The Value of Science and Values in Science

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Many an internet troll has recited the cliché, "Facts don't care about your feelings." In a similar sense, many have thought that science and values can have nothing to do with each other, the one being the realm of hard, objective facts and the other being the realm of subjective whims and desires. It only requires a little reflection to see that there cannot be a *complete* separation of science and values. Science is a human practice which we value enough to make central to education, to rely on in many of our personal and public decisions, and to devote significant resources to. Some people value science so much that they devote their lives to it. As an activity engaged in by human beings, science is also guided by values. Science is part of the social learning process that over time changes and improves our values. In this chapter, I will explore some of the interplay of science and values, beginning with the attempt to understand the value of science itself.

To add some concreteness to the discussions that follow, consider the case of climate science. Climate scientists try to understand the workings of the climate system, a system that is large, complex, and somewhat chaotic. The climate system has a major impact on a variety of things humans care about, from the quality of your summer vacation to food production to the viability of whole regions as livable human habitat. Over the last several decades, there has been a significant consensus among climate scientists that human activity is driving significant changes to the climate system, such as a rise in average global temperatures, and so much effort in climate science aims to understand, predict, and propose interventions to mitigate the effects of these human-caused changes. Is this kind of science valuable? Is it because it helps us understand the natural world, or because it helps us anticipate

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problems that affect human lives? Should our values—ethical values like concern for human or ecological wellbeing or political values like liberalism, environmentalism, freedom—have an influence on climate scientists? What about economic values like growth and stability? Should climate science be value-free (neutral, impartial) and focused purely on creating an objective understanding?

1 The Value of Science

The most general thing one can say about philosophy of science is that it asks philosophical questions about science; as with many very general things we can say, it is not so illuminating. More specifically, for the most part, philosophers of science have investigated something we might call "the nature of science." This includes trying to understand the *results* of science, how those results are to be interpreted, and how they bear on our understanding of our world and ourselves. The nature of science also includes the *processes* by which science produces its results, how and why it works. Philosophers of science thus try to interpret and clarify both the knowledge that scientists produce as well as to understand how they produce it and why what they produce deserves to be called "knowledge."

It has been less common for philosophers of science to think carefully and critically about the *value* of science. As Paul Feyerabend provocatively put it, philosophers of science have long debated a variety of answers to the question, "What is science?", but they have hardly ever asked the question, "What's so great about science?" (Feyerabend 1978, 73). The excellence of science is generally assumed rather than argued for (Feyerabend 1976, 112). After all, if science is worth philosophizing about, it is almost certainly important; it makes sense that those who are interested in philosophical questions about science would be predisposed to assume it is valuable. So the major response to the question, "What's so great about science?" is *the uncritical assertion*—it just is. This seems so obvious to many people that it is rarely even explicitly stated.

But as philosophers, we ought to be uneasy about unquestioned assumptions like that. And after all, the excellence of science is not equally obvious to everyone. Science has historically caused harm to various already-marginalized groups of people due, for example, to the role of psychology, anthropology, medicine, and other fields in supporting racism, sexism, and colonialism.

There have long been political fights about how many public resources should go towards science, as well as whether certain kinds of science should be the basis for public policy, our example of climate science being one where such fights have been prominent. Religious believers and traditionalists as well as radical scholars from the arts and humanities have argued that we tend to overvalue and overestimate science. So the value of science is very much in question and worthy of close scrutiny.

1.1 The Question

So the question is: *What is so great about about science?* Or, *why should we value it?* Before we start to think about how to answer the question, we should try to dig into the question itself, try to break it down into other questions that might be easier to answer.

It is not plausible to think that science is the kind of thing that is intrinsically good, for its own sake, without further analysis. Very few things are good in that way; some possibilities for values of that kind include pleasure, absence of pain, satisfaction of our interests or desires, autonomy, the protection of basic rights. Even the value of those sorts of thing is open to argument and may depend on further considerations. Most other things are valuable *for* something else that they provide, and it seems complex human practices are mostly like that. Democracy is valuable because it provides for autonomy or fulfills basic political rights or is likely to further our interests. Art is valuable because it provides experiences of pleasure or sublimity or provides an opportunity to express ourselves or challenges our preconceptions or captures ultimate meanings or essential features of the human experience.

In order to understand the value of science, as with any practice, we need to understand how the practice works and what it results in. In other words, we need to answer the questions: *What are the aims of science?* and *what counts as success in science?* In this way, we can evaluate the value of what science produces when it successfully meets its aims. It would also be worthwhile to know how often it is successful by its own standards, though this is typically an empirical question that I can, at best, gesture at how to answer.

1.2 Answer 1: *Realism*

According to a view about the aims of science that I will call "*realism*," science aims to answer specific questions about the way the world *is* (See Chakravartty 2017, sec. 1.1; Lyons 2005; Khalifa and Millson 2019, the latter is particularly close to this formulation.). When successful, science provides answers to those questions that accurately represent a part of the world, that is, it answers by providing something like a true theory or a model that fits very well with a part of reality. The criteria for judging accuracy are generally understood to be empirical, having to do with careful observations and experimental tests, though they might also include theoretical criteria like simplicity or aesthetic criteria like elegance. Such criteria are themselves sometimes conceived of as "values," so-called "epistemic values" because they are concerned with what constitutes knowledge.

Of course, those theories or models tend to be partial, concerning physical particles and fields, organisms, chemical reactions, or the atmosphere. Some scientists long for and even hope to achieve a true *theory of everything*, but no such theory has been found that satisfies scientists' criteria. Even if it were found, it would only be very schematic in the way that it was a theory of *everything*, since it would probably at best very accurate with relatively simple phenomena in physics, and very difficult in practice to apply to anything complicated, like biology or psychology.

There are several problems with the realist answer to the question of the value of science. The first is that there seem to be a diversity of scientific aims and practices, not all of which can be reduced to accurate representation (Kukla 2024; Lusk and Elliott 2024). Different parts of science seek to improve health, protect the environment, meet our energy needs, feed populations, and protect human safety. It takes complex philosophical contortions to describe what biomedical science is doing as *representing the way the world is* when it is producing medical interventions judged by how they change (improve) human health, and similarly with many inquiries in climate science. In a similar way, accuracy is not sufficient as a criterion for judging scientific results. At best, it is one criterion among many, and typically we will find that it trades off against other criteria that we regard as important. Already, when we start to talk about theoretical criteria like simplicity and elegance, it seems like we may be talking about criteria beyond accuracy. In addition to wanting accurate results, we want results that that are timely and obtained in resource-efficient ways. Also, we want results that minimize the risks of harmful errors or side

effects. In many cases, it is more useful to have a somewhat simpler, less precise or accurate model that better helps us understand or is easier to use. And when we do research using human subjects, protecting the rights and wellbeing of the research subjects become criteria by which we rule out some methods entirely.

Perhaps the most significant concern about realism as an account of the value of science is that it simply kicks the can down the road a short distance. It is not at all clear why answering questions about the way the world is and getting accurate answers to such questions is itself valuable. The realist merely asserts that it has value, and thus makes very little progress beyond *the uncritical assertion*. It is coherent to ask the further question: What is so valuable about *that*? Surely there are many such questions that answering provides no value whatsoever: How many dust particles are on my desk at just this moment? How many hairs did Julius Caesar have on his head the day he crossed the Rubicon? How many milliseconds did it take me to write this sentence? It is not that any of these questions is completely unanswerable; it is just that it is impossible to justify expending resources on even partially adequate answers to such questions. It is hard to say that such questions or the attempt to answer them are even *scientific* at all.[1] Is understanding the climate system different from such trivial questions, and if so, *why*? It is unclear how the realist could justify such a difference.

1.3 Answer 2: *Pragmatism*

I have argued that the realist answer to the question of the value of science is unsatisfying, in part due to the diversity of scientific aims, practices, and criteria for success, and in part because it is open to a further question it seems to lack the resources to answer—What would be so valuable about that? Given the diversity inherent in scientific activities, is there anything general one can say about the value of science? And will that answer avoid such a further-question objection?

I think so: I think we can understand the core of science as a process of *inquiry*, as a kind of problem-solving practice. Science provides powerful tools for solving all sorts of problems. Such a view has been associated with the labels "pragmatism" and "instrumentalism," though each label also suggests

[1]Kitcher would say that such questions are not *significant*, or their answers even if true are not *significant* truths, and that science seeks *significant* truths. (2001)

many other meanings that would be misleading. I will nevertheless call this understanding of science (as problem-solving inquiry), "pragmatism" (Some pragmatists of this sort include Peirce 1877; Dewey 1938; Laudan 1977).

According to *pragmatism*, scientific problems are continuous with practical problems, in that they concern how we are to accomplish our various goals. Science does not pick out one or a small number of specific kinds of problems. Scientific problems in this sense are not sharply demarcated from problems of an everyday sort or those in specialized, non-scientific fields; at best, they are recognizable as *scientific* in tending to be more systematic, general, technical, and empirical. Mostly, we call those inquiries "scientific" when they are part of a pretty specialized field of inquiry. Of course, among our goals are a desire to predict, explain, and control the world around us; these goals are pretty recognizable in the scientific practices of observation, theorizing, experimentation, and technological application. But as we have seen, these are a few among many other goals that scientific inquiry promotes. In the case of climate science, these include attempts not only to understand the past impact of human activities on the climate system, but to predict the future development of the climate system under various choices we might make for the future, and to recommend choices, policies, and technological interventions that can mitigate climate change or adapt to its effects. These aims are made significant by the various impacts a changing climate will have on human lives and other things we value.

Scientific problem-solutions are judgments about what to do, how to act, or what to build in order to overcome obstacles and accomplish the various goals that spur inquiry in the first place. As problem-solutions rather than merely answers-to-questions, they recommend or require *doing* something to respond to the problem. This gives us our criterion of success: science is successful when it actually clears the obstacle out of the way and helps us accomplish our goals. The criterion is contextual, in that it depends on the nature of the problem. It is also practical, in that it involves not an intellectual feature of the representation but a change in the practice-world relationship where the problem is resolved, or at least, mitigate to the point that meets our goals.

The value of science is thus found in its power in providing successful solutions to our problems, in providing means that allow us to achieve our ends. The actual track record of science on this account is imperfect; in some areas at some times it is highly successful, and others less so. There is no standing assumption that science will always be successful in solving

problems; indeed, it often fails. Elitism and imperialism complicate this story as well, especially as we ask about the *comparative* value of science. Does science do better than traditional indigenous knowledge systems and systems of practice? That is a difficult question to answer not only because it is contextual (it depends on the goals and problems we are trying to address); it is also impacted by a history of colonialism and oppression that means we have never had a fair playing-field for the comparison. What's more, the solutions that science recommends must actually be tried out, their impact assessed, as the sort of ultimate criterion of success; with cases like climate science, where the will to implement solutions is limited, the success remains indeterminate.

The value of science is not sharply demarcated from other successful forms of human intelligence and deliberate practice; it is not all-things-considered better, and it has many networks of dependency upon practices we tend not to call "science," such as education, technology, politics, and economic activity. The value of science is deeply dependent on context, on the wider scheme of social, cultural, personal, and professional values that it is embedded in. It receives its value from goals that we *already* value, that it helps us forward. Of course, one of these goals is understanding the world around us, and here the pragmatist and the realist answers overlap. But unlike the realist, the pragmatist has no problem answering the further question, which parts of the world are worth understanding? It is those that interest us and that bear on our other goals. There is no further pressing argument, What is so valuable about achieving our goals? If there were, they would not be *our* goals.

This means, on the pragmatist view, that our personal and social values play a deep role in science itself. It is to this role that I now turn.

2 Values in Science

In the first part of this chapter, I asked how we are to to evaluate science, what value it provides to society or to humanity. Two opposing views were discussed: according to the first, *realism*, the value of science is exclusively its ability to discover the *truth* (accurate representation). According to the second, *pragmatism*, science can be a powerful tool for solving all sorts of human problems. In this second part, we turn from the question of the value sciences provides to society to the converse question, whether society's values have anything to contribute to science.

Each of the views discussed in the first part suggests a somewhat different view about the the role that *values* have to play in science. By values, I mean the sorts of considerations that play a significant role in ethics, morals, politics, religion, art, prudence, and economy—considerations about what is good, right, rational, or preferable and about what is bad, wrong, unreasonable, or undesirable. Value judgments in a broad sense are uncontroversially pervasive in science, in that some research proposals are judged more promising than others, some experiments are considered better than others, and some methodologies are considered altogether wrong. The question is, are such decisions to be guided and evaluated entirely by values entirely internal to the practice of science, or should our social and personal values also play a role?

2.1 Realism, Naturalism, and Value Neutrality

On the realist view, recall, science aims always and only to discover the truth about the natural and social world, to accurately represent that reality. On such a view, it is plausible to think that judgments about what is right or best in scientific practice should only be guided by that aim, and so only scientific values, values internal to the practice of science should play a role. Such values have also been called "epistemic values," to indicate that they are knowledge- or truth-promoting values.

Another sort of view called "realism" holds that science not only aims at but achieves true knowledge about mind-independent realities (See Chakravartty 2017, sec. 1. We might thus distinguish *aim-realism* and *achievement-realism*). Realists of the first sort are often realists of the second sort, though it is coherent to be a realist of the first sort while being pessimistic about the track record of actual science, and so rejecting realism of the second sort. The converse of the second sort of realism is *naturalism*, the view that the reality of the world is what successful scientific knowledge discloses. If realism tells us that what successful science discloses is real, naturalism tells us that there is no real beyond what successful science has or will disclose. Realists of both sorts are often naturalists in this sense, though it is coherent to be a realist but not a naturalist.[2]

[2]There are other forms of naturalism, realism, and pragmatism that combine in different ways, including naturalisms that have very little to do with realism and realisms that are compatible with pragmatism. Philosophers love to fiddle with concepts and terms in such a way as to make heads spin.

Because values are not objects of natural science, and because they are typically understood only subjectively by the successful social-behavioral sciences, as the contents of cultural beliefs or psychological attitudes, the realist and naturalist tends to understand reality as *disenchanted*, as devoid of values. If reality is devoid of values, and science aims at depicting the truth about reality, then values ought not to play a role in science. The latter claim is sometimes called "the value-free ideal of science." Since only the search for truth or accurate representation ought to guide our inquiries, and values are not a part of the world to be depicted, values ought (ideally) to play no role.

This is strictly speaking fallacious, confusing the product and the process. Scientists use microscopes to investigate biological mechanisms; but biological reality contains no microscopes. That does not create a problem, nor does an intermediary role for values in science. And even the defender of the value-free ideal acknowledges that scientific values have a role to play, that is, those values that are instrumental towards promoting the truth, such as the value of empirical accuracy, logical coherence, theoretical simplicity, and so on. It does not follow from the absence of values in the content of the theories of physics or biology that values like concern for human wellbeing and environmental integrity, curiosity, or efficient use of resources will lead these sciences astray.

Nevertheless, it is clear why such a view is compelling to the realist and naturalist. When making decisions in science, a consideration will either tend to lead towards the truth, in which case it is a good candidate for an internal criterion of science, or it will not, in which case it can at best be neutral but will more likely be misleading. Some opponents of the value-free ideal have tried to make a realist-friendly argument that the space of neutral influences is much larger than it at first seems, and these arguments have been very effective.[3] On the other hand, as we have seen, realism as a view about the aims of science is open to pretty difficult objections; there are related and similarly difficult problems for the achievement-realist and naturalist. How do things look for the pragmatist?

[3]The famous "argument from inductive risk" is such an argument; it relies on the significant space of uncertainty between evidence and conclusions to argue for a role for values in science. See Douglas (2000); Douglas (2009); Havstad (2022); Brown and Stegenga (2023).

2.2 The Practical Reason Argument

For the pragmatist, scientific inquiry is a practice, a practice of problem-solving. As a practice, it consists of various sorts of actions, such as articulating problems, proposing hypotheses, collecting evidence, and asserting results. Some of these acts are routine, and others require deliberate judgment about how to act; either way, they depend on *practical reasons* that motivate and justify them. Indeed, on the venerable view in the philosophy of action, what distinguishes an *action* from other sorts of natural events is that actions are explained by *reasons* (Davidson 1963). As far as I am concerned, "practical reasons" is just a different way of saying "values."

This much, the realist could and generally does accept; they insist, however, that the only relevant values are scientific, epistemic values. The pragmatist would go further in two respects. First, because the pragmatists sees a diversity of goals and criteria for scientific problem-solving, and sees those goals and criteria as dependent on rather than autonomous from the social context in which science is embedded, there is no good reason to insist that only internally determined scientific values apply. Second, for the pragmatist, these scientific values are not action-guiding practical reasons of the right sort. While empirical accuracy is certainly a good thing for a theory or model to have for all kinds of reasons, this does not tell you how *much* accuracy one needs before, for example, concluding data collection or publishing results. Similarly, while logical inconsistency is a property that it is generally bad for a theory to have, this will not prevent scientists from publishing or using theories that include, for example, equations that mathematicians regard as ill-defined (such as delta functions) or even logically inconsistent theories (such as the Bohr-Somerfeld model of the atom), if they have other good reasons to do so. The sorts of epistemic values that realists point to tend to be good reasons for claims, but not practical reasons for action (Brown 2020, 65–66).

2.3 The Value Judgments Needed in Science

If I choose to pursue a certain hypothesis in my scientific inquiry, I need to know not only the information that makes that hypothesis seem plausible, but I need a *reason* to pursue it over others—perhaps I think that this hypothesis is more likely to help me achieve certain goals, or that it is the most likely to guide fruitful experiments, or it is the safest option for securing funding

support. If I am deciding whether I have enough evidence to publish my results, the amount of evidence by itself cannot make the decision for me; I need further reasons to consider *that* amount of evidence sufficient. I need to ask, is this enough evidence to lower the risk of being wrong to a tolerable level, given the ethical, social, and reputational harms that might accrue from asserting these results erroneously? Would waiting for further evidence itself have bad consequences, including delaying a solution to the problem this inquiry was meant to solve, or allowing a competitor to get credit for making the discovery first?

Scientific inquiry seeks to make judgments about what to do, how to act, or what to make; it is thus pursued both in the service of various values that are the motivating goals of the inquiry in the first place, and it is constrained by values that determine what is right and wrong, appropriate and inappropriate, wise and foolish in the way of action. All actions, whether they involve explicit decisions or not, are brought about by practical reasons—values. Those reasons may be obscure to the non-specialist in highly technical inquiries, but they exist all the same. The specialist ought to be able to articulate the reasons behind their actions, though they do not always do so before acting.

Most of the time, scientific researchers, like the rest of us, act out of habit and training rather than an explicit decision. That is necessary if science is not to slow to a snail's pace, and to the good insofar as those habits are formed by thoughtful attention to the relevant values and are sensitive to changes in a situation that might require reconsideration. Insofar as we act thoughtlessly with respect to the values that motivate and justify our actions (or would judge other actions as better justified), in science or elsewhere, we are liable for criticism of acting recklessly or negligently. When we act, we are responsible for the reasonably foreseeable consequences of our actions, even when we were not thinking about those consequences at the time. If a reasonable person could realize that they were making decisions that would harm others, violate or disrespect the rights of others, or cause damage to what others would value, then thoughtlessness is no defense.

As an ideal, we ought to practice thoughtful foresight with respect to our actions. This is an ordinary ethical responsibility, and it is just as important in science as elsewhere. Indeed, because of the relative power of science to affect the world and influence decision-makers, scientists should be especially careful to think through what they are doing and make wise value judgments to guide their decisions and actions.

2.4 Ethical and Political Critiques of Science

Another consequence of the pragmatist recognition of the central role of values in science is that it opens the door to the ethical and political critique of science. If all sorts of values do and ought to motivate and justify decisions in science, and if scientists are responsible for the foreseeable consequences of their research activities, then it follows that those activities and their results are open to evaluation and critique on the grounds of values—on ethical, political, and prudential grounds.

For the realist-naturalist, as we have seen, ethics and politics are seen as most likely to lead away from the truth, and thus ethical and political critique are unwelcome impositions on science. Scientists should have unrestricted freedom to pursue the truth, come what may. We might make an exception in the case of research involving human or animal research subjects, to rule out research protocols that would cause the subjects of research harm, even when those protocols might achieve better accuracy. We might even insist on some restrictions concerning research whose results could be particularly harmful, such as preventing open publication of instructions for creating biological weapons. But other than such side constraints on research, science ought to remain above ethical and political critique.

For the pragmatist, by contrast, such critique is apropos when directed at the goals that scientists seek to forward, the criteria they have applied in justifying their problem-solutions, as well as whether they have properly constrained their actions according to their possible consequences. Seeking the truth is not, by itself, motivation for pursuing a line of inquiry, and accuracy is not, by itself, a sufficient criterion for success. Why do we seek to solve this problem rather than that one? That is a question that concerns prioritizing various goals, decisions about allocation of scarce resources like grant money and researchers' time, and deliberation about the likely side effects of the knowledge gained. Should we accept this solution? That depends not only on the quality of the evidence for it, but also on whether the actions that the solution requires are acceptable in our society and consonant with our various other aims.

This does not mean that anything goes, that any critique of science is fair game. That one does not like some scientific results or wishes they had come out differently is not a good reason to critique those results. Fossil fuel producers may wish that the overwhelming evidence did not point towards the fact that carbon emissions from burning fossil fuels is causing signifi-

cant climate change; they might not like the models that suggest that the consequences of climate change will be quite harmful.

To make a convincing critique of climate science, fossil fuel interests would instead have to argue in something like the following way: Climate science focuses a lot of research effort trying to understand changes in the global climate system as a result of human activity, and in particular the future harms that could accrue to human lives and property as well as to the biodiversity and ecosystem health. As a result, it causes reputational and economic harms to the fossil fuel industry, which in turn leads to loss of jobs and decreased return on investments in those corporations. These priorities are unacceptable, as the lives, welfare, and rights of future generations and present and future ecosystems and non-humans are much less important that the financial wellbeing of large fossil fuel corporations and the jobs in those very specific industries. What's more, the solutions that could possibly address the problems climate science identifies involve reducing consumption and replacing fossil fuels with alternative sources of energy. These solutions unacceptably infringe on our individual rights to spew whatever we want into the shared environment and unfairly favor carbon-neutral industries; these individual rights and concerns of competitive fairness are much more important than ecological stability, the integrity of the agricultural system, the welfare of future generations and current humans in the future, and all of the other things threatened by climate change.

No doubt this defense seems like a bad satire, a caricature of the unfeeling corporation. But this sort of extreme argument is precisely what a complete attack on climate science as such would require to be legitimate. There is certainly plenty of room for reasonable people to disagree both on how to prioritize the problem of climate change or different aspects of it and what sorts of solutions are acceptable. Different views in this range would lead to reasonable and legitimate ethical and political critiques of very specific priorities and approaches within climate science. But only views that seem wholly unacceptable on ethical or political grounds could justify complete climate denialism or wholesale attacks on climate science. This is generally true; the legitimacy of ethical and political critiques of science does not justify an anti-science attitude. Indeed, reasonable and responsible ethical and political critiques of science, if scientists were responsive to them, would likely make science better and increase support for it in society.

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