue and green, but when you look at them from far enough away, they mix together to make colours just like the left-hand slide.

And what you see on the television or phone or something is only the inside of the triangle, because you can only get positive amounts of red, blue and green. So you have a much smaller set of colours. And so getting outside and getting into the daylight is really a very good thing to do.

Designing buildings

Now let's go down to business. My theme is essentially just a variation on what Irene said in her introduction. And my theme is just one extension to what she said: it is that if we really work to design our buildings in everything we do with them, to design them in a properly accessible and inclusive way, from the bottom up and from the very beginning, then far more people will benefit than those who are in whatever category we might say is ‘disabled’. Because, as I say, in my view of the spectrum, the ranges are incredibly blurred. It's not a pointless exercise, it's necessary for legal reasons, if nothing else, it's a tremendous spur to action for us to have this notion of ‘disability’. But I am arguing that by working to make things better that way, we will make things better for everybody. That is such a powerful motivation that it should really be running through everything that we think and do. So that is the general philosophy of this lecture. And the other thing that I think is absolutely critical to say is that we have to do this from the bottom up, and from as early as possible onwards.

Certainly, in my experience, and I'm going to give you some examples in a minute, doing things late in the day or thinking about things late in the day is simply hopeless. It never works. You never get enough – you can never get things done because there are always so many reasons not to. So that's the general theme, and then there's another thing to say, especially for someone like me talking about this, because I've done a lot of things in the University, and I've got a lot of experience. I was fortunate enough to be the Head of the

Maths Department when we were building the Andrew Wiles Building. But nonetheless, I am no expert and the temptation is very, very strong for anybody, in that sort of position, to adopt a stance. This is an aphorism: 'For every complex problem, there is a solution that is clear, simple and wrong'. 'Wrong!' 'Clear, simple and wrong' is a motto that should be engraved in all planning departments, because it is so true. I don't like aphorisms actually, because I think they stifle thought. This is a kind of anti-aphorism, because it says aphorisms are clear, simple and wrong, doesn't it?

Oh, I can feel a word cloud coming on. Most unlike me, those of you who know me. I promise I won't make you write your thoughts on post-it notes and come up and put them on the board. This is a word cloud [on slide]. It's got a lot of words in it, not all of them probably very easy to read, but one in the middle is certainly, absolutely key: 'Complexity'. There is no escaping complexity in everything, to do with design and making it accessible and inclusive. There are other words in there: 'wellbeing', I think is a really important one, one we don't talk about wellbeing in our design enough. 'Cost' is clearly crucial. 'Compromise', 'care', 'responsibility', and several other words as well. But 'complexity' is the one. So let's go back a year.

A year ago, I was asked to come and give the vote of thanks for this lecture, an invitation I accepted very gladly. ... and I didn't realise at first that it was the audition. Anyway, I walked over from the Maths Building, and I came towards the Blavatnik.

Figure 5: Bollards outside the Blavatnik School of Government

And so what you are looking at there is the view from outside Somerville's new buildings towards OUP. And I saw two silver anti-parking bollards in the pavement and I thought – 'oh

good, I've spotted them and I'm not going to run into them, I will go right through the middle of the gap and then I'll be safe.' Well, right in the middle of the gap there was that bollard there [lying flat on the ground]. 'Bollards!' I said. Well, I didn't quite say that. By the way, it's still there. I checked on my way over today. So I said 'Bollards, bollards, bollards!' That got me going a little bit.

A journey to work

Let's take a journey to work, opening up a world of obstacles. Here are some pictures of the sorts of things that one will encounter on a typical journey to work. We have sandwich boards, designed to push you off into the traffic. We've got signage. We've got people putting those things that tell you the floor is wet and slippery. And then they go and put them at the top of a set of stairs. What do you do? Do you slip over or do you trip over? Anyway, things like that. And then, once you get going on this, we've got bicycles, yes, bicycles. Wheelie bins, I mean wheelie bins all over the pavement. And other people, the great long crocodiles of tourists who don't see you coming. And I mean, you can get yourself quite worked up about this and start writing letters to the paper in green ink. So you've got yourself to work, you are sort of happy. Well, no, you have not quite got yourself to work.

Figure 6: Crewkerne Station platform

This is quite an interesting slide this one. This is two pillars. The one on the left is a little station down in Somerset called Crewkerne, and in the picture, you see the station platform and you see the awning to keep the rain off you while you're waiting for your train (and waiting and waiting). And then you see that it's held up by a set of pillars, just iron girders painted white. And they have painted black stripes across them at eye level through various

heights for people. That is a game changer for a lot of people. It enables you to see something that you might well not have clocked when you're getting out of the train, you know, you get out of the train and you come out into dazzling sunlight or something like that, and you might well not clock that there's a pillar there. That is something that it is ugly to do in retrospect– I mean, just imagine putting white stripes around the pillars of the Clarendon Building, let's say. It is not to be considered. But if you think about this early enough in your design, well, we know Departments have logos; Colleges have coats of arms that could be easily put round quite a lot of these things and make them more visible with just that little bit of forethought.

Figure 7: Lamppost in bright sunlight.

On the right, a lamppost. I've slightly hammed this picture up by fiddling with it – but that is sort of what a lamppost might look like if you had incipient cataracts. And a lot of people in this room will get cataracts. The good news is that the treatment is excellent and the treatment for cataracts is transformative, actually. Although it's not how you would spend an afternoon by choice, it's not the sort of end of things that once was. But there you see how a tonally similar lamppost and pavement can just blend into to each other in glary sunlight.

You approach your building. Now, this is the approach to the Weston Library in Broad Street, the steps outside the Weston Library.

Figure 8: Steps of the Weston Library.

I am afraid I'm going to be critical about this. I don't have many kind thoughts for the design of this. What we have is a set of steps running up to the building: very wide steps the width of the building. Then there is a wheelchair ramp which runs diagonally across the steps. So every step is crossed in a different place by this wheelchair ramp. This is an absolute nightmare to walk up or down if you are not able to see where you are going terribly well. It really is a nightmare. And you imagine coming out of there on a cold November night, having been to a wonderful talk in the Weston Library, and your head is full of medieval manuscripts or something; and then you've got to make your way down there. No handrails, of course, because you can't have handrails across the wheelchair ramp. You can see where they were coming from. You can see the idea was good. Obviously there has to be wheelchair access, that goes without saying. But this particular compromise was all one and none of the other. So here is another thing that's coming to come into this, as a theme: there is going to be a conflict between the needs of different people, and we need to recognise that and balance it, balance it up, not just sort of shove it away. We need to recognise that and work out our solutions, and if possible, work out solutions that avoid that conflict altogether.

Figure 9: Christ Church Hall steps

Here are some more steps. This is the approach to Christ Church Hall, my College, Christ Church. This is Harry Potter territory. And, it's a very tall flight of steps. Again, not much in the way of handrails. If Henry VIII had listened to his Accessibility Advisor, we would not have had to paint those ugly white stripes in the middle of the steps to help everybody, and I mean everybody, see where they're going on those stairs. But I don't think Henry VIII was very keen on that sort of thing somehow.

So, you arrive at your building, and maybe it's locked. Maybe you've had to go in at the weekend or something, or maybe it's always locked for security and you're faced with a keypad. Now I had a tantrum back in January, because I went into the Maths Building to return the lapel mic with which I had walked off after my lecture the previous day. So I was doing good, right? I get to the door, freezing cold, pouring with rain. You have to put your PIN into this keypad. By the way, the PIN is not the first 6 digits of Pi, were you're thinking of that. You have to put your PIN into this thing, and you find that it is essentially completely black and completely invisible.

Figure 10: Keypad for the Maths Building

The original one had an American-style telephone punch keypad, but this one is smooth, and the numbers have got worn off. So I wrote a pretty polite e-mail to the Maths facilities team, who wrote back immediately, and were very apologetic and explained it was the contractors who had put this on and we had not, somehow, been able to get them to get a proper keypad. So there's another thing we have to worry about: our relationship with our contractors, and are our contractors on board with the way we're trying to approach things? And are they going to come to us with helpful suggestions that will take us from the sort of basic level to up to where we need to be? They did source another keypad quite soon. And there it is on the right. Not great, but the numbers are indented so you can feel your way around in the dark, if you need to. And you do need to feel your way around, because, in this picture, you see what the keypads look like, for someone of my height, which is not uncommon. You are looking down at them from an angle. You need to sort of bend down – oh creak, groan – and squint at the numbers; or you can rely on trying to see them from an angle. And here's another thing: they have to be down there, because wheelchair users need to be able to get to them. Again, that is without question. What is the solution to this? Maybe you have to have two keypads, or maybe put your keypad on an angle so you can at least see it sort of straight on from above.

It's these details that really make the difference between a seamless welcoming working environment and the one that you are sort of having to struggle to get into. I should say the very helpful young student who eventually let me in, totally in breach of all protocols, said,

‘My God, that was a nightmare, that keypad. I can't do it either’. So, you know, this is a case of benefiting everybody.

In the workplace: lifts, stairs, and meeting rooms

Right. So you are in your building. And what are we going to do? Well, the first thing we might be faced with is stairs, if we are a stairs person. Or we might have gone upstairs in the lift and the lift keypad is the right-hand of one of those two keypads on that picture. Again, the same thing: you're in crowded lift with a whole lot of other people, and you've got to see the thing at an angle. The numbers aren't even in any sort of logical order, like the top floor at the top and the bottom floor at the bottom. Lifts are not particularly easy.

Figure 11: Three images showing the stairs in the Andrew Wiles Building.

However, these stairs... I've been complaining, right? I have got the green ink out. I'm going to put it away again because these stairs are lovely. These are stairs in the Maths Building again. And they have all the attributes of good stairs. They are wide so that two people can pass without having to manoeuvre. The front of the steps are cleanly delineated. The numbers of steps in each flight – eleven – is the same throughout the building, so you can kind of do it on autopilot. The ergonomics of it are right in the sense that the step length is good, the handrails are good, there's a good contrast between the floor and the walls: this is good design. If you want to see some good stairs, go to Maths and ask to be let in to have a look at these stairs in the interior of the building. There are other stairs in the Maths Building which aren't so good. (Am I allowed to say the word ‘seagulls’ here now? No, I thought not, because, er...) Well, a few years ago, water started coming in through part of the glass roof at the Maths Building and the contractor said, ‘It was a bird dropped a stone

on it'. And we all said, 'Oh, yeah'. Well, maybe it was true. Anyway, there are places where water comes in, and it has to be caught by buckets. And when it drops on the stairs, what do you do? You have a trip hazard or you have a sign.

Anyway, what do we do when we get to work? We go to a meeting. We spend our time in meetings and meeting rooms. So why is it that so many of our meeting rooms are so bad? I know that we are having to retrofit in old buildings, but nonetheless, so many meeting rooms are awful. The one in this picture, with its glass walls and the sun shining in, is clearly a nice sort of architectural conception, but it would be a horrible room in which to have a meeting for many reasons. It would become very hot. If you were sitting on the wrong side, you would see everybody as silhouettes against a bright background. You can imagine it not being a very comfortable room in which to work at all. (That is a random picture off the Internet. I will show you one of ours in a moment.) So, what can we do? What are the issues with meeting rooms? Well, one of the issues is simply the shape of the room. The room may be very long and thin, and we may be using long, thin rooms for meetings. And that means, inevitably, that the people at the end of the table, either at both ends or the far end from the chair depending on how it's arranged, are going to end up being far from the action. Very hard to follow without visual cues, and so on. That is certainly one thing.

We have meeting rooms where there is a lot of external noise, especially traffic. And in some ways, maybe it's quite nice to know that people are alive out there and that you're not locked away in this hermetically sealed room. But nonetheless, when traffic noise is drowning out speech – or let me put it this way, when you are working at the margins of your hearing – that extra bit of noise from traffic is really seriously disruptive. So, external noise is a problem.

Internal noise: now there's another area of conflict. Air conditioning: you need air conditioning, and especially as we know since COVID, we've realised the benefits, indeed the necessity of having good air changes in rooms. And that means air conditioning. But air conditioning can be very noisy. I don't think it always has to be very noisy. Let's just pause for a moment and listen... It's pretty quiet in this room. I'm sure there's air coming in from somewhere. But it's pretty quiet. And it's very quiet in some of the bigger rooms in the Maths Building and very noisy in others. Some of the committee rooms in Wellington

Square, where all the key decisions are made, are really very noisy indeed. So again, this is a conflict between fresh air and getting rid of the CO^2, which makes us feel stupid; and on the other hand, having to sit through the noise of having our meetings, as it were, on an aeroplane.

Again, you don't want to end up with a building where you say, ‘Oh, our meeting rooms are very noisy’. We need to be thinking about this from the word go and we need to be working with architects to make this work from the word go. Because if we say, towards the end of a process, ‘Oh, we don't want our meeting rooms to be noisy’, they'll say, ‘Oh, the M&E is all designed. We can't change it now, and we've got such and such a spec’. So that is a consideration. And there is a question also of hybrid meetings. I have said this before: this particular room is an excellent one for a hybrid meeting, and there is something clever about the IT that means when somebody speaks in the audience, it sort of zooms in on them and you can see who it is and you can hear them, and the acoustics are very good, too. But most of our rooms are pretty terrible for hybrid meetings and the person online is kind of isolated. I know they're isolated anyway, but they're kind of isolated from the main room. So that's another thing for us to be thinking about.

So overall, I think we can ask ourselves a question: Do our meeting rooms help us make good decisions? It's not a question we ask ourselves, but we should. Because we should be making decisions in the best conditions possible to make decisions in. And I don't think making decisions in rooms where you can't hear yourself speak is going to be very good at all. By the way, if you are beginning to zone out at this point, why don't you spend the rest of the lecture designing in your head the ideal meeting room? It'll give you something to think about while I carry on.

Figure 12: Quillen Room in the Maths Building.

This is one of our meeting rooms. This is the Quillen Room in the Maths Building. It's actually a nice room in many ways, but it's not a good meeting room. It's got all the attributes of a difficult meeting room. It has a very large glass wall, which I think the architects conceived of as a clear wall, and a mathematician said no, we don't want people looking in, we want privacy. And so you ended up with an opaque wall, but it's still very bright when the sun shines through the glass and onto that wall, so anyone on that side of the table, you are sort of peering at them. It's a very long table, the people at the end… (well, the people at the end tend to be the ones who ostentatiously are not quite paying attention and then occasionally chip in with a question and then leave five minutes early. Oh, I could write you a book about the types of peoples and committees). It's very hot because of all the solar heating, and the air conditioning struggles and is a bit noisy. The screens are a long way away and not easy to use. It's not a good meeting room. I think it's a compromise between an architect's design, a bit of vanity, but also trying to shoehorn into a difficult brief: an interesting case study.

Lecture theatres

So you've had your meeting. Maybe you are not a staff member, maybe you are a student and you want to go to a lecture.

Figure 13: Still photo from Maths lecture video.

This is one of my colleagues, Jan. Giving a lecture, a very interesting lecture about probability. And this is a still from the movie, given in our main lecture theatre, L1, which is a lovely lecture theatre with excellent acoustics. That does not, by the way, excuse not having hearing assistance. The room we are in now is not a very large lecture theatre. It's a medium-sized lecture theatre. But even in a room one third of this size, you would still want hearing assistance. Quite a lot of people would find it very helpful. And I'll come back to that in a moment. So, there is Jan giving a lecture about stopping times. I listened to a bit of it, and I learnt something, so that was good. Now, when you look at the picture, you cannot really see his face because the illumination is incorrect. The illumination of the lecture theatre is incorrect. You have a white board, which has to be illuminated so that you can see what Jan has been writing. Sometimes you have a screen, as we do today. Then you have the speaker. The speaker needs to be illuminated from the front, so that the visual cues are there. You know, these visual cues, everybody uses visual cues. If I put my hand in front of my face so that you can't see my lips, you won't be able to hear me quite as clearly as you will when I take it away, because, however little and however subconsciously, you are using visual cues. Those cues are not really available in the picture on the slide. In fact, we even have to bring in lights in Maths when we have a big event, a big public event, when we have an important person coming, like the Vice Chancellor coming to speak. We bring in lights to make sure that the illumination is good. So that is not good. In the room we're in, I'm afraid these lights are not helping with seeing what's on the screen. I prepared a lecture on dark

slides because I think that's actually easier to read and more comfortable on the eye. But it doesn't work in here, does it, because of the contamination from the front row of lights. The one flaw I have found in this otherwise excellent lecture theatre is that one of lighting.

Figure 14: Maths lecture theatre

This slide is the same Maths lecture theatre from the other side. And the story of this lighting is, roughly speaking, that we did realise, we did say you have got to arrange the lighting so that, for example, when the screen is being used, the speaker can stand in a convenient place and be illuminated without contaminating the image on the screen. So you know light goes in straight lines, and the pixels on your screen are [indicates with hand] that big, that is how precisely you can control light if you have the right kit. There are hundreds of years of experience of lighting theatres. We must be able to get this right. We did raise it with the architects, and there was resistance. I think, actually, as you see in this picture, they have a very elegant design in which the curves in the ceiling mirror the curves and the seating and the room has a kind of integrity, and to put lights in the front of the ceiling would have spoiled that. The difficulties were all about – 'Oh, there's no power up there.' Well, there's power up there, look, there are lights. But the real truth is, it was too late in the process. It was not built into the brief and it was not built into the thinking.

Working in a noisy environment

Hearing. I have talked about visuals, mostly, because, well, somehow the consequences of running into something visually that you didn't see are worse than the consequences of not hearing something you didn't hear. But nonetheless, hearing is something that we need to think about more. Working in a noisy environment is just not good for you, for a start. Ear protectors are there for a reason. Working in a noisy reception because there's not enough sound-proofing cannot be good for anybody.

The building on the left in this picture is the Earth Sciences Building, another recent Oxford building, 1980 I guess. And it has an atrium with graduate study spaces, which open directly onto that with no gaps. These spaces are apparently not at all popular because there's a lot of noise from the atrium which gets into the heads of the people who are working there. Some people love working in a café. There are always people in the Maths café working, but there are lots of people who need peace and quiet to deliver their best work – they need to be able to concentrate. They need to be able to mutter to themselves as they do some complicated calculation. I know I do. So, that is another piece of design that doesn't work when it is the only form of workspace in the building.

So those are just a few thoughts on hearing. And it's the same thing about thinking through the from the beginning: how are we to do this? and how are we going to optimise the experience for everybody? Because if we optimise it for everybody, we will certainly be doing the right thing by people who are in the 24% that Irene mentioned, who are disabled. And the last thing on hearing before I move on: hearing assistance is a very tricky subject. I know this from experience. There are various systems around the place, many of them, almost all of them, unsatisfactory. There are infra-red ones, which tend to not to work terribly well and can get blocked by not having line of sight communication. There's Bluetooth through your phone, which is fine if your phone talks to your hearing aid, but you have latency, which is to say the sound comes to you after a processing delay, and so it's not synced with the action. There are induction loops, which is what I think we have in this room. The one in here, I should say, is excellent. I've said this before, it's a really good one, it works very well in various places in the room, but induction loops can be difficult. However, my feeling is that if we were to build them into the design from the very beginning, they

would be a robust and widely usable solution. But I think they always get put in at the last minute, at the last stage, not built in as an essential part of the building.

Using IT

We're more or less done, I think. Oh, no, we have got to go onto IT. Well, now... How to lose friends instantly! IT is very difficult, especially in Oxford because the Oxford IT system is so spread out and diverse. But even if it was command and control from the centre, it would still be very, very difficult. You have a huge range of users, and they all have strong opinions, and they are prepared to let everybody know about them. You have a huge range of devices. You have Macs and you have Linux and you have Windows and you have other things probably as well. You have mobile devices, you have desktops and a background which is constantly changing as technology evolves. And our poor IT staff are expected to keep up with us. So, they have a really tough time of it. And yet, and yet...

So, I think you can tell that there are a couple of personal complaints coming along here. I will just make a couple of points. One of them is that we are very prone to buying software which does not adopt the standard high-contrast themes on Windows or indeed other operating systems, but mostly on Windows. So, if you are, like me, and indeed like many ordinary people – when I say ordinary, I mean, people not like me... I am surprised at the number of people I talk to who like using a light text on a dark background. It's so much easier on the eye. And why should backgrounds be white just because paper is white? We have training resources like some in Health and Safety and Information Security, which do not have accessible versions. So, I remain a walking health and safety risk and a walking information security risk. I'm sorry about that, but there really is nothing I can do about it, because I cannot actually read those screens except by taking about half an hour per page; and I'm not prepared to do that. The one at the top is so-called accessible text which puts the text, which is very small, in black boxes. You can read it, but again you have to work very hard. It's not the effortless thing that you have to have in a critical and important training video. I should say that the inrehearsal videos that University has are much better in this respect. But these ones come out of CoSy and are absolutely terrible.

I do not get the feeling that accessibility is yet bottom-up in our IT. As I said, I think this is really hard to do. But I was very encouraged to listen to a podcast recently with Anne

Trefethen and colleagues [Episode 8 of this series] in which they talked about how accessibility was going to be built into IT far more than it is at the moment. And again, this will benefit everybody far more than just a small number.

Final thoughts, and a challenge

So I'm approaching the end of my time, I think. In that case, I'll wrap up very quickly with some final thoughts: first of all, we have to build accessibility into our design from the bottom up and from the very beginning. It's absolutely essential that we do that. I think we need ways of documenting that and making sure that we are not relying on individuals to make our projects accessible and inclusive. This needs to feed into the interface with our architects in our designers and everybody else.

I went and read the University's Accessibility Design Philosophy Document. I did not have high expectations, but it turned out to be an extremely good document which said a lot of the things I wanted to see said. I think we can use that document, I think we can take it and we can build on it, and we can make it into something which is really authoritative in this sphere and informs all of our projects, every single one of them, for the future. I really think that we've got to do that and I think we've got to gather the knowledge from our community of people across the whole University. I think we need to recognise that this is an important job and we need to, for example, use our system of responsibility allowances to pay for people to doing it and giving them time to do it. In other words, we shouldn't rely on people in the disability and non-disability community to give their time to this sort of thing. It's a professional thing. It's part of our professional endeavour and we should recognise it as such.

I have the idea that we should give all our architects, and designers and our contractors, too, what I would call accessibility tours, which would be a kind of walking version of what I have been talking about with my slides. In other words, you would take them round and show them some of our buildings, show them the successes, show them the failures – very important to show them the failures – and say 'We don't want any of those'. Talk about the desires. Talk with the people in the departments concerned. But really build this into their thinking before they start putting pen to paper or mat to screen or however they do it these days. I think that is an important thing to do.

And overall, I would like to pose a challenge which is: Can we make Oxford a beacon institution in this respect? I think we are in a good place. We've got a lot of hard work and thought that's gone into it. Can we take it to the next level? Can we make Oxford the place that everybody else looks at it and says, 'This is how you do it.' 'We need to go and ask them how they did it.' 'This is fantastic.' That's what I would really like to see. And if there's one point in my lecture, it's that doing that will benefit every single person in this University.

Every single person.

Thank you for listening.

(Applause)

Vote of thanks from Professor Elizabeth Frood

I very much hope this is not an audition. That frightens me, Sam!

I am Elizabeth Frood. I am an Associate Professor of Egyptology here. And I feel very privileged to be in this space, to thank Sam for articulating such a powerful call to arms for the University, which placed the individual body at the centre, and I loved that. I loved starting out with the detail of the ear and just moving out to how we navigate spaces.

And I want to thank Teresa and Catherine for creating this critical space for discussion, through the annual Disability Lecture. I know you have worked really hard to create this. So thank you both so much.

When I first began, almost ten years ago now, to have to navigate the world and everything, literally every thing, literally things in the world, anew – I had to renegotiate my relationship to the world – I read a book. And maybe it should be a new textbook for architects, by the artist and designer Sara Hendren, about adaptive design and technology from an artist and a designer's perspective. It's an incredibly inspiring book, and it helped me rethink how my relationships with the world could work, even though I'm not an artist or a designer. But she begins this book right at the start with a quotation from a philosopher Albert Camus: 'But one day the "why" arises and everything begins in that weariness, tinged with amazement'. The 'why' there for me, for me personally, encompasses the 'what if': what if things, spaces, the world, could be otherwise? And I think Sam has shown us, beautifully,

this evening, the possibility that resides in that 'why' and the 'what if'. There are many of us in the room who will be familiar with the weariness, the labour that goes into navigating this world. But I want to just touch a little bit, because I thought Sam also brought this into his lecture, the amazement, in a positive way, in a delightful way, because we are throwing down a gauntlet to the architect, to the designers, to the digital world that I have to navigate to do my job every day, the people that create software, for imaginative, creative, holistic design that can be really beautiful. And that the aesthetic of that is so important.

All of you who halfway through the lecture started to design your meeting room, I hope you were creating spaces that are visibly, *visibly* – visibility is really important – audibly, and sensorially useful. Because it is possible. Sara Hendren talks about case studies where it's really possible. And yes, it has to start from the ground up, and it has to be a collaborative community, and we are so privileged in Oxford to have the potential for that.

So, Sam, thank you so much for highlighting all of this for us. I am really grateful to have been here to hear that, and to be able to respond in this small way.

So I would just like to, on behalf of the entire room and everyone online, offer another round of thank-yous and applause for Sam.

(Applause)

END