

INTRODUCTION: Disturbed by the Thought of Philosophy

The titan Prometheus defied the gods to give human beings the gift of fire. It was a dangerous magic with the power to hurt, destroy and transform, which gave us warmth, light and comfort. Prometheus's magic fascinated us and still does. In gratitude for his gift, we devised a philosophy in his honour named 'materialism'.

Physical science has allowed us to find innumerable technological applications for Prometheus's gift, as has precision engineering and many other endeavours that are not physics. The current manifestation of the materialist philosophy maintains that physical science tells us the ultimate truth about reality. Materialism dominates our world as secular common sense when it comes to philosophical matters. Outside of academic philosophy, it is very widely supposed that everything that exists ultimately consists in the particles and forces described by physics, and that existence itself began with the Big Bang. Where there is disagreement with this picture, it is most likely to have religious inspiration. Materialism is the respectable default within today's academic philosophy too, in that it is the only philosophy of the nature of reality which can be presupposed without argument in a journal article, with any suggestion of difficulties for materialism being automatically deemed worthy of interest. Materialism, as Hilary Putnam observed in the 1980s, and as is no less accurate today, is the only metaphysical philosophy with 'contemporary "clout"'.¹

Given this situation, you might be forgiven for expecting scientists, and especially physicists, to love philosophy. But although many working scientists do indeed, the message being sent out about philosophy by the most prominent public spokespeople of science in their popular

books, broadcasts, interviews, and – increasingly – social media, is so thoroughly negative as to be puzzling.

The best-known example is:

Philosophy is dead.

Stephen Hawking said that – the greatest hero of recent science, who overcame debilitating illness to revolutionise our understanding of black holes.² Why did he say it? Because he did not think philosophy had kept up with the latest developments in physics. But why should it? Division of labour requires that chemists focus on chemistry, accountants on accountancy, and philosophers on philosophy. Imagine there being some future breakthrough in biology which is relevant to physics, but which physicists ignore. It might then be appropriate for a prominent physicist to chastise their own profession for not keeping up with developments in biology, but not for a biologist to declare that physics is dead. Hawking's statement suggests that philosophy is unique among academic disciplines, other than physics, in being something physicists know best about; and materialist philosophy does say something in that vicinity. Despite what Hawking believed, however, many philosophers have gone to extraordinary lengths to keep up with contemporary science, and particularly physics.³ If he was just badly informed, and a philosophical focus on physics is what matters most, then what he should really have said is that philosophy has never been healthier.

Astrophysicist Neil deGrasse Tyson agrees wholeheartedly with Hawking's statement.

During a knockabout interview in which a variety of philosophical questions had been discussed, and practically nothing else – for example, Tyson speculates about whether the

universe is a computer simulation, and if it was, whether he would choose to stay within it (he would not) – the interviewer mentions that he studied philosophy at university. Tyson immediately butts in:

That can really mess you up!⁴

They all proceed to laugh at how ‘futile’ philosophy is, with the interviewer calling it ‘a fat load of crap’, and Tyson correcting the suggestion that it is good for comedy, since ‘you need people to laugh at your ridiculous questions’. He tells the one about the scientist and the philosopher crossing the road – the scientist says to the philosopher:

Look, I got all this world of unknown out there. I’m moving on. I’m leaving you behind. You can’t even cross the street because you are distracted by what you are sure are deep questions you’ve asked yourself. I don’t have the time for that.

Here we see to the heart of his sentiment: keep moving on and never let philosophical qualms get in your way. The story might have ended with the scientist being run over. According to Tyson’s history, however, philosophy once helped science to move on before it was left behind by the scientific revolutions of the 1920s, after which it became a hindrance. And yet ever since the late 1950s, when Tyson was born, philosophy has embraced materialism.

The particle physicist Brian Cox has said:

I don’t ‘do philosophy’ in the same way that I don’t ‘do homeopathy’.⁵

Homeopathy has been scientifically discredited – after a substance has been diluted to the prescribed levels it is ineffective. But since there is no testable claim that all philosophy relies upon, this makes you wonder what Cox thinks philosophy is. The answer both he and Tyson are working with, I suggest, is that philosophy is anything you *cannot* scientifically test. When discussing the origins of reality, for instance, Cox says there is some speculation among scientists that the Big Bang may not have been the beginning of the universe, since the universe may have always existed. Then he says: ‘Whether or not this would be a satisfying answer is up to you. I’d be comfortable with it.’⁶ What he must mean by a ‘satisfying answer’ is a philosophically satisfying answer, since he cannot be allowing that the science could ever be a matter of personal satisfaction and comfort. That would explain the comparison to homeopathy. The believer in homeopathy ignores science because they find homeopathy satisfying, just as the philosopher ignores science because they find certain philosophical views satisfying. Not all reasons are scientific reasons, however, and philosophy is famous for its focus on arguments and reasons. I expect Cox thinks long and hard about non-scientific reasons when deciding how to vote, for example.

According to biologist Richard Dawkins, the physicist Lawrence Krauss’s book *A Universe from Nothing: Why there is Something rather than Nothing*, may deal the deadliest blow to religion since Darwin’s *On the Origin of Species*.⁷ From ‘staggeringly beautiful experimental observations’, as Krauss puts it, he discovered that ‘getting something from nothing is not a problem’. Since the idea of observing nothing is very puzzling, Krauss realises he needs to say something about philosophy at the start of the book:

I have learned that, when discussing this question in public forums, nothing upsets the philosophers and theologians who disagree with me more than the notion that I, as a scientist, do not truly understand ‘nothing’.⁸

He then presents a philosophical argument:

For surely ‘nothing’ is every bit as physical as ‘something,’ especially if it is to be defined as the ‘absence of something’. It then behoves us to understand precisely the physical nature of both these quantities. And without science, any definition is just words.

If ‘nothing’ has a physical nature then ‘nothing’ is something with a physical nature. If that is ‘just words’ then what Krauss said is too, since there is no science behind it. It seems to me that if you want to avoid philosophy, you cannot do so by making ill-considered philosophical claims while showing disdain for philosophy, any more than you can avoid a game by playing it badly and saying you do not like it. If Krauss is uninterested in the philosophical question – which I find hard to believe given the area he went into – then why do everything possible to create the impression that this is the question he has answered, while letting Dawkins talk about religion at the end of the book? He could have easily avoided the issue by claiming to have shown how the universe sprang from a ‘minimal something’, for instance. That he did not reveals the influence of the materialist philosophy: he was driven by the thought that physics cannot be allowed to leave such a large and obvious mystery unaddressed. When David Albert, a philosopher of science with a solid background in theoretical physics, reviewed the book to point out that Krauss’s understanding of ‘nothing’ obviously has a very strong bearing on the philosophical issue,

Krauss called him a ‘moronic philosopher’. He later apologised, while restating his claim about definitions needing science, and saying that philosophers who cannot accept this do not interest him, the others being okay.⁹

Not all public physicists are quite so negative about philosophy, but the need to pass judgement on it does seem to obsess them. Going back in time a little to the 1990s, we find a chapter of Nobel laureate Steven Weinberg’s book, *Dreams of a Final Theory*, entitled ‘Against Philosophy’, in which he does at least find a positive use for it: for dismantling philosophical preconceptions which get in the way of science. The ultimate goal of this task would presumably be for nobody to think philosophically about science anymore.¹⁰ But if we go back even further, we see what a recent phenomenon this all is. Consider the most acclaimed publically-engaged physicist of all, Albert Einstein:

A knowledge of the historic and philosophical background gives that kind of independence from prejudices of his generation from which most scientists are suffering. This independence created by philosophical insight is — in my opinion — the mark of distinction between a mere artisan or specialist and a real seeker after truth.¹¹

Einstein was always interested in philosophy and made it his business to converse with philosophers, fully aware that his work had many possible philosophical implications which needed to be worked through and rationally debated.

But perhaps we should put aside physics to see if a rosier view of philosophy is presented by spokespeople for other sciences. Psychologist Stephen Pinker delivers just that throughout his various works, but even here there is an important caveat:

Today most philosophers (at least in the analytic or Anglo-American tradition) subscribe to naturalism, the position that ‘reality’ is exhausted by nature, containing nothing ‘supernatural,’ and that the scientific method should be used to investigate all areas of reality, including the ‘human spirit’.¹²

He is not wrong. But what he means by ‘naturalism’ is basically materialism, since as many of his writings make clear (I discuss Pinker in chapter 5), he would count any philosophical view of reality with a non-physical component, such as idealism or dualism, as committed to the supernatural. So what we see here is some reassurance being offered to readers: ‘don’t worry about philosophy because it is respectably materialist these days.’ We finally see some appreciation being shown for philosophy’s turn to materialism. It is no longer poisoned by archaic, anti-scientific nonsense, because it recently made the right choice in a debate that existed in ancient Greece.

Pinker is quite the exception, however. Biologist Edward O. Wilson, despite being very positive about the humanities in general, has this to say about philosophy:

I like to say that most of philosophy, which is a declining and highly endangered academic species, incidentally, consists of failed models of how the brain works.¹³

He said this while trying to justify his own parallel move to that of Krauss, namely to show that science can solve a traditional philosophical problem, this time the meaning of life.¹⁴ The statement itself is very odd, however. Since models of how the brain works have not loomed large in the history of philosophy, what he must mean is that when philosophers thought they were theorising about reality, knowledge and morality, for example, they were really, unwittingly, trying to understand the workings of human brains and getting it wrong. Brains are part of reality, however. So if you need to know about the workings of brains to know about reality, then you must need to know about the workings before you can find out about those workings, which is impossible.

Richard Dawkins says that, 'At its best, philosophy can aid understanding. At its worst, its jargon supplies a handy toolkit for charlatans to bamboozle the innocent'.¹⁵ That is fair comment, but it should be added that dressing up philosophical opinion as scientific fact provides a particularly powerful toolkit for bamboozling the innocent at present. But even Dawkins, thoroughly embroiled in philosophy as he is, has not been able to resist the urge to make a blanket denouncement:

Philosophers' historic failure to anticipate Darwin is a severe indictment of philosophy.¹⁶

And yet the concept of natural selection has a history stretching back to Empedocles.¹⁷ There were over two thousand years of philosophical anticipations, but Darwin was a biologist, so philosophers could not have been expected to anticipate his biology. They were quick to read philosophical significance into it, however, with Nietzsche being a good example.

All of the scientists mentioned above write books which make philosophical claims. Some are full to the brim with philosophy, as you might expect from titles like Wilson's *The Meaning of Human Existence*, Krauss's *A Universe from Nothing*, Hawking and Mlodinow's *The Grand Design* and Dawkins' *The God Delusion*. This makes their denouncements of philosophy particularly puzzling. Academic philosophy has never been more materialist, and this builds deference to science into the discipline in a manner not encountered in other areas of the humanities. Similar philosophical commitments are widespread outside the academy, except where religious beliefs prevent them. So the atmosphere has never been more conducive to reading philosophical significance into scientific knowledge, which seems to be exactly what these scientists want to do. And yet they denounce philosophy and, presumably, do not think they are making philosophical statements.

What we are seeing, I think, is the influence of the materialist philosophy. It only became established in the English-speaking world in the middle of the 20th century and has now reached maturity. The present generation of public scientists have thoroughly absorbed it, just like the rest of us, and it says that science is the best route to truth. So as scientists, they have been encouraged to feel they are the only ones with a right to talk about philosophy. This provides a personal motivation for their attacks on the non-scientist philosophers, who, while they still exist, pose a disconcerting threat to their freedom in this regard. But I think it goes deeper than that.

The deeper explanation is that to acknowledge that there is a legitimate area of concern called 'philosophy' gets too close for comfort to recognising that their materialist convictions are philosophical. For if materialism is a philosophical view, and it might be a false one, then there might be philosophical questions about reality which science cannot address – big ones,

like why the universe exists or the meaning of life. A wholesale denouncement of philosophy removes any potential for having your materialist convictions challenged. So I think the scientists most inclined to denounce philosophy are those with the deepest, most uncritical love of it – but only philosophy of one particular kind. Since materialism is not science, the thought of philosophy disturbs them. When they denounce philosophy, they yield to the demands of their own.

The reason I do not take these denouncements lightly, as many might think I should, is that they seem to me symptomatic of a wider situation in which philosophical reflection is coming to seem less and less important, while the power of science and technology to change the basic conditions of human life are rapidly increasing. I think this is a bad combination, because as more technological transformations of the conditions in which people live their lives become possible, the more we should be philosophically reflecting on which of the transformations we want to enact. The more we *can* do, the more we should reflect on what we *want* to do – where the ‘we’ who should reflect is ‘as many people as possible’. It seems to me that materialist philosophy actively discourages the kind of widespread philosophical development we need in order to keep pace with technological development and thereby allow it to improve our lives in a rationally constrained and popularly mandated framework. I also think materialism is false, which is an excellent traditional reason for not believing something and thereby allowing it to alter your behaviour.

Hawking said ‘philosophy is dead’, but look at the kind of concerns he expressed in *A Brief History of Time*, when connecting Darwin’s theory of evolution with the quest for a single, unified theory in physics:

It has certainly been true in the past that what we call intelligence and scientific discovery have conveyed a survival advantage. It is not so clear that this is still the case: our scientific discoveries may well destroy us all, and even if they don't, a complete unified theory may not make much difference to our chances of survival. However, provided the universe has evolved in a regular way, we might expect that the reasoning abilities that natural selection has given us would be valid also in our search for a complete unified theory, and so would not lead us to the wrong conclusions. Because the partial theories that we already have are sufficient to make accurate predictions in all but the most extreme situations, the search for the ultimate theory of the universe seems difficult to justify on practical grounds. (It is worth noting, though, that similar arguments could have been used against both relativity and quantum mechanics, and these theories have given us both nuclear energy and the microelectronics revolution!) The discovery of a complete unified theory, therefore, may not aid the survival of our species. It may not even affect our lifestyle. But ever since the dawn of civilization, people have not been content to see events as unconnected and inexplicable. They have craved an understanding of the underlying order in the world. Today we still yearn to know why we are here and where we came from. Humanity's deepest desire for knowledge is justification enough for our continuing quest. And our goal is nothing less than a complete description of the universe we live in.¹⁸

He says 'our scientific discoveries may well destroy us all'. Like the rest of us, it does not keep me up at night; news about nuclear proliferation occasionally invades your consciousness then floats away again – most of us have never known any different. But there is clearly an important debate to be had about whether we actually want physicists to press on

towards their final theory, if doomsday is the risk involved. All that craving to understand which he talks about might well be considered a very minor factor to consider if a debate were to transpire among all the relevant stakeholders. Perhaps the yearning is more philosophical than scientific. Perhaps the latter is largely confined to the scientists doing the research, and most people, unable to understand it properly anyway, only really care about the technological consequences and how they change their lives. Would they be wrong to think that? Would asking for some restraint show that people do not know what is good for them, or are showing insufficient gratitude to science?

The great jazz saxophonist Sonny Rollins has said:

Everything about technology, folks, is not good. Hate to tell you, folks, but it's not all good.¹⁹

The way he says it ('Hate to tell you, folks') is a reminder that these days, it needs to be said again, and again, and again. Natural positivity and optimism about life, combined with one-sided views tirelessly promoted by those with vested interests, make it all too easy to forget. The occasion for Rollins' comment was provided by a spoof article purporting to be a confessional piece he had written, which was widely circulated on the internet (it 'went viral'). The article portrayed him as someone who hates jazz and believes himself to have 'wasted [his] life' – infantile, but no big deal. But deep down we all know that internet technology is 'not all good' and that this is sometimes a really big deal. We know this because it changed our lives and we know what our lives are like now. Hours spent trying to get your computer working again are not good hours; an inbox full of hundreds of emails will rarely make your spirits soar; attempts to trick you popping up onto your screen are

annoying; worrying about an illustrated encyclopaedia of depravity and malice at the end of your children's fingertips is a problem we never used to have. Quite possibly it made things better than they were before, although I remember no beautiful emergence from a cocoon during those years when I, like the rest of my generation, started using the internet. There was certainly no widespread, all-consuming debate about whether we should transform our lives in the widespread, all-consuming way we have. Now far greater transformations are envisaged, and they are engineering projects, not propositions to consider. A more balanced, rational and pro-active attitude to technology needs to develop among its consumers, and a more balanced and rational attitude needs to develop among its producers.

This is a standard theme in the philosophy of technology. Hans Jonas advocated a new, more consensual ethics developing around technological development, and many others have followed suit.²⁰ But philosophy of technology remains a minor area within the wider academic discipline. Langdon Winner felt justified in saying, back in 1986, that 'the most accurate observation to be made about the philosophy of technology is that there really isn't one'.²¹ Whatever truth there was in that – it depends on his view that there was 'little of enduring substance' in the thousands of books and articles he surveyed – things are changing. Increasing numbers of philosophers now put their minds to the question Jonas and Winner prioritised, namely how to establish limits in a world in which science and technology are continually expanding the scope of what it is possible for us to do. To make these efforts practical requires being adequately informed about the working practices involved in technological development, as well as the funding decisions that get them started, and much collaboration now takes place with the interdisciplinary field of Technology and Science Studies.²² A discipline of Engineering Ethics has been established (Langdon found such considerations to be completely alien to engineers in 1986²³), as well as Computer Ethics,

Nanoethics, and various other subdisciplines devoted to specific developing technologies.

There is a *Centre for the Study of Existential Risk* at Cambridge University, co-founded by a philosopher (Huw Price), an engineer (Jaan Tallinn) and a scientist (Martin Rees), as well as philosopher Nick Bostrom's *Future of Humanity Institute* at Oxford University.

Such developments are to be welcomed without reservation, but they face a very serious uphill struggle. As a member of the public, one who actively listens out for this kind of thing, I have noticed no sign of widespread, all-consuming debates starting to materialise over the particularly dramatic new technologies currently envisaged. When I hear politicians mention artificial intelligence, they are talking about the economic benefits which they promise not to allow my country to miss out on. When I hear about major developments to neural implantation technology, this is because it holds out the prospect of curing Parkinson's Disease – an exceptionally powerful pro, now what about the cons? Concerns are always dismissed, typically seen as a source of amusement or sign of ignorance; details and arguments are always absent. I do not feel I am giving informed consent to developments that will fundamentally alter the future of human life, and I very much doubt that this is because I am a philosopher, rather than an airline pilot, nurse, architect or builder. It seems to me that something very dramatic is going to have to change before this process of radical change can be considered remotely democratic.

I am not silly enough to think that academic philosophy will lead the way. Plato tried some direct action and regretted it on his return from Syracuse. Academic philosophy exerts its influence more indirectly, as vague contours of new ways of thinking gradually catch on to alter behaviour in the long run. What I do think, however, is that 'philosophy' in a more general sense, one which explains why there is an academic discipline, is something that

could spread far beyond the academy to make a decisive difference to how human beings develop in a technological world. It is well-placed to do that because it is neither science nor religion, but can rationally reflect on both. I defended this conception of philosophy in my previous book, and I also published a paper defending it in the appropriate academic journal. It is a task very few philosophers undertake. My leading thought was that there must be some kind of subject-matter which explains why there should be a discipline which encompasses fields as seemingly diverse as metaphysics and ethics. No criticism of my conception of philosophy has ever been made, to my knowledge, so I feel justified in proceeding to work with it, as I shall do in this book. In a nutshell, it is that, ‘Philosophy is the study of a range of related issues concerning knowledge, reality, and moral conduct, which traditionally centre on the question of life’s meaning’; my use of the word conforms to that conception throughout.²⁴

I think materialism is the main philosophical obstacle to philosophy (in my generalist sense) becoming a more widespread, self-conscious preoccupation which might benefit our approach to technological development. Materialism not only blurs the boundaries between science and philosophy, but works to actively discourage the notion of philosophy as a distinct field of interest. It also encourages apathy, in that it is liable to stand against an image of people as conscious free agents who determine their own future by independently thinking through the available options to try to make rational decisions in light of the truth.

Materialism has this in common with another major current of 20th century thinking to which it is instinctively opposed, namely the counter-Enlightenment currents of de-centring thought associated with the likes of Freud, Durkheim, Barthes and Derrida.²⁵ Materialism is similarly attracted to a picture of us as powerless pawns in a game played by nobody. Philosophy, however, is an assertion of rational autonomy, even when that autonomy is being used to

deny itself. And for philosophy to spread, I think, it must draw on the best resources at its disposal, namely the natural interest of the traditional problems of philosophy, which need to be shown as relevant to the problems we face today.

As such, I shall be arguing against materialism, suggesting an alternative, and talking about some traditional problems in light of our contemporary situation. This book is not a specialised monograph on the philosophy of technology, just as my previous book, *Philosophy in a Meaningless Life*, was not a specialised monograph on the meaning of life. Once again, I aim to show the continuing relevance of the traditional problems of philosophy to matters outside the academy, while arguing for particular views on them within it, albeit in a manner that might be understood from without – attempting this balancing act is what my conception of philosophy, and of its value, requires. This time technology is my theme, and the more specific traditional problems are materialism and idealism, freedom, personal identity and truth.

How these topics fit into the overall argument of the book can be understood as follows. Materialist philosophy has exerted major historical influence over how we think about ourselves and our collective future. As the largely unreflected belief-system it has now become, it continues to shape the directions of our technological development, while encouraging us to think these directions are inevitable, that we have no freedom to do anything about it, that seeking truth is a specialist pursuit, and that our very identities are within the scope of technological development; that humanity itself is within that scope, in fact, and might even be worth replacing. Materialism has never been a rationally established philosophy, however, and for most of its history was embraced as a political agenda opposed to organised religion, with the technological advances of the 20th century falsely seeming to

vindicate it. Now it obstructs the kind of widespread public reflection which might break the current deadlock between resigned pessimism and blinkered optimism over the development of radical new technologies. In the poetry of Lucretius, which conveyed materialism from the ancient world to the modern, the myth of the war between gods and titans was interpreted in favour of materialism: in defiance of the gods, materialist philosophy sought technological aid from the titans to improve the human lot. But seeking this aid may result in horror, as we are reminded by Mary Shelley's novel *Frankenstein*, subtitled *The Modern Prometheus*. If technological development is to be driven by collective, rational debate, and the deadlock between pessimism and optimism broken, then we must find balance between gods and titans: between imagination and rational deliberation, and the power to enact our visions. I shall argue that a new, idealist philosophical understanding of ourselves, one which expands rather than challenges everyday understanding, encourages individual reflection, reasserts our freedom, and reflects the kind of lives we now live, would help us to find that balance.

I do not think that the materialist philosophy is an appropriate form of gratitude for Prometheus's gift. The appropriate gratitude is shown through the superlative status in modern life of scientists and inventors, alive and dead. Anyone inclined to doubt whether that status is appropriate, with their central heating, electric lights and flush toilets, smartphone in pocket and hospital within short driving distance, could do worse than to reflect on the doctor, philosopher and scientist Raymond Tallis's memorable question: 'How much of the history of human consciousness is a history of itching?'²⁶ Nevertheless, in the current intellectual climate, the argument of this book is liable to bring accusations of being anti-science, anti-technology, or just generally anti-modern life. I am not sure it will help to say that I am none of these things; in my previous book, it was not altogether effective that I immediately and completely disassociated pessimism from my view that life is meaningless.

But, for the record, I certainly do think that science tells us the truth about our physical environment; I just think such statements are open to competing philosophical interpretations, and that the interpretations are important. I am glad to have been born into an age of high technology and look forward to further developments within my lifetime, such as green technologies. I do not look wistfully back to a supposedly better bygone age; I think I would have been one of the peasants.

So with the preliminaries over, let me tell you what will now follow. In chapter 1, I will try to imagine what a world without philosophy might look like, before introducing the gods and titans myth, and what I shall call the ‘problem of ceaseless technological advance’. In chapters 2 and 3, I will portray materialist philosophy, as well as philosophy itself to some extent, in a hopefully enlightening manner; simply the facts I will recount might be enough to have something of this effect. In chapter 4, I will argue for an idealist philosophy which could replace it. Idealism has acquired a thoroughly bad name during the materialist era, as has metaphysics itself, but I think the version I defend fits in well with how we ordinarily think, as well as with those things we know – and know we do not know – which are most relevant to metaphysical assessment. In chapter 5 I look at the deadlock between pessimism and optimism we currently face over concerns about technological development, and propose philosophical education as a way of breaking out of it. In chapter 6, I argue that we are free, and explain how materialism and superstition have combined to create the false impression that this is impossible. In chapter 7 I argue that – in a manner that requires some explanation given the contemporary connotations of the word – it makes sense to think of ourselves as souls. This understanding is forward-looking, not backward-looking, as I illustrate with a discussion of video games. Then I finish up in chapter 8 with a reflection on the importance of truth, which too many powerful people seem to be forgetting about these days. This

chapter includes a sketch of a utopia, with the final and very short section explaining its significance within the argument of the book.

¹ Putnam 1983: 208.

² He said it with Leonard Mlodinow; Hawking and Mlodinow 2010: 13.

³ Tim Crane (2017a) notes that *The Grand Design*, in which Hawking made this statement, is 'probably Hawking's most philosophical book', and that 'much of the book's own philosophical argument is of a very low standard, and shows a striking lack of reflection on the complexities of what is being claimed'. He goes on to say that 'On the evidence of Hawking and Mlodinow's book, the situation is actually the opposite of the way they describe it: it is the scientists who have not kept up with developments in philosophy. Serious philosophers of science are doing quite well in keeping up with science, as the most cursory glance at the leading academic journals in this area will show.'

⁴ Tyson 2014.

⁵ Twitter, July 21, 2014; he was replying to philosopher Philip Goff.

⁶ This comes from a book co-written with Andrew Cohen; Cox and Cohen 2017: 142.

⁷ This claim is made in Dawkin's 'Afterword' to Krauss 2012a.

⁸ Krauss 2012a: xiii-xiv.

⁹ Albert 2012; Andersen 2012 [interview with Krauss]; Krauss 2012b.

¹⁰ Weinberg 1993: chapter 7.

¹¹ This comes from a correspondence with philosopher of science Robert Thornton in 1944. It is a quotation which has been reproduced in many books and is used to frame the online *Stanford Encyclopedia of Philosophy* entry on 'Einstein's Philosophy of Science', but the correspondence itself is currently only available from the Albert Einstein Archives in Jerusalem.

¹² Pinker 2018: 392.

¹³ Wilson 2014a.

¹⁴ Wilson 2014b.

¹⁵ Twitter, May 18, 2013.

¹⁶ Twitter, February 12, 2014.

¹⁷ See Zirkle 1941.

¹⁸ Hawking 1988: 13-14. The scope of Hawking's 'our' seems to change from 'human beings', when he starts out by talking about the prospect of our destruction, to 'physicists' at the end.

¹⁹ Rollins 2014.

²⁰ Jonas 1979. The need to introduce the democratic process into technological development is emphasised by Sclove 1995 and Feenberg 1999.

²¹ Winner 1986: 4.

²² Pacey 1999 advocates a 'people-centred technology' on the basis of a particularly diverse range of considerations and studies.

²³ Winner 1986: 5.

²⁴ Tartaglia 2016a: chapter 3; Tartaglia 2016b (quotation from p. 301).

²⁵ This tradition is critiqued in Tallis 1999.

²⁶ Tallis 1999: 201.