TRANSCRIPT

An Undeceptions podcast.

John Dickson:

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Speaker 2:

I don't think you ought to be doing this to yourself, Andy. Mexico is way the hell down there and you are in here and that's the way it is.

Andy:

Yeah. Right. That's the way it is. It's down there and I'm in here. I guess it comes down to a simple choice really. Get busy living or get busy dying.

John Dickson:

Movie goers will recognize that scene from The Shawshank Redemption. It should be on everyone's must see list. And yes, Mark, I have watched that movie. In 1994, it was voted the greatest film of all time. It's certainly up there for me. It's also the brainchild of the fantastically successful author, Stephen King. King has countless bestsellers and over 92 of his novels and short stories have been made into films and television programs. He's one of the world's most creative storytellers with yarns covering possessed cars to death row angels. So where do his stories come from? "I get my ideas from everywhere," he says, "but what all of my ideas boil down to is seeing maybe one thing. But in a lot of cases, it's seeing two things and having them come together in some new and interesting way." And then adding the question. "What if?" His imagination ties two unlikely things together and voila, a fantastical storyline.

John Dickson:

Musicians report experiencing similar creative lightning strikes.

Joni Mitchell:

(Singing)

John Dickson:

Joni Mitchell is a musical poet with amazing lyrical and melodic sensibility. Her Both Sides Now was released before I was born, but it is honestly one of my all-time favourite songs. Talking about the source of her inspiration. She once wrote, "You could write a song about some kind of emotional problem you were having, but it would not be a good song in my eyes, until it went through a period of sensitivity to a moment of clarity. Without that moment of clarity to contribute to the song, it's just complaining."

John Dickson:

That moment of clarity, that imaginative insight is something we often associate with the creative arts, the artistic process, but we don't typically think of it as part of the scientific process where logic and testing reign supreme. But that's probably wrong. It seems that science, no less than art, fiction writing and music, is a right side of the brain thing just as much as a left side of the brain thing. Now, of course, when we do our episode on neuroscience, we'll discover this left side, right side thing isn't exactly right. But you know what I mean, it may just be that science is an imaginative, creative and even emotive enterprise, just as it is obviously a rational mathematical and evidence-based discipline, which to my mind and to that of my expert guest, makes perfect sense. After all, the creator is an artist and logician in one.

John Dickson:

I'm John Dickson, and this is Undeceptions. Undeceptions is brought to you by Zondervan Academic's new book, Biblical Critical Theory by Christopher Watkin. That is quite something. Each episode here at Undeceptions, we explore some aspect of life, faith, history, science, culture, or ethics that's either much misunderstood or mostly forgotten. With the help of people who know what they're talking about, we're trying to undeceive ourselves and let the truth out. And if this hour of undeceiving isn't enough, join the Undeceptions Plus community for just $5 Aussie a month. That's about 280 rupees for our Indian listeners. Yes, we see your downloads, too. You'll get extended interviews with my guests, bonus episodes and tons of other stuff. For this episode, our Plus community gets a feast of extras. Just head to undeceptions.com/plus.

Tom McLeish:

Walking on the walls is great. Well, in fact, just there, about the best quarter of the walls to walk on, if you can see the flight of steps there, just were behind that red bus.

John Dickson:

Yes.

Tom McLeish:

There's some steps up onto the walls and you carry on around the cathedral close and you come down again. So you can look down into all the cathedral park and everything from the walls. And that's fun.

John Dickson:

I will definitely do that.

John Dickson:

My guest today might sound like an enthusiastic tour guide for the city of York in England's Northeast, but that's just part of his multifaceted charm. He's actually one of the most celebrated scientific minds in the UK. Tom McLeish is a theoretical physicist at the University of York. He's also a fellow of the Royal Society, the preeminent scientific academy of the UK and his work is renowned for breakthroughs in our understanding of the properties of soft matter, like liquids, foams, and biological materials. He is a nerd's nerd, a scientist specializing in polymath physics, but his formal title at the university is almost medieval like the city of York itself. He is professor of natural philosophy in the department of physics. More about that weird title in a moment.

John Dickson:

Tom is the author of The Poetry and Music of Science: Comparing Creativity in Science and Art. He is at the cutting edge of a new or rediscovered perspective that celebrates the imagination of scientific discovery as well as of course its rationality and a clue to his approach is in that strange title, professor of natural philosophy.

John Dickson:

Can you tell us something about the meaning and the history of this venerable term?

Tom McLeish:

Yeah. I'm very excited and very grateful to York for doing this because they have actually dug up the old name for physics professors or even just for general natural scientists. The word scientist, we know who invented it. It was William Whewell. He was a master of Trinity College Cambridge in 1830s. And he invented it because he thought we needed the term to pull together all these geologists and astronomers and natural scientist and artists have a term don't they? So let's call us all scientists. But before then, we would all have been called natural philosopher and the old, the ancient universities, the ancient Scottish universities, and the two older English universities still preserve. One of their professorial titles will be the professor of natural philosophy.

John Dickson:

And there's an arch in the Oxford quad that goes into the natural philosophy.

Tom McLeish:

Yeah. The philosophy of that is there indeed, and it's a term that in my thinking and writing about science and the public wishing that we could make science as it inherently is more approachable for people as well as making it clear its roots within faith and belief. I've often wished that we could go back to the old word because if you unpack the word scientist, it comes from the Latin verb to know things scary. So if you remember saying a scientist, it's making a knowledge claim. It sets apart. It distances. It is not an invitational thing. Well, leave me with a knowledge. But a natural philosopher is Greek, of course, whether the philosophy bit. It comes with the love of wisdom. So actually if you say, "I'm a natural philosopher," unpack that word. You're saying I love wisdom to do with nature. And isn't it invitational? Isn't it like, "Would you like to have some wisdom to do with nature? It's much more humble and it's much more invitational. My home department is physics. You're right. But I've got a lovely remit to work across all departments here in York.

John Dickson:

Tom is a great example of the growing realization or prediscovery that we need more than evidence and rationality in the scientific process because science itself, that is knowledge of the natural world, has a lot of overlap with art, philosophy, metaphysics and yes, theology in its classical form. It's a medieval idea like most of the best ideas, contrary to popular ignorance. It was commonplace from the 500s through to the 1500s for the biggest brains to pursue at the same time, language and rhetoric, music and theology, as well as mathematics and astronomy, all in an effort to understand the world in a holistic way. Feel free to go back and listen to episode 74 medieval science for more on that. Tom is even better than the proverbial Renaissance man. He's a medieval man. And one of the cool projects he's involved with is called Ordered Universe, which investigates the scientific work of medieval polymaths. Well, they're considered polymaths now, but at the time, they were just well-rounded scholars. And one important name in this club is Robert Grosseteste.

Tom McLeish:

The only way we can understand the work of someone like Robert Grosseteste is extraordinary Oxford, Lincoln, Paris, [inaudible 00:10:34] scholar of the early 30th century. Great polymath is to sit around the table with about 20 disciplines, all of which can understand a bit of what he said. And we're trying to put it back together again. Now, to answer your question about what I personally got from this extraordinary thinker of the 13th century, when we started this project, we thought, "Oh, wouldn't it be lovely if we could, as I explained, help our humanity scholars in some of the technical mathematical aspects of what they're reading and indeed, so I think we've been able to do. We were able to point out that Grosseteste treat his own colour, is talking about a mathematical three-dimensional space, just like ours, a bit red, green, blue, where colour exists. We were able to translate his extraordinary Big Bang Theory for the origin of the medieval cosmos into mathematical algebra.

Tom McLeish:

So we could refine it and interrogate the text anyways and so on. What we didn't expect is that just about every medieval 13th century treaties we've looked at and we looked at colour, light, rainbows, comets, the motion of the planets and so forth. At some point, one of the scientists said, "Oh, that's an interesting way of thinking about it or that's an interesting question. Has anyone ever followed that up?" And it turns out they haven't. So this first part of science that people forget the inspirational formation of the question, the imaginative step into new science. We've got 10 times now, just once or twice from medieval text. So one of the answers to your questions is it's giving us at least 10 pieces of brand-new science or the starting point for them anyway.

John Dickson:

That's the benefit of scholars across the range of disciplines working in cooperation. They put back together certain important insights that have been pulled apart in our modern atenistic approach to knowledge. And one of those insights is the way creativity and imagination right alongside rationality and evidence undergird science, certainly undergirded the medieval science of someone like Grosseteste. But Tom says he's had glimpses of it in his own specialty of polymath physics. I asked him about one of his imaginative scientific breakthroughs.

Tom McLeish:

We know that certain polymaths are giant like tiny strings. If we were to drink Alice Wonderland's or eat the mushroom and dive down, become a million times smaller, we would see a stringy group of strings. Right? But of course, one thing you can do with string is tie knots in them, or you can join strings in different ways to make nets or networks or different shapes or topologies as the mathematicians would say. And here's the thing. Some very clever chemists had managed to make fluids starting with fluids with each of its molecule was a long single snake-like string. They'd managed to turn each of the molecules of fluid into something that looked more like a starfish that had three or four or five or six arms, each of which radiated from a central point. They're all very wiggly, very tangled strings, but nonetheless, they were each a star shaped.

Tom McLeish:

And when you make a fluid out of those, that fluid can have a viscosity thickness, dewiness, or gloopiness which is a thousand, even a million times that of the same chemistry, same fluid, simply whose molecules are simply snakes rather than a starfish. So it's nothing to do with the chemistry. Nothing to do with the forces. Nothing. It's just purely the mathematical shape of the molecules. And this was the problem to understand. And it turned out that we thought we could understand it because you can think what the snakes do. The snakes wriggle along, wriggle along like winding up spaghetti or noodles from a plate. And they can escape and let the whole fluid escape from being trapped entangled with their neighbours. And the whole fluid can flow because of that. And that's what starfish can't do. Their arms get tangled with each other and they can't move.

Tom McLeish:

And the fact, the only way they can move is to sort draw their arms in. You have to understand that all these molecules are, they're not alive, but they're wiggling around all the time because of heat. Another great payoff for the molecular theory of matter. Heat is as explained, not some additional substance, but just as the random jiggling about of molecules and hot stuff jiggles faster than cold stuff. Right. So they're jiggling around all the time. We were overestimating how bizarrely... We were getting billions and trillions time more viscosity. And that was when my PhD supervisor and I were stuck on this problem. And then there was this conversation we had. I was really exhausted. He's a very clever guy, far clever than I was. And we're having a conversation after a long day's work. I think we're on the train coming back to Cambridge.

Tom McLeish:

And I just lost that plot. I couldn't understand anything he was saying. I knew this problem and he had some hair-brained idea, but I had no idea. And then went to bed, had a good night's sleep. Next morning, I woke up. Everything was absolutely clear. I knew what was going on, that these were sort of self-dissolving molecules that as each one gave a little bit of freedom to the neighbours, they would give their freedom back. And we were making a mistake by thinking of each starfish as it were stuck in a pit fixed net. It's not in a fixed net. It's a field of other starfish, all doing the same thing. And I was able to couple it around mathematically and immediately just in the same one morning out came the numbers we'd been looking for a bit. So we had this. I knew-

John Dickson:

The thing is, you saw it in your mind's eye as it were before you just did the next.

Tom McLeish:

I saw it. Yeah. I think I saw this picture of all these molecules behaving together and each one making a bit of room for the others so they could give that room back and the whole thing accelerating each other. And then I was able to see how we could represent that in mathematics so we could turn that into numbers. What happened on this night is that although I had not consciously understood what my colleague was saying, there must have been an unconscious level to which the words sort of sunk that from the surface of the ocean of my mind, they'd sunk to the bottom and they'd formed and gelled and linked together there and the next morning had floated back as a connected, created thought to the surface.

John Dickson:

And plenty of scientists are forwarding their fields through imagination. And you say this is common, this imaginative vision for what's a better term among scientists.

Tom McLeish:

Yeah. Well, different versions of it are common. They're not commonly told because we're not encouraged to talk or publish our science in that way. We cover our tracks. We talk about the articles and the evidence and the deductions and the hypotheses but we don't talk about... We talk about our route to testing hypotheses, but we're not encouraged to explain the imaginative, tortuous, anything goes, no method holds road by which hypothesis arrive in the first place. That's what I got interested in because it's not talked about enough.

John Dickson:

So I guess I'm asking you to describe for us if it's possible, and I know you've written a 350-page book on this, but what's the relationship between the scientific method and scientific imagination?

Tom McLeish:

Right. So the way I put it, there's two ways of articulating this. In so far as there is a scientific method, and we can talk this about another day. I'm not persuaded that there is a scientific method and I'm not... Well, look here. Here's one thing. Look, I'm a professional scientist. I've been a professional scientist for now 40 years, right? If there was a scientific method, I'd have done a course on it. In my formation as a scientist, no, I haven't. Now historians and sociologists of science have done courses on method, but the scientists haven't.

Tom McLeish:

I therefore deduce that the scientific method has more to do with a neat way of wrapping things up than we do. If you're a sociologist or a historian science, then if you are a scientist, be that as it may, the best thing that scientific method could possibly be, if it really exists for scientists, is the second half of the scientific process. There is a method and Karl Popper wrote three books about this, logic of scientific reputations, conjectures, or reputations, all this sort of stuff, logic of the scientific method of how you test an idea when you got it. So you've got science of-

John Dickson:

Karl Popper, by the way, was one of the 20th century's most influential philosophers of science. Popper is best known for his principle of falsification, which he used as a means of distinguishing genuine science from stuff that merely claimed to be science, stuff like astrology. He argued that the thing that makes science science-y is that it can be tested and conceivably proven false. Science, he said, should attempt to disprove a theory rather than attempt to support theoretical hypotheses.

Tom McLeish:

... an idea when you've got it. So you've got science of theory for how this works. You've got this side theory that heat isn't a substance. It's about motion of atoms and work and heat equivalent. So that you've got this idea. This suggests an experiment. In fact, it might suggest even the experiment as George MacDonald's, the poet and author, pointed out is an act of formulating experiment, is an act of imagination itself. But then you have some predictions from your theory, you test them. If they're right, okay, you live for another day. If you're wrong, you're dead. Think again. But of course, that assumes you've got a hypothesis. So the first half of the whole scientific process, the climb up the mountain, is to get an idea that there are these long string-like molecules. And this is hard.

Tom McLeish:

When Hermann Staudinger, German organic chemist, proposed the idea of macroscopic molecules, he was ridiculed, he was ostracized, he was laughed out of the scientific court because as we all know, molecules are precise and to have this well determined structure. It's very German accent sort thing. Right? It's difficult to break the mould and have new scientific ideas. It's as difficult as to have poetic ideas, write new plays, write new symphonies, decide what music, whole visitors of avenues and musical genres have never even been touched on, explored, ditto poetry and so forth. It's like that. And so that's where imagination fits fundamentally in the first half of what could be going on? It's a sort of act of recreation. It's recreating what the world might be in its substructure in our minds and then it's inducing. You can't deduce, you see, the structure of the world from scientific observational experiments. You only induce it. And that's imagination.

John Dickson:

It's not just that scientists often need creativity and imagination before they mix stuff in the test tube or look out through the telescope. Tom says they frequently rely on immediate visual perception, just like a visual artist.

Tom McLeish:

Yeah. So it's not ubiquitous. It doesn't happen to everybody, but I'd handle these conversations as I mentioned in the book, but for scientists and I also had conversations with artists and musicians and composers and so on to sort compare and contrast. And I noticed that many of the scientists that I was talking with, including mathematicians actually, think visually. They don't think in algebra. They don't think in data even. They think visually. They think in pictures. Now, I'm one of them actually. I'm one of them. I'd sort of described these star pods are wiggling around. There's another time when I had a dream or a daydream of a protein dancing about and sending information across itself. So I think visually too. Not all scientists do. But those that do conceive their landscape, two-dimensional, three-dimensional in... Well, at least they talk about. They use a very, very similar language to the way that some of the creative artists will [inaudible 00:22:53] but artists like to talk about their creative process. They'll sometimes draw outlines.

Tom McLeish:

We're right outside York Art Gallery as we're speaking and the exhibition on at the moment is a written discovery of Gainsborough's sketches that we never thought... Literally, they've been attributed to him for the first time just last year. It's a wonderful discovery.

John Dickson:

Thomas Gainsborough was a leading portrait painter in England in the late 18th century. I'd never heard of him before Tom mentioned him, but I looked him up. Oh my goodness. He's amazing. He was known as one of the most inventive painters of his time. And he was the only grand portrait painter of the era to pay special, detailed attention to landscape. His painting, Mr and Mrs Andrews has been described as a triple portrait of Robert Andrews, of his wife, Frances, and their beautiful land around them. Actually, there's a lovely dog at their heels. So it's maybe a quadruple portrait. Google it. It's really quite something. Anyway, back to Tom's actual point.

Tom McLeish:

... last year. It's a wonderful discovery. And he made sketches. Some of them, even half completely, these sketches he made for his landscapes and you can see what he does. He takes a piece of chalk and he draws the outline of the trees, just the outline, jaggy, jaggy, jaggy outline, and trunks going down, the leaves and then the outline of the rocks. And then he'll fill in the detail afterwards. Not many artists do that. I met composers actually who compose visually. One of the composers, Jaki Graham, who says she's invented her own sort of coarse-grained, rough, defocused musical score.

Tom McLeish:

It's not got bar lines and things, but it's got sort of bar lines seen from a distance and she'll scratch out the piece going up and down and you can see how the whole formal piece of a whole symphony or long piece will go. And then she'll fill in the detail. It's a narcissistic process. So that's one way in which science is like art, because we see almost literally sometimes in our mind's eye the rough picture our things must be. And then we'll beaver away at the detail just as Gainsborough later went to his canvas. It's all paints and literally paints every single leaf on that huge beach tree.

John Dickson:

Tom points out that this marrying of science with the more imaginative arts, a marriage that should never have ended in divorce, goes much further than big picture thinking. Technical skill is also central to both obviously, well, to good art anyway, and that brings us naturally to one of the other great art forms that's very much like science, music, but we get to music by way of Fermat's last theorem.

Andrew Wiles:

Perhaps I could best describe my experience of doing mathematics in terms of entering a dark mansion when it goes into the first room and it's dark, completely dark, one stumbles around, bumping into the furniture and gradually you learn where each piece of furniture is. And finally, after six months or so, you find the light switch, you turn it on and suddenly, it's all illuminated. You can see exactly where you were. At the beginning of September, I was sitting here at this desk when suddenly, totally unexpectedly, I had this incredible revelation. It was the most important moment of my working life. Nothing I ever do again will...

John Dickson:

I love this. A Princeton mathematician brought to tears by a moment of mathematical insight. A revelation. Tom starts his chapter on music and mathematics by describing the scene we just heard. It's from the 1996 BBC series, Horizons, and it features the mathematician, Andrew Wiles, from Princeton, and then Oxford. He recounts the moment when, after months of effort and a lifetime of pondering, he realized the flaw in his first attempt to prove Pierre de Fermat's celebrated last theorem. The mathematical problem, while solved, had been lingering since 1637, famously bedazzling mathematicians for more than four and a half centuries. In the BBC scene, the producer freezes the frame on this prize-winning professor who's overcome with emotion over a piece of mathematics. "How can maths be so beautiful?" asks Tom, "How can it evoke such depth of emotion, almost spiritual ecstasy?" Music, on the other hand, is something we completely understand, giving us goosebumps and making us cry, like Julia Roberts crying at the opera in the 90s romcom, Pretty Woman.

Speaker 9:

Did you enjoy the opera, dear?

Julia Roberts:

Oh, it was so good I almost peed my pants.

Speaker 9:

What?

Speaker 10:

She said she liked it better than Pirates of Penzance.

Speaker 9:

Oh.

John Dickson:

But there is a connection between mathematics and music that goes right back to Plato to Saint Augustine and to all of the medieval philosophers. The fifth century theological giant Augustine wrote some fairly heavy tomes on music, six books on rhythm and meter, and an intended six books on harmony, though we don't know if he completed those. You might ask, "Why on earth is a theologian so interested in music?" And the simple answer is music was the audible embodiment of the numeric structure of reality. A tune is a mathematical thing. What makes a melody beautiful to our ears is the way it pulls out of seemingly nothing a harmonious pattern, which somehow resonates with the patterns of the physical world and with the patterns of our own brains. The uplift we can feel just by hearing good music quite apart from lyrics seems to be the result of some harmonious loop or resonance between the structures of the sound waves and the structures of our minds.

John Dickson:

And that is theological or at least metaphysical, which is why music was a mandated subject in the liberal arts in the Western tradition from at least the time of Cassiodorus in the sixth century and firmly established by Alcuin of York in the eighth century. Proportion, number, harmony. These are all features of music and art. They are features of science as well. They are features of our universe. And until about five minutes ago, well, maybe a couple of centuries ago, most people saw these as deriving from the one eternal mind behind reality. So let's get back to music.

Tom McLeish:

In so far as geometry is the mathematization and our mapping out of space, so music bears that relationship to time. One, two, three. One, two, three. An interval and process. And music was the formal exploration of time, which is of course why there's also a strong link between music and astronomy, because the heavens were also, if you like, God's given all the cosmos this mapping of time, the regular cycles of seasons of the day and the year and the lunar month and so on. So once music is our human creative mapping out of time, there's obviously also a link to music and astronomy, which is God's mapping out of the [inaudible 00:31:35]

John Dickson:

Of course, harmony is mathematical. Melody is mathematical.

Tom McLeish:

Absolutely. You get [inaudible 00:31:39]

John Dickson:

Resolution is mathematical.

Tom McLeish:

Yeah. That's the point, not just in... So if you like, mapping out time is the additive arithmetic of time, but harmony is the proportional arithmetic, so a fundamental note. You pluck a string, "Dong," and you then make the string half as long, and you get, "Dong." It's an octave. "Bam, bam." It's a whole octave above, and then you make it a third and a "Ta, bam, bam." You got a perfect fifth and all these wonderful intervals were known to bear mathematical relationship to the lengths of the pipes or the strings that produced them. So you can understand how music and mathematics together led to the mathematization of the world, which is what we do in physics today. So right at the cuff of where we are.

John Dickson:

Professor McLeish is a huge fan of Robert Schumann, the 19th century romantic composer. He makes Schumann an object of comparative study in his book, The Poetry and Music of Science. He argues that in his prolific work, Schumann is exhibiting two of the constant themes we can see in any radically new idea, whether in art, science, literature, or music. The first is the forging of connections between two distant streams of thought. And the second is what McLeish calls the power of creative duality. Stay with us. It'll make sense in a moment.

John Dickson:

Can you give me a sense of who Robert Schumann was and the kind of musical culture he was surrounded by?

Kirsty Beilharz:

We think of him as a romantic composer. That's romantic with a capital R alongside people like Brahms and Liszt and some of the later romantic composers, some people even distinguish and call it the late romantic period. Then you have people [inaudible 00:33:40]

John Dickson:

That's my friend, Kirsty Beilharz, a former professor of music, sonics to be precise, who, after completing her second PhD just because, now works as a theologian, musician and philosopher at Excelsia College in Sydney. She is the biggest music nerd I know. You might remember her from season three in the amazing episode titled, Creations of Music. She's the ultimate phone a friend for this one.

Kirsty Beilharz:

Then you have people like Wagner, Bruckner, Mahler, still with the Germans at this point. And he was also very influenced by other romantics in genres of things like painting, poetry, literature. And I think that's really important to us thinking about his music. It was very visual for him and quite poetic.

John Dickson:

So I'm fascinated with this description that you've built up of him being romantic in that capital last sense. He's integrating poetry. And yet I'm told it's highly mathematical, that there's mathematics at play. I know there is in all music, but Tom McLeish sees the sort of mathematical brilliance in it as well.

Kirsty Beilharz:

Yes. Well, I think this is also his looking back towards the Baroque. Now I know you are a great fan of the solo sweets by Bach for cello for example. A lot of people are familiar with the two part or three part inventions of J.S. Bach for the piano. And when you look at the way that music like that is inventive, their solar instrument works. It's not by grabbing for lots of colours and textures through a diversity of instrumentation. The way that this melodic complexity and interestingness and inventiveness is created is through structure and form. And that's where I see the link to the mathematical side or the geometrical side in particular, so mentioned of proportion and shape. I think shape, pattern, proportion are actually the mathematical criteria that are very interesting here in music. So when you listen to, for example, the first movement of the horn concert piece, you actually hear a very concise thematic language.

Kirsty Beilharz:

In other words, there's really one melodic idea that he uses for the entire movement, but the way he chooses the interestingness is through things like, this is where the maths comes in, are changing the proportions, inverting, turning upside down in a horizontal sense, like a reflection in a lake or a proportion mirrored back to front as well, retrograde and forwards, if you like, changing the amount that it's stretched or contracted, transposing into different keys, having that dialogue in space and time. So time being things like rhythm and how stretched a melody is, but space because you have the solo horns passing this melody amongst themselves in different registers and then between the soloist and the orchestra.

Kirsty Beilharz:

But that motific way of working with the pattern and working then with the permutations of the pattern upside down, back to front, inside out, transposed into different keys, stretched, contracted, changing the rhythms, varying it in as many ways as he could think of, I think shows very resourceful inventiveness. And so it's that kind of mathematical concept of patterns within patterns and permutations that I think takes its cue, even if subconsciously, from geometry or from pleasing symmetries. And on the one hand, that might seem completely at odds with the poetic and nature, which might maybe seem to be rambling and romantic in the free sense. But I think there is a connection because nature itself, perhaps art echoes nature. I don't think we can say the other way around. Obviously, nature's been there for a very long time, but the created world, you see the same forms and we also find them aesthetically pleasing. So think of fractals and the shapes of mountains or crystals or snowflakes and the way that they form symmetrically and incredibly detailed patterns.

John Dickson:

Kirsty, I'm so glad I phoned a friend on this one and now I can't wait to go and listen to the Four Horns concert piece.

Kirsty Beilharz:

Yes.

John Dickson:

With all of that in mind, thank you so much.

John Dickson:

We've been listening to the Konzertstück, Opus 86. That's Schumann's concert piece for Four Horns played by the Seattle orchestra. And by the way, that's the hidden code for this episode if you happen to be playing along in the one millionth download competition in August. Code Schumann. Now, classical music might not be your forte, but Tom McLeish says you don't have to know anything about music or mathematics to appreciate their shared beauty. In his book, Tom puts musical and mathematical notation side by side for the reader's appreciation. Even if you can't read either set of squiggles, you can certainly get a sense of both as elegant patterns and that's his point.

Tom McLeish:

But I wanted to say, look, with a musical score, you don't have to know what a crotchet is or where F is on the stave. There are simple ways that you can appreciate the beauty of a musical score just by knowing that when the little dots are high, it's the high notes. So little dots are low on the gate, it's low notes. It's why you just watch the pattern and time goes from left to right. So now it's like a sort of graph. Now, do you see there's some notes or little runs there? Do you see there's this big, big, long notes, arching things? Do you see where this phrase is going and how this helps the creative process? And then having prepared the way ever so gently I say that some people who don't read music would've found that bit quite difficult.

Tom McLeish:

Now, some bits people who don't do mathematics at all will find the next bit difficult, but don't panic. Don't panic. Look at the way these letter forms dance around each other. Look at the beautiful structure. Look at where the overall shape. Don't worry about not understanding the details. Very few people do but look at the overall shape. And the reason I wanted to just exhibit the notations is to say, "Look, here is the notation. It has a beauty of its own in the same way musical scores or in the same way pictures do." So I hope that works.

John Dickson:

Looking at a mathematical equation or a musical score and recognizing the similar beauty in its structure is one thing. To get to that structure requires at some point, a blank piece of paper. The process of music and mathematics is also mirrored. "Mathematics, like music, explores vast and intricate structures as well as elements of detail," McLeish writes. Mathematicians construct proofs, but debate over how much of their work is discovery, how much invention. Like music, there are true but dull results, trivial as well as profound. Some mathematics is pedestrian. Some, breathtakingly elegant. Both require a germ, a starting point that breaks the sterile symmetry of the blank paper or empty stave. And the choice of project is bewildering. Possible starting points are too numerous to contemplate, but the potentially fruitful are rare. For Andrew Wiles who proved Fermat's last theorem, McLeish says that his protracted mathematical journey consisted of struggle, incubation, verification, and eventual clarification of a result that drew from much of modern mathematics in unforeseen ways to reach its final destination.

John Dickson:

Schumann's journey in composing his concert piece for Four Horns was similar. He drew inspiration from the great musicians like Bach, whom he admired, but also was influenced by the romantic literary writers of his date. It was a combination of two ideas that hadn't been brought together before. Both the mathematical equations and musical scores require immense imagination. One is considered art, the other science, but really, both are arty and science-y at the same time. And after the break, we are going to push this boat out into even deeper waters. We've seen the links between science and imagination, the visual arts and music. But what about emotion? Does emotion play any role in the scientific enterprise as it obviously does in music and the arts? Stay with us.

John Dickson:

This episode of Undeceptions is sponsored by Zondervan Academic's new book, Biblical Critical Theory: How the Bible's Unfolding Story Makes Sense of Modern Life and Culture by Christopher Watkin. Critical theory aims to make visible the deep structures of a culture in order to expose and change them. You've probably heard of critical race theory or feminist theory or queer theory. These theories can be quite controversial. They seek to unmask and then undermine so-called oppressive structures in Western society.

John Dickson:

Many Christians have been quite vocal against such theories, but Christopher Watkin, who's an expert in all this stuff, argues that the Bible has a type of critical theory of its own, a way of exposing the main flaws in the dominant culture's narratives. This is a magnificent achievement. It is a must read for Christian leaders wanting to think biblically about our dechristianizing world. It's also a gift for those who aren't sure what to make of the Christian faith. Here is a total defence and commendation of Christianity like no other. Buy it, read it, ponder it, pass it on. We are chatting with Christopher in an upcoming Undeceptions episode. In the meantime, you can find his book on Amazon or head to zondervanacademic.com for more.

John Dickson:

In Tarime in the Mara region of Tanzania, schools are often built one wall at a time, raising money brick by brick. The Tarime Girls' Secondary School currently has one classroom block for about 160 students. It also has one wall of a science lab and another wall of a proposed library. The roof and the rest of the walls are well, it's up to us.

John Dickson:

The vision for this school belongs to Bishop Mwita, a respected Anglican Bishop, who is hoping the school will offer an attractive alternative path to the girls of Tarime. Many of these girls are dropping out of school too early, keeping to traditional views that girls are more useful in the home as wives and mothers, even girls under the age of 18. Anglican Aid is working with Bishop Mwita and local churches to get this school up and running to serve these girls. Once complete, it will give 800 girls an opportunity to complete their secondary education, giving them an extra four years of learning that is bound to open doors and give them options. You can help Anglican Aid in this important work, valuing women and championing education. It's an organization I really trust. Go to anglicanaid.org.au to give today. That's anglicanaid.org.au.

Sheldon Cooper:

Amy, Amy.

Amy:

Come in.

Sheldon Cooper:

There's something I need to tell you. Wow, you look amazing. That's not what I need to tell you, but you do.

Amy:

What's wrong?

Sheldon Cooper:

Something incredible just happened. Remember when you were telling me about my bow tie and how a little asymmetry is good?

Amy:

Yeah.

Sheldon Cooper:

My equations have been trying to describe an imperfect world. And the only way to do that is to introduce imperfection into the underlying theory.

Amy:

So instead of super symmetry, it would be super asymmetry?

Sheldon Cooper:

Super asymmetry. That's it. Give me your lipstick.

John Dickson:

That's the world's most popular theoretical physicist, Sheldon Cooper from the Big Bang Theory. It's sometimes pretty fun, not least because it popularizes some pretty heady concepts, but also because it often links science to the emotions, to enthusiasm, though perhaps not in the poignant way you heard earlier from Andrew Wiles, whose proof of Fermat's last theory led him to wonder in awe and tears. Professor Tom McLeish is eager to point out that science need not be the emotionless world of pure rationality that some think it is. Emotion is in fact key.

John Dickson:

One of the things you draw from the medieval world is the role of emotion in science or to use the medieval terminology, the affections of knowledge. So some of my listeners might be puzzled that there would be any connection between science and emotion. So can you help us out? What's the relationship between intellectual insight and desire, emotion?

Tom McLeish:

Surely. Absolutely. Well, this was one of my most delicious discoveries, right, doing the research for this book, because I was interested in scientists talking about their creative process and then realizing that it was my creative process and I was like, "Art is a creative process." There is this [inaudible 00:49:16]. And then I noticed that everybody, when they told these stories, these personal stories, whether they were poets or whether they were mathematicians or astronomists, would inject emotion into the telling of it. Actually, sometimes they would weep. It's a recapitulation of what they'd known before when it first happened. It's that sort of shadow emotion. But in any case, all of them described different emotions, engaging at different stages with their intellectual pathway. And I thought, "Who's written about this?" And let me sort of go back. And actually, it's the clearest articulation of this. So I found it. Guess who? Robert Grosseteste. Back again. There we are in the [inaudible 00:49:58]

John Dickson:

That's [inaudible 00:49:59]

Tom McLeish:

They know about this, and they write about this affect or some aspect, which is, excuse me, the affect, the emotion and sight, it's slightly rotated around a bit, but that's basically what it is. And it's golden, honestly. And it maps onto the most honest stories I've had before. So just think about how difficult it is to bring something, this miracle of bringing something de novo into the world. It's never existed before. Whether it's a poem or a play or whatever it is, it's hard. Yeah. It's hard work.

Tom McLeish:

It involves huge amounts of labour and massive disappointment and getting nowhere for ages. If that's not fuelled by desire and a sort of love, without the emotions, the most cerebral of people don't have the fuel in the tank to see things through. And of course, there are other emotions in the way. There's joy when you see something and then there's despair when it all goes away and a puff of logic and no, that's no good, and darkness of despair and grief if nothing happens forever. And then this little tingling, tingling feeling of hope, hopefulness and joy when you think, "Oh, perhaps there is a way through to solving this problem after all."

John Dickson:

This interweaving of the rational and the emotional challenges common ideas about the structure of the brain and fits much better with the latest neuroscience. The idea that the humanities are more emotional than the science just isn't right.

Tom McLeish:

So that was honestly my prejudice. I was expecting that. And I couldn't write that. I had to write what I found, which was that the whole creative process, the cognitive or cerebral aspects are so tangled up with the emotive or affective. You can't tease them apart. And I realized actually, we're whole beings. Of course, we are. We're whole minds.

Tom McLeish:

Our emotions and our minds and our rational minds, it can't be teased apart. They're part of the same thing. And in fact, you could even ask the neurology, there's some pseudo neuroscience, which says left brain, right brain, emotions are right. No, that's not how that works either. You can show that both hemispheres of the brain light up in both cognition and emotion. So I'm sorry, guys. There is absolutely no evidence, circumstantial evidence in terms of narrative or experience or even neuroscience that points to this separation. And that's something which surely can, I hope, just retell the human story of science because we've got ourselves into a mess. We've told a lie about science. We've said, "It's not emotional. It's purely logical. It's not creative." And I know this because this is what the school kids have told me. And this is why they don't choose science and my heart breaks because we've just sold them a bummer. We really have. If we were more truthful, we'd find lots of great young people engaging with science and finding much joy in it.

John Dickson:

And am I right that in this 13th century model of affections and cognition, they're recursive?

Tom McLeish:

Yes.

John Dickson:

That is, the affections do have to be schooled by knowledge and knowledge has to be directed by properly schooling affections.

Tom McLeish:

Yes. Yeah. And not only are they need to be schooled, they're also moral. There's a whole ethical dimension behind this [inaudible 00:53:24].

John Dickson:

Yeah. Because desire.

Tom McLeish:

Absolutely.

John Dickson:

The love of the good.

Tom McLeish:

Right.

John Dickson:

The love of the good.

Tom McLeish:

And the hate of the bad. So hate is important emotion as well. So role of hate is to drive us away from what is bad. And the role of love is to attract us towards what is good. But we know we also rationalize what is good and bad. So there are ways in which we can rationally direct our emotions. We need to be mistresses and masters of our emotions in order to live full human beings, as human beings, not only as individuals, but in families, societies too. But our emotions need to energize and drive our cognitive facilities too.

John Dickson:

This leads to what someone think is a controversial question. This idea of the love of the good raise the question of the purpose of science. Many people say science doesn't have a telos.

Tom McLeish:

Yeah.

John Dickson:

It only has a holos, a way, a method.

Tom McLeish:

Yeah.

John Dickson:

I know you don't agree with that. So what is the purpose of science, Tom?

Tom McLeish:

[inaudible 00:54:30]. Well, of course, I have to think about it.

John Dickson:

I wrote The End of Science. Pun intended. I love the word end, meaning both telos, being the end of the road, but also the purpose, the end of where we're going. And so I wanted to explore this very much and the reason I wanted to explore this is because although purpose has been driven out of academy in the last, well, generations, you're not supposed to talk about purpose, whether you're a humanities scholar, whether you're a scientist.

Tom McLeish:

And even biologists have particularly developed... Because evolution looks so purposeful, biologists have developed a sort of rhetoric for covering themselves. Yeah. It's a neat shorthand. These beaks evolved for the long-billed for the purposes of getting insects out of things. However, human beings act purposefully all the time. This is my empirical observation. I'm not being a theorist when I say that.

Tom McLeish:

I'm just being a humanist. I'm just being interested in human beings. Even my friends who deny free will, and I have several friends who denied the existence of free will, don't live as if they denied free will. They live as if they had it enacted purposefully and followed ends deliberately and made choices towards an end. So I know we need to talk about purpose and of course, absolute cards on sleeve, a purpose of a system, an end of a system, I suppose can be all agents in a system could decide on our purpose, but purposes are much more set by external, by creators. And so that's where theistic thinking I think helps because I think we have tools. I think a Christian approach to academy has certain academic analytical tools at our disposal that atheist approach does not have.

Tom McLeish:

And one of those tools is the freedom to be allowed to talk really meaningfully, constitutively about purpose, including an externally framed purpose, including a moral purpose. Because I found being a

Christian actually in this way, in many other ways, one of the reasons I found it intellectually enriching and intellectually creative. And so we can talk about the purpose of science within a theistic framework. I found that sits with a larger question. What's our purpose as human beings? And our purpose as human beings has a big clue in our biblical story of being made in the image of God. And I've thought for a long time about what it means to be made in the image of God. The Imago Dei has been expanded, of course, for centuries by theologians. Does it mean we have a moral right or a wrong? Does it mean we have loved? Does it mean we have sacrificed? But the first thing that God does in the biblical story is create something.

Tom McLeish:

So I would've thought that the first interpretation that you might want to make or be made in the image of God is that our role is to be actors, creators as well. And then when you think, "Well, what should we create? What do we create? Can we create beings and universes?" Well, no, God does that. But in so far as human beings are made in God's image, our purpose, God's self-made purpose is to design the world, design and create the world to love and to act in love and to be in a relationship with him. Our purpose, if we're in God's image, maybe it's to create an image of the world in a way that will help us to serve each other and the world and the material world. And I think, well, actually, that's really helpful because what is science if it's not the creation of an image of the world? Physics talk about electrons.

Tom McLeish:

We don't rub up against. We don't immediately experience an electron in its bare material, natural, weird, inhuman, what George Steiner called the sheer inhuman otherness of matter, but we get as close as we can to it when we talk about our model of an electron. We've created an image of the electron. That's what we're talking about. And the more we learn about electrons, the more we hope our picture of electron will look more and more like the real one, but that's what we do. And there's a sense in which our scientific purpose is to create this image of the world so that we can serve God better in the world.

Speaker 15:

The book of Job, Chapter 28, "People assault the flinty rock with their hands and lay bare the roots of the mountains. They tunnel through the rock, their eyes see all its treasures. They search the sources of the rivers and bring hidden things to light. But where can wisdom be found? Where does understanding dwell? No mortal comprehends its worth. It cannot be found in the land of the living. The deep says, 'It is not in me.' The sea says, 'It is not with me." It cannot be bought with the finest gold nor can its price be weighed out in silver. It cannot be bought with the gold of Ophir, with precious onyx or lapis lazuli. Neither gold nor crystal can compare with it, nor can it be had for jewels of gold. Coral and jasper are not worthy of mention. The price of wisdom is beyond rubies. The topaz of Cush cannot compare with it. It cannot be bought with pure gold.

Speaker 15:

Where then does wisdom come from? Where does understanding dwell? It is hidden from the eyes of every living thing, concealed even from the birds in the sky. Destruction and death say, 'Only a rumour of it has reached our ears.' God understands the way to it. And he alone knows where it dwells for he views the ends of the earth and sees everything under the heavens."

John Dickson:

You frequently point people to the book of Job. What an earth has an ancient text like that got to do with a lovely scientist?

Tom McLeish:

Well, look, here's the thing. Think about music. If music is really deeply part of being human, then we would've expected to have been deeply part of being a human for as long as we've been human. And although I don't think 3000 years ago anyone would've made anything out of a Mozart symphony, let alone anything by Bartók, we find wonderful evidence that stringed bows, we use these instruments, that horns were drilled, little holes in the side where fingers could stop, and lo and behold, they make the same notes that flutes and recorders make now. And this is from 20 or 30,000 years ago. So music, because it's so deeply human, becomes identifiable in the past as on the... Not as the music we know as we play music now, but on the journey towards it. So you know what I'm going to say. If science or what we call science now by another name in different ages is so deeply human.

Tom McLeish:

It drives us to look into the structure of the world to create this image of it. It's part of what we mean. You'd have expected that same drive to appear yes, in different forms, but also on the road to science we have now in different ages. And so it proves to be. So the book of Job is the science, what that ancient reindeer flute is to music, I think. And therefore it is of interest to scientists to know where our scientific drive comes from. Job 38 to 42, which is I think the most beautiful, extraordinary, deep nature poem in all of the coming out, all of the ancient world, is doubly significant for science because it's a poem whose every stanza is a question. And as we've talked about before, it's questions, the imaginative questions, which are like the axe strike that chips the rock in the right plane, or that cuts the wood in the right plane.

Tom McLeish:

The creative question is the important step in science, not so much the answer, which follows later. So questions are, "Do you know where the hail or the ice comes from, the storehouses of light? Can you come on the date I've drawn? Do you know the laws of heavens? And can you apply it with the earth?" That's a question in Job 38. These are questions which are foundation questions to science. And I think it's deeply important that they come from this ancient Hebrew text about the awkwardness and chaotic, apparent inhumanity of the world, which touches with our current questions about the chaotic and difficult relationship we have with the mature world around us. So actually, I think it's very relevant and very important.

John Dickson:

Tom has a passion and affection in the medieval sense for opening up science to everyone. For him, it's almost like a religious mission as it was in the middle ages. He speaks of science as a palace with many entrances. He tells me that he first picked up this idea from Andrea Wulf who received a prestigious award for her biography of the German scientist, Alexander von Humboldt, titled The Invention of Nature.

Tom McLeish:

The Royal Society, we have a science writing book prize every year. You can imagine, it's been like the Oscars for contestants and they read 10 minutes from their books. And then Brian Cox gets up with the envelope to a great flashing lights and sound. And the winner is Andrea Wulf for Inventing Nature.

Brian Cox:

The winner is Andrea Wulf.

Tom McLeish:

Then we have the Prosecco afterwards. Yeah. And I go up to Andrea. I say, "Congratulations. Who are you looking forward to telling about this award?" And she said, "I'm looking forward to telling my German chemistry teacher in my former school. She's still alive. She's a very old woman, but I want to tell her." And I said, "Well, Andrea, that's lovely." She said, "No, it's not nice at all because this was the woman who told me I was stupid girl. I would never understand science. I should write about cookery and gardening and stick to those pursuits." And she said, "Yeah. You said it's true that I had difficulty at school, but I know I can understand science because I've had to understand Humboldt's very subtle science."

Tom McLeish:

And then she said this beautiful thing. She said, "Science is life. It's a beautiful palace," she said, "with hundreds of doors. But," she said. "At school," she said, "We only show kids one door and we can't go through that door. I could go through another door, which was writing biography. And since then I said, 'Well, one of my purposes is to hack the thorns away from those other doors to find other doors into the palace of science that other people can go to, that aren't just the usual school course.'"

John Dickson:

If you like what we're doing here at Undeceptions, perhaps you'd consider a donation to help us with the cost of the show. We have our Undeceptions Plus program, which you can find in our website, but if you don't want all those extras and you'd like to just give us a one off donation, I'd really appreciate it. Just go to the website, udeceptions.com, and you'll see an oversized donate button. We're always looking at ways to expand and improve this show and what you contribute really does make a difference. And I appreciate it.

John Dickson:

Next episode. Well, it's this season's Q&A, and you've served up some of your trickiest questions ever. "Why is Israel so special? Why won't sin get in the new creation just like it did in the first creation? If God knows everything, why bother praying? How do we square dinosaurs in the Bible?" Plus tons more. In fact, I'm way behind telling Producer Kaley how I'm going to answer them. So maybe I'll just ad lib. See you. Undeceptions is hosted by me, John Dickson, produced by Kaley Payne and directed by Mark [inaudible 01:07:18] Hadley, editing by Richard Hamwi, social media by Sophie Hawkshaw administration by Lyndie Leviston. Our online librarian is Siobhan McGuiness. Special thanks to our series sponsors, Zondervan Academic, for making this Undeception possible. Undeceptions is the flagship podcast of undeceptions.com, letting the truth out.

John Dickson:

An Undeceptions podcast.