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The most important thing about science is values

Harry Collins
email: collinshm@cardiff.ac.uk
School of Social Sciences, Cardiff University, UK

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Harry Collins

Abstract: Science is the search for truth about the observable world. But it rests on values. The only thing that can be discovered by observation is the immediate here and now. Otherwise, knowledge about the observable world is based on hearsay, spoken or recorded, about others' observations. Therefore, apart from small and fleeting observations, science rests on trust. Our scientific lives and scientific knowledge depend on choosing who and what to trust. Since we can meet only a few scientists at best, we have to decide whether to trust science as an institution. Science is a good bet *because* it it aims is to create truth, perhaps posthumously; truth is its end as well as its means. In today's world science is vitally important as a check and balance on democratic power and an object lesson for decision-makers. To do good, honest, science is to support democracy in the face of populism.

Keywords:
Observable world; trust; the institution of science; truth; checks and balances; democracy; object lesson for democracy; populism

Once, it all seemed simple

Once upon a time life was easy for the philosophically inclined scientist. Before the Second World War a philosophical doctrine called, among other things, 'logical positivism', stated that there were only two kinds of meaningful knowledge. One kind of meaningful knowledge is true by definition: for example, 'a rainy day is a wet day'; you don't have to go outside and have a look to know if it's true, but it doesn't tell you anything about the world beyond how words are used – it's *analytic*. Another kind of meaningful knowledge is 'a rainy day is a cold day'. You have to observe rainy days to find out if it's true and when you find out you will have learned something new about the world, something *synthetic*. But when we come to 'a rainy day is a good day', there's no way to settle it because it's a matter of values, not facts, or analytic acuity. Life seemed so easy because the pinnacle of synthetic knowledge was based on what you could test through observation, leaving ethics, aesthetics, religion, and that kind of thing as meaninglessness; under this model science was king and values could only get in the way.

The problem

But it doesn't work when you think harder. What is meant by a 'a rainy day is a cold day'? Does that refer to all the rainy days there have ever been, and all there ever will be? If it does there is a problem because you can't observe past days and future days, you can only observe what's happening right here and now and while that must be the most secure form of knowledge you can't do much with it. You might say that you can 'observe' past days so long as people have kept records but then you are no longer observing the days, you are observing the records, and how do you know you can trust them or that you are interpreting the properly? To know the past, you have to know how

trustworthy the record keepers were: were they honest? And you have to know something about your interface with documents and language? So suddenly we're back in the realm of values. It turns out that to know what the past looked like depends on something that, according to that attractively simple accounting of the nature of knowledge mentioned in the first paragraph, is meaningless.

In the early decades after WWII, Karl Popper thought he has solved this problem with his principle of falsificationism. He said that science consisted of putting forward 'bold conjectures' – you claim '*all* rainy days are cold days' – and then you could falsify that claim if only one wet day turned out not to be cold and that is how reality could bear on the observable without trust. Scientific knowledge was what could be falsified but had not been falsified, and that which had no means of being falsified was not science. In sum, Popper tried to establish an 'asymmetry' between corroboration, on the one hand, and falsification, on the other: corroboration was not possible without trust whereas falsification was possible with a single immediate observation.

Popper's 'falsificationism' is a very powerful idea: if you tell someone that their claim or idea is not falsifiable it mostly acts as a strong and worthwhile criticism. Unfortunately, the asymmetry on which the idea is based does not hold up. Suppose you went out on a rainy day and it felt warm? How could you be sure it really was raining from the heavens and not someone's domestic shower pointing out of a window? How could you be sure you had not been given some mind affecting drug? How could you be sure you were not living in *The Truman Show* or *The Matrix*? It turns out that to falsify something you need another raft of related investigations, and these will also depend on trusting other people or ideas. Indeed, think of any laboratory experiment that you have done: even if you can convince yourself that you are really seeing what you are seeing, if you use any kind of materials or instruments in the experiment, you have to trust all those theories that go into the making the things you are using and all those people who put them forward and tested them.

You can *feel* this problem for yourself whenever you do an experiment. Mostly experiments don't work and when one doesn't work you tend to try it over and over until it does give you the kind of result you expect. So even to say you have done an experiment adequately depends on you trusting the sources that tell you what the result should be. Why, when an experiment goes wrong, don't you immediately say, 'I've done a negative replication'? And when should you say you've done enough to claim a negative replication has been conducted?

At the frontiers of science this is a practical problem because if people are arguing about what the right result should be you have the 'experimenter's regress': to know you have done the experiment right you have to know what the right result is supposed to be, and this goes round and round when you are at the frontiers of science because knowing what the right result is supposed to be is the very point of the experiments you are doing. This means testing results by replication of experiments is a much more complicated matter than it seems. Scientists wind up trusting one lot of experiments and distrusting another lot for all kinds of value-laden reasons.[1] In sum, a scientific finding does not stand on its own, but depends on a whole raft of assumptions that have to be taken on

[1] My book, *Changing Order* (Collins 1985/1992), explains all this with examples drawn from field studies.

trust, so values are right at the heart of science: you can't have science without values. These are sciences' '*internal values*'.

This allows science to work

In less than 1,000 words we have come a long way from the first paragraph or two. There it was being claimed that the bottom line of knowledge about the world was science, with ethics and other values being meaningless or, at least, mysterious, in respect of where their warrant comes from; now we have reversed the priority and we are saying that values are the foundation of science! As someone who has spent a professional career studying how science works, I have been surprised how secure I feel now I have argued myself into this position. The position is that the founding warrant for science is its values not the other way round.[2]

Actually, the position has a nice positive side to it because it allows us to rescue the ideas of corroboration *and* falsification from their philosophical contradictions and from their mutual antagonism. 'Yes', a claim is still open to the objection that it is unfalsifiable, and it should be, because falsifiability is one of the internal values that motivates and constitutes science: we strongly prefer to put forward claims that are potentially falsifiable even if there are some scientific claims that aren't clearly falsifiable and even if there are always problems in pinning a falsification down. The idea of falsifiability doesn't provide a clear demarcation criterion between science and non-science, but it does indicate what you should aspire to if you want better science. The same goes for corroboration and replicability: neither work in a straightforward way, but as soon as you stop caring about them you have stopped doing science – they are crucial scientific values.

Some contemporary examples

In case this all seems abstract, even though I have tried to tie it down to laboratory practices familiar to early-career scientists, let me provide a few examples from my 45-year long field study of the detection of gravitational waves. In a paper called 'Tacit Knowledge, Trust and the Q of Sapphire', published in 2001, I describe how the transfer of the ability to measure the quality factor of sapphire crystals from Russia to the West depended on visits from a Russian scientist who acted in such a way as to cause scientists at Glasgow University to trust his abilities and veracity under circumstances where events would normally cause distrust (Collins 2001). In my book describing the first detection of gravitational waves, *Gravity's Kiss*, published in 2017, I describe the five months of work that went into convincing the scientists and the scientific community that the vestigial signal detected on14th September, 2015, really was a gravitational wave (Collins 2017). Among other things, they had to reach a 5-sigma level of statistical significance. 5-sigma is itself based on a value judgement: publishability in most science is accepted at a level of 2-sigma; in physics it was 3-sigma in the 1960s, growing through 4-sigma to 5-sigma more recently and 5-sigma has been agreed on in the hope that such an unlikelihood will swamp various unknown systematic errors. This is because any such statistically-based warrant is itself based on a raft of other assumptions that have to be ignored, such as who

[2] For the most forthright statement of this position see Collins and Evans (2017).

else is doing similar statistical work which might vitiate the result because of the 'trials factor'.

I describe the way the committee set up to determine if the 'signal' could have been an artifact inserted by hackers into the interferometers, concluding that it could not have been, as it would depend on an *implausible* betrayal by project insiders. I describe the announcement of the discovery at CERN where a member of audience pointed out, correctly, that everything claimed depended on the fact that gravitational waves travelled at the speed of light, something that had never been directly shown, but that another member of audience warned that if that kind of thing was open to question, we'd soon be *undiscovering* the Higgs Boson as well as much else!

As we see, there are an indefinite number of logically viable criticisms of a scientific claim or finding, but the level and tenor of those that are acceptable as legitimate in practice is a value judgment. Without logically viable criticisms being restricted, science would come to a halt. Thus, I describe the questioning of the discovery of the first gravitational wave by various groups, most of whom were ignored as being too 'fringe-like'. And so on. Take away all those *internal* value judgements and there would be no discovery of gravitational waves.

But what about the impact of outside values or '*social values*'?

Now that we have established that you cannot have science without values it opens the door to questions about whether science would be better if it adhered to other kinds of values too. There are lots of case studies that show that *social values* creep into science whether one likes it or not. The very idea of the double-blind control trial, along with various other methodological safeguards, shows how hard it is to eliminate outside influences of various kinds on scientific conclusions, including scientists' own expectations of what result they want – it is scientists who invent these methodologies, indicating that they know how vulnerable they are to these kinds of bias.[3] Social and historical studies of science have shown that wider values, such as those based on race discrimination, have their impact too. For instance, one of the earliest studies shows that the form of the correlation coefficient that is used in statistics to this day, was influenced by the eugenic theories of the time (see Mackenzie 1981).

Philosophers and analysts of science mostly agree about the dependence of science on *internal values*, but they often disagree about the proper role of *wider social* values. The disagreement turns on the relationship between the views of scientific elites, and other expert authorities, on the one hand, and social values as expressed by ordinary citizens on the other. It is important to understand this debate as it is not just science but the future of democracy that is at stake, and that affects the very existence of science, its role in democracy, and the duty of scientists in political life.

Two models of the role of science in democratic society

Under the early models of science discussed in the first paragraphs, an essential feature of science was that it stood above society: that was why the knowledge it produced was more reliable than other kinds of knowledge – it was value free. We now know that this

[3] For a detailed analysis of the double-blind control trial see Chapter 1 of Collins and Pinch's (2005), *Dr Golem: How to think about medicine.*

cannot be true in any straightforward way. Here, however, the road of reason forks: some analysts argue that since science can't be value free, we should be aware of the social values that affect science and scientists should self-consciously endorse good social values; let's call this the '*endorse social values*' position (ESV). Other analysts, including the current author, argue that a crucial feature of science is to *aspire* to be free of the biasing effect of social values even if we can never achieve complete freedom from these effects. Let's call this the '*aspire to neutrality*' position (ATN). Of course, the aspiration to value freedom is best achieved by trying to understand biases but then, instead of endorsing a chosen set of biases, using the knowledge to try even harder to eliminate the biases that have been uncovered, even while knowing that the complete elimination of such biases is impossible. It's science's aspirations that define it not what it can be certain to accomplish.

We are talking here, remember, of the wider societal values that affect science as most, if not all, contemporary analysts agree that the internal choices to do with trust and the point at which criticism has to stop and certain assumptions must be accepted, the preference for corroboration and falsification, and so on, cannot be eliminated from science – indeed, it will be argued here that they are a constitutive feature of science. To jump ahead, I am going to try to 'square a circle' by arguing that the crucial internal values of science should be helping to form the wider values of society so the division between internal and wider social values has an overlap; the crucial point is the direction of influence: is it from society to science or from science to society?.

To understand all this we must turn to sociological considerations and discuss social 'institutions' and science as an 'institution'. The sociology of knowledge points out that nearly everything that anyone believes is a function of where that person was born and brought up. That may sound crazy at first, but let us start by dividing the process of being 'brought up' into two phases: 'primary-socialisation' and 'secondary socialisation'. Primary socialisation is what happens before you go to school – you are born into a certain household in a certain location and brought up by your parents or guardians. Those few years fixes nearly everything you'll ever know. Think about it! If you had been born and brought up in some isolated Amazon tribe the chance that you would ever know that arguments such as the one you are reading now even existed is close to zero. Think of the influence of the natural language you acquired in those first few years without ever knowing that you were acquiring it – natural languages are full of implicit practical knowledge and ethical guidance, not all of it positive. Maybe you acquired a religion in your primary socialisation with all kinds of moral and judgemental values within it. Maybe you acquired an inclination to know some science though this probably would not have happened if your parents were not already inclined that way. Just think about how different you might have turned out if you had been born somewhere else.

Then we get to secondary socialisation, which continues throughout your life. If you are born into the right kind of society, some secondary socialisation will take place at educational institutions. One of the characteristics of educational institutions is that they encourage competition and along with it, they encourage the idea that what you learn is self-consciously acquired as result of individual worth or effort. To encourage this view is a deliberate policy in countries with an individualistic politics, but is pretty well inevitable anyway, because of the way education works. So, if you are brought up in a 'Western society' it is hard to understand the sociology of knowledge because religious

institutions teach you to think that you as an individual are lucky to have been 'chosen' to learn the true faith and education teaches you that your own efforts and reasoning are the source of what you know. But this self-conscious effortful learning applies, at best, only to a tiny subset of what you know.

Actually, you don't even know *that* you know nearly all of what you know, and you certainly were not aware you were acquiring it. A surprisingly large part of even secondary socialisation is like primary socialisation – remember how you learned the grammatical rules of your native language? Of course not: you did not know you knew them, and you did not know you were learning them!

Native languages exemplify quite a lot about knowledge in general. As has been mentioned, a language involves a lot of implicit rules, not only grammar, but all kinds of things about ethics and behaviour and the assessment of others.[4] I can break away from a small part of this early socialisation. Though I am a native English speaker I later 'learned French' at school. But I have never become fluent in French; to become fluent I would have to have spent a long time living in a French-speaking society – I would have had to become socialised into French speaking, because there is so much more to fluency in a language than vocabulary and grammar.

Coming to believe most of what we believe follows this kind of pattern and that applies to secondary socialisation too. It even applies to science. As a scientist, dear reader, I will assume you do believe that a gravitational wave was detected on September 14th 2015. You probably think you believe it for 'scientific reasons', but it is almost sure that you have no real 'evidence' for it; it is just what you have been told by others. It happens that in your culture, a much-publicised paper, in *Physical Review Letters*, backed up by media discussions and followed by a Nobel Prize, counts as scientific reasons, but these things are not science but your traditions of what and who to trust.

Now we can get back to institutions. An institution is a sub-group within the society as a whole. Institutions include *religion, business, science, physics, gravitational wave physics, and gravitational physics wave-form calculation*, and so on. How big is an institution? It's as big as a social group – a set of people who have been socialised in a certain way, either as they are brought up as children or as they are socialised into groups later in life. As is becoming clear, the question of 'how big' doesn't make much sense: instead think of societies as like fractals. The society as a whole is a group. but it is made up of multiple groups, complexly overlapping and embedded within one another cascading down until the point is reached where there are just small sets of individuals (just as fractal that is a cauliflower – florets within florets – eventually cascades down to sets of a few cells without a discernible pattern, or the coast of Norway cascades down through smaller and small inlets and sub-inlets until the last 'inlet' has no pattern but is just a few grains of sand). The similarity between the elements in the structure that invites the fractal metaphor to be applied to societies, is the way that socialisation into every

[4] A lot of this is becoming clearer these days as we try to instil natural languages into computers. A popular example is the relative proximity in corpuses of English of 'he' and 'she' and high-status professions such as 'doctor'; the language is full of prejudices, and we learn them as we learn the language.

element turns on the same kind of tacit understandings that are not self-consciously acquired: each sub-element from the largest to the smallest partakes of this structure.[5] How do you know if it is correct to refer to some sub-set of people as a social group? Think of the Turing Test: does it make sense to ask if a human outsider could pass as a member of that sub-set when questioned with creative inventive questions by an insider in a way that bears on their tacit socialisation.[6] Yes, it makes sense to ask if a French speaker who had learned English at school could pass as an English speaker, and it makes sense to ask if a non-scientist could pass as a scientist, and it makes sense to ask the question in respect of the remainder of the italicised list of institutions presented a few sentences back.[7] But it does not make sense to ask if someone who wears brown shoes could pass as someone who wears black shoes when questioned by 'a black shoe wearer'– people demarcated by the colour of their shoes are a 'set' not a group, and pretending to be one or other in a Turing Test is not a matter of socialisation but simply knowing what you are pretending to be so you can provide the appropriate false 'information' (as opposed to exhibiting fluency acquired through socialisation).

[5] We are going to spend some time talking of the difference between the sub-groups and how you might recognise them, and this is where the fractal metaphor does not help. But there is nothing to stop the substance of the elements of fractals being different in real life so long as the structure is the same: taking the coast of Norway, not every inlet and sub-inlet has to be made of the same kind of sand in order for it to be recognisable as an element in the fractal.

[6] Unfortunately, most accounts of computers passing the Turing Test are, effectively, publicity stunts, because the criteria are not sufficiently demanding. For a discussion see Collins (2018); see Chapter 10 of that book for examples how to create appropriately demanding Turing Tests.

[7] In Cardiff we have done many experiments using what we call 'The Imitation Game' to test various hypotheses about members of which sub-sets can pretend better than others.

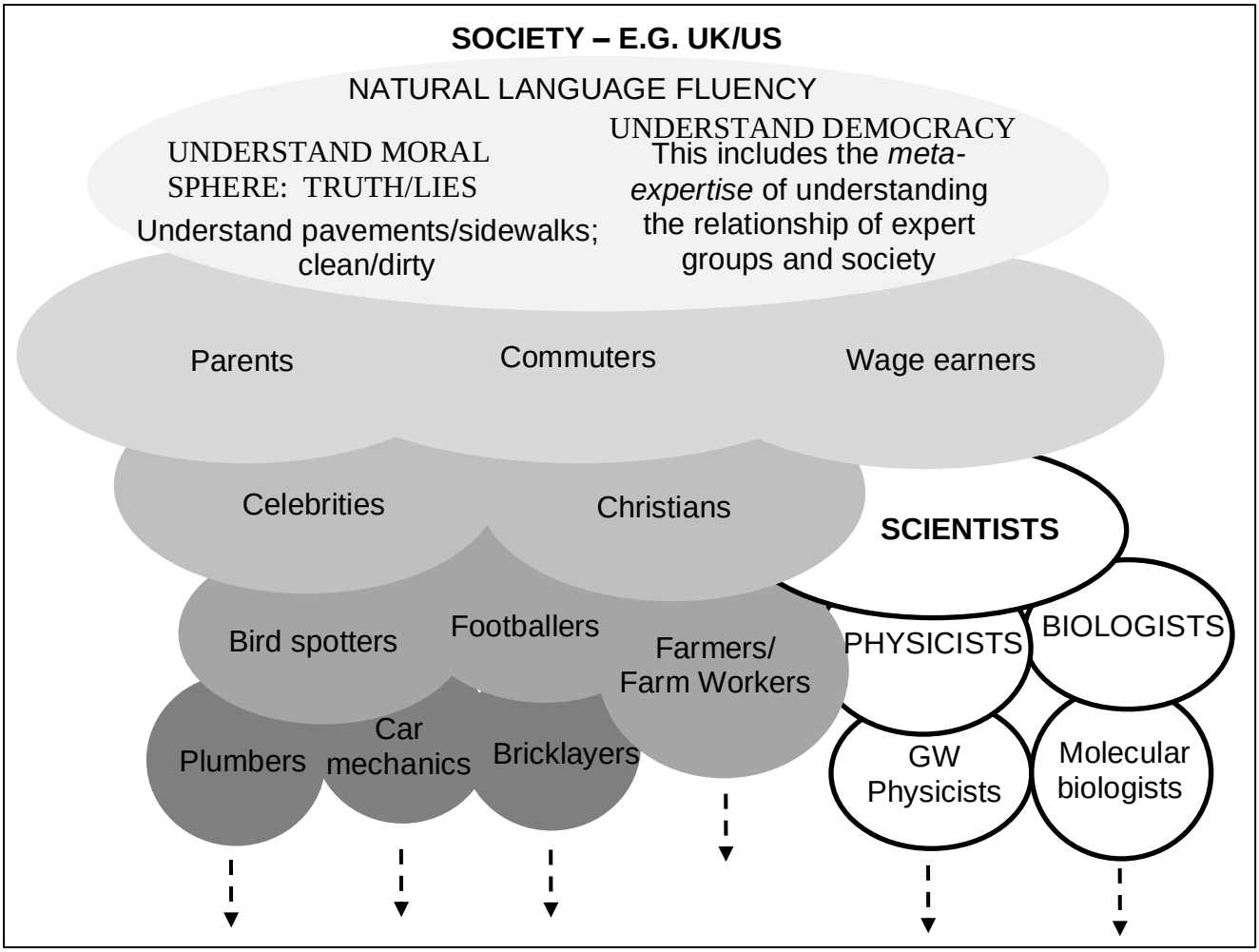

Figure 1: A simplified fractal model of society (adapted from previous publications with science emphasized). The cascades continue as indicated by the dashed arrows. The actual complexity of the mutual embedding, being many dimensional, has to be imagined.

Figure 1 is an *aide memoire* using the fractal metaphor to describe a society as made up of mutually embedded social groups. As in other fractals, the overall structure and the lower elements are integrally related, and the form of the lower elements is also the form of the overall structure. With societies, we depart from the metaphor in saying that an important part of socialisation at the highest level – the ubiquitous expertise – is meta-expertise, as shown in Figure 1. Meta-expertise is knowing how the sub-elements are ordered in terms of prestige in that society and knowing how and when to rely on members of those sub-elements. One would expect this prestige hierarchy to be reflected within the lower elements, but the metaphor is inexact because individuals differ in their views regarding this kind of thing. Nevertheless, the meta-expertise varies from society to society and characterises that society as a whole. Sometimes medical science is more prestigious than shamanism and sometimes not. Importantly, since the entire society is

made up its citizens, the values represented in the top level will depend in a complicated way on the values that form the lower elements and vice-versa.[8]

Scientific socialisation

This takes us to the question of what socialisation into a science comprises. It will depend on the particular science and on the sub-specialty within the particular science so to get a more useful picture we need to go up the fractal to the institution of science as a whole.[9] What is it that makes science in general, science, rather than some other institution? We have to separate the contingent features of science and the essential features and if you are a scientist or have been socialised into scientific values in some other way, this separation can be accomplished with a little reflection.

For instance, the physicist, Stephen Hawking, wrote a book for general consumption called, *A Brief History of Time*, and it was widely publicised and sold many copies. But to sell popular books of this kind is not 'a formative aspiration of science'. If the book did not exist, science would remain science. Indeed, one might argue that promulgating such books is more like a formative aspiration of business, or even of certain religions. Hawking's book was widely praised and respected but none its popular readers could understand it: like the Latin Bible it was more like a holy object than an essential feature of science. The same is more obviously true of books by scientists talking of the discovery of 'The God Particle', or the 'Face of God', referring to the Higgs Boson and the Cosmic Microwave Background respectively. One could also take away the venture capitalists and their start-up companies, and all the other front-page stories, and one would still have science, though, perhaps, not so much of it, but what is good for the business of science is a different question to what makes science, or science would simply collapse into business.

To go back to the more fundamental questions, if you take away integrity in the search for evidence and honesty in reporting results one would not be doing science. The same goes for not ruling out a scientific claim a priori because of the claimant's race, creed, or social eccentricity; if you did that you could not have results that would appeal across cultures and aspiring to have one's findings potentially acceptable as truth across all cultures must be part of science even if it is very hard to achieve. Again, science has to be ready to expose its findings to criticism and debate so long as the critics are not manifestly unqualified. And, as already mentioned, science must *aspire to* specify the means by which theories can be corroborated or falsified. And all this depends on the acceptance that good experimentation or theorization usually demand high levels of craft skills, and this implies that in virtue of their expertise, some are more capable than others at both producing scientific knowledge and at criticizing it. Take away any of those characteristics and the institution of science would no longer be recognisable. So long as

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[8] In some early discussions, professions such as law and medicine are linked with the moral qualities of their practitioners. This was said to have a stabilizing effect on society as a whole. See, for example, Durkheim's *Professional Ethics and Civic Morals* (1958), in which the professions play a crucial role as institutions that link the individual and the state.

[9] Two recent papers by the author and colleagues (Collins, Leonard-Clarke and Mason-Wilkes [2022] and Collins et al [2022]) explain how scientific conferences work as a component of socialisation and how this differs between domains of physics on the one hand and molecular biology on the other. These papers contain many quotations from working scientists.

science is a central institution in our society, those values will feed back into the society as a whole – or so it is being argued here.

As we said, when it comes to science there is disagreement among analysts between the endorse social values (ESV) view and the aspire to neutrality (ATN) view. The disagreement can be thought of in terms of whether the emphasis is placed on values as they come down from the top of society to the institution of science or on the values as they go up from the institution of science to the society as a whole. Thus, Heather Douglas understands the way that institutions socialise their members into a distinctive set of values during professional education but seems primarily concerned with their taking social values into account -- the top-down direction:

> Many of the most central values scientists hold are those they developed whilst training to be scientists, and this alone can create divergences between the scientific community and the general public . . . Thus, even a demographically diverse scientific community may still hold values that clash with the broader public's values. (Douglas 2009, 172-173)

Douglas believes that the 'remedy' is for scientists to take social values – the general public – into account when doing their work.

This seems not unreasonable so long as the society is a benign one. But how would it work out in a malign society? Would you want scientists in Nazi Germany to take on Nazi values? Would you want scientists in Afghanistan to agree that women should not be professionally educated? Do you want scientists working in Trumpist America to take on Trumpist values, values that put popularity in the polls ahead of honesty? One of the very foundations of the institution of science is not preferring popularity to truth. If a scientist promulgates results that they know are not true in order to garner popularity with politicians or fellow scientists, or the public, or to be rewarded by powerful corporations, they are not doing science.

The argument of the *aspire to neutrality* view stresses the importance to society of the bottom-up direction, from the values of science to the values of society: the more that scientific values influence society, the better that society will be. How can we not want a society that values honesty, readiness to listen to criticism, universality, corroboration and falsifiability, in political and economic judgements as well as scientific judgements – these are what I'll call 'the good values'? If you would prefer another set of values to be dominant in society, such as meaningless slogans instead of honesty, unwillingness to listen to criticism, prejudice against persons with certain physical characteristics, unwillingness to think that corroboration of a claim is more important than the person who makes it, and unwillingness to countenance the possibility that ideas are better if they are potentially defeasible by evidence – what I'll call 'the bad values' – then this paper will have no appeal. The claim is not that science alone represents these values – many institutions in society represent one or other of them at least some of the time – the claim is that science is integral with them in a way that no other institution is integral with them because for science, truth is not just a means but an end.

At this moment in history, with the growth of populism, the most damaging change we are confronting is the dissolution of truth, so let us concentrate on that alone. Science, I have suggested, cannot exist without truth and integrity as a central value. That means that a society that puts science at its centre will be a 'veritocracy': it will value truth in a way that populism/fascism does not. And that is why scientists should adhere to

and champion the values of science and never sell them out for other kinds of gratification. Scientists are doing more than science when they work at the bench, they are forming the culture of their society, and they are helping to create the envelope of legitimate politics. If the values of science as describe here are maintained, and if they travel upwards into the ubiquitous expertise of the citizens, there will be no Nazi societies, no misogynist societies, and no nationalistic populism, because the values of science are incompatible with those views.[10]

This may seem utopian, because we know that members of the scientific profession (we cannot call them scientists) can be corrupt, but that is no reason to be corrupt. It is important not to be too cynical as a result of the corrupt actions of certain individual scientists. Instead, make the sociological perspective the way you see the world: the actions of the majority are formed by the cultures into which they have been socialised and truth is integral with the culture of science. [11] Chaos theory tells us that individuals can have an important influence on how history unfolds where conflicting cultures are in balance, but it remains that utopia is what we prefer (how can you prefer dystopia?) and maybe it will be your actions that are the equivalent of the flap of the butterfly's wing. But, whatever, those actions will contribute to the way the culture of the social groups in which you are embedded are formed.

Even if utopia is not realised, pluralistic democracies depend on 'checks and balances' to limit the power of elected governments. One of the most important checks and balances, and one whose importance became blindingly clear in the first Trump administration, is science. Proto populist dictators like Trump do their best to erode the credibility of science because science limits their power to express what they proclaim to be their exercising of 'the will of the people'. This was never more clear than with Trump's approach to the Covid pandemic.[12]

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[10] My optimistic view grew out of my long experience working with the gravitational wave scientists, whose search for truth seemed an object lesson in how to reach for it. There were a couple of 'bad eggs' among the thousand or so scientists, but their activities came as a shock because they were so unusual. I should make clear that the field was characterised by strong disagreements, mass resignations, and so forth, but one could discern the that all these things, and the way they turned out, always had to do with the search for truth, not personal gain.

[11] It is a 'formative aspiration', see Collins and Kusch (1998).

[12] Unfortunately, calls for more accountability for scientists giving advice on the Covid Pandemic plays right into the hands of a populist leader like Trump and his conspiracy theorist supporters. Here is an example of the way science can become confused with politics, stressing the top-down, 'endorse social values', view to endorse populism.

(around 12.00 minutes in) [Kant represents the enlightenment in demanding that people make judgements for themselves and not take the word of authorities]. Immaturity would be to trust what a book, or a spiritual director, or a doctor says; instead, you're supposed to be exercising, in some sense, your own judgement. Of individual enlightenment and maturity to exercise your reason to weigh the decisions of the world? One thing that's happened is that we've written, de facto, a new constitution for modernity which was not in the original wording of the revolutionary era constitutions of the late eighteenth century. Today … we have masses of areas … in which we delegate our authority to experts precisely to tell us how to behave. … we grant them epistemic authority to know for us how we should be exercising judgement, and then when we refuse [eg to accept the advice of people like Anthony Fauci, medical advisor to the US President] it becomes a problem because people are not trusting science because they should have been trusting science. So, this is a huge evolution in 200 or so years, away from a view of enlightenment that said it was a good thing to doubt, it's a good thing to trust your own judgement, to a position that we're in

Conclusion

Science is more important than its findings and being a scientist is more important than many other professional roles. This is because in being a scientist one is more responsible for the moral environment of the world we live in than the members of most other professions. If one prefers a pluralistic democracy based on truth, then as a scientist one has not only the responsibility but the ability to contribute to its maintenance. The implication is that one should always aspire to find the truth and never violate the internal values of science that support the pursuit of truth even when they seem impossible to fulfil; it is the aspiration that is the key.

Notes on contributor

Harry Collins is Distinguished Research Professor at Cardiff University. He is an elected Fellow of the British Academy and winner of the Bernal prize for social studies of science. His 25 books cover, among other things, sociology of scientific knowledge, artificial intelligence, the nature of expertise, tacit knowledge, and technology in sport.

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now, where distrust of institutionalised authority is seen as a problem in and of itself. So, I think that even to begin to get to grips with the state we're in, we have to begin by recognising that these expert institutions that we've created are not simply telling us the state of the world in an unmediated fashion so that we can trust those claims in a direct way, instead they are exercising authority that is political ***in the very same way*** that our elected bodies are political, or our politically appointed bodies are political … [my stress] Jasanoff 2022 presentation at Cambridge University entitled 'Democracy and distrust after the pandemic' Democracy and distrust after the pandemic - Networks of evidence and expertise for public policy (cam.ac.uk)

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