

# 1

## *Introduction*

*We are complex and intelligent creatures and we can hold multiple ideas in our heads at the same time. We can be critical of the things that we love. That is possible.* – Anita Sarkeesian

### *1.1 The Interplay of Values and Science: 3 Cases*

This is a book about the interplay of values and science. Science and values are mutually influencing and implicated in one another. I argue that the influence of values on science is pervasive and that science also can and should have an influence on our values. I argue further that this interplay must be guided by accounts of scientific inquiry and of value judgment that are sensitive to the complexities of their interaction in practice. Scientists and moralists, as well as philosophers of science and ethicists, have often presented distorted and even harmful pictures of science and of values for lack of nuance about their interplay.

The book is unabashedly normative, where “normative” means making claims about what *ought* to be and guiding our *evaluation* of the quality and worth of certain things. An argument could be made that, historically, sociologically, and psychologically speaking, science has been influenced by the values held by scientists and by the society in which science is embedded. Likewise, one could argue that, as a matter of fact, our beliefs about values, our norms, our mores, our culture have changed in part as a result of scientific progress.<sup>1</sup> Both of these arguments could be understood as merely descriptive arguments that leave untouched our ideals about how science ought to work and about where moral truths come from. By contrast, this book directly challenges the views that science ought to be value-free and that values ought to be evidence-free, independent of science. Though I will challenge the very idea of a “merely descriptive” argument, and thus the fundamental nature of the descriptive/normative

<sup>1</sup>Such arguments have, in fact, been made many times by feminists, sociologists of scientific knowledge, and other thinkers.

distinction, I do not shy away from making normative claims. This book provides normative arguments about how we ought to evaluate episodes and decisions in science as to the way they incorporate values, as well as to provide guidance to scientific practitioners and institutions on how they should incorporate value judgments into their work. As such, it seeks to revise our understanding of how science ought to work.

To introduce you the kind of ideas that structure this book, I will start by briefly telling the story of three cases in science where values have played an important role. The first is the long history of scientific racism, the second is a specific early example of feminist psychology, and the third concerns embryonic and adult stem cell research. In the rest of this introduction, I will give an overview of the argument of the book, its fundamental presuppositions, and the general structure of the book and the ways it can be read.

### 1.1.1 *Scientific Racism*

The history of modern ideas of “race” is intertwined with the history of scientific racism; the emergence of each of the human sciences is tied up with emergence of modern ideas about race.<sup>2</sup> Starting with natural historians and philosophers as early as the 16th century, the modern concept of race was developed to explain the superficially obvious differences between human geographical populations and to justify the racist atrocities that Europeans began to instigate throughout the world starting in the 15th century. While some argued that racial differences were merely superficial and environmentally caused, many others argued that racial differences included deep differences in capacities including mental abilities, and that the differences were biologically determined.

In the nineteenth century, concepts and theories of race were further developed by physical anthropologists and evolutionary biologists. Pre-Darwinian scientists like Samuel Morton and Louis Agassiz, made extensive physiological and anthropological comparisons of members of different races in order to argue that the races were different, hierarchically order species. Many Darwinians and Social Darwinists like Herbert Spencer used the theory of natural selection as a mechanism to justify the racist ideology of biological determinism. (Darwin himself, who certainly did not completely escaped the racism of his time, does seem to have largely opposed a biological determinist view of racial differences.)

In the early twentieth century, with the emergence of the new scientific psychology, came attempts to measure the differences in mental ability between races that had been posited by earlier thinkers and defended by Morton on physiological grounds. A variety of psychophysical, behavioral, and cognitive tests were developed in the early days of psychology, the most (in)famous of which was the intelligence quotient (IQ). When IQ

<sup>2</sup> The history summarized in this section can largely be found in Stephen Jay Gould, *The Mismeasure of Man*, Revised and expanded (New York: Norton, 1996) and Audrey Smedley, “Science and the Idea of Race: A Brief History,” in *Race and Intelligence: Separating Science from Myth*, ed. Jefferson M. Fish (Lawrence Erlbaum Associates Mahwah, NJ, 2002), 145–76.

tests became common in the early 20th C, it was quite soon after that this was added to the repertoire of ways that scientific racism attempted to establish the innate hierarchy of the races. Ironically, the creator of the IQ test, Alfred Binet, did not believe the test measured a heritable trait, or even a single property that could be called “general intelligence.” But the essentialist, biological determinist reading of IQ became popular as the test became widespread, especially in America.

By and large, this history of thinking on race existed to reinforce status quo racism and white supremacy by rendering it natural or inevitable. While once could also defend racist and paternalist policies on a cultural/environmental view of racial differences, historically biological determinism has been more commonly linked to such policies. Today, it is relatively easy to see the fallacies and biases behind such research, and there have been several prominent analyses.<sup>3</sup> Yet the research in its time was well-regarded and considered of high quality, and such research reappears regularly in the press, despite the fact that it is inevitably shown to be of poor quality.

Nothing about the processes of science as they exist prevent biases like racism from being reinforced by science. Indeed, science is a relatively conservative institution that often reinforces the status quo, not because it contains big-C Conservative political values (many scientists are liberal<sup>4</sup>), but because science works on a system of peer review in which established experts vet the work of less established members. What’s more, scientific careers are still difficult to access for those with less social privilege, and in the past they were completely closed to all but white men of means. Furthermore, as the relevant sciences all began intertwined with racist ideologies, overcoming them is a long-term process still incomplete.

Science need not, and does not always, problematically reinforce the status quo. Science has the capacity to self-correct, but only when scientists and society carefully foster that capacity. Anti-racist and egalitarian values, used appropriately, have helped debunk bad science and led to better science across a variety of fields in the human sciences. Stephen Jay Gould made clear his values in writing *The Mismeasure of Man*, citing his personal experience in the civil rights movement and arguing that, “We have a much better change of accomplishing something significant when we follow our passionate interests and work in areas of deepest personal meaning.”<sup>5</sup>

<sup>3</sup> Gould, *The Mismeasure of Man* being the classic.

<sup>4</sup> 81% of US Scientists are Democrats or lean Democrat, according to a 2009 Pew poll:  
<http://www.people-press.org/2009/07/09/section-4-scientists-politics-and-religion/>

<sup>5</sup> p. 37

### 1.1.2 *Feminist Psychology*

Patriarchy and feminism play much the same sort of roles in science as white supremacy and anti-racism.

One interesting early episode comes from the work of three collaborators, William Moulton Marston, Elizabeth Holloway Marston, and Olive

Byrne.<sup>6</sup> The three made important contributions to scientific psychology from 1915-1931, to popular psychology in the 1930s, and to pop culture in the 1940s. The Marstons invented the systolic blood pressure lie detector (a component of the modern polygraph), wrote widely on emotions, consciousness, and the relation of psychology and neurology. They did work that anticipated the positive psychology movement decades later. After an academic career cut short by social prejudice, the Marstons went on to create, write, and popularize the comic book superhero Wonder Woman (who was often a mouthpiece for their psychological theories).

The Marstons were convinced that the status quo of their time was deeply unjust *and* psych-emotionally unhealthy. This was a judgment based on an engagement with major feminist political writers and movements, on scientific experiments and clinical observations, and on personal experience of living a marginalized lifestyle. They wrote apt criticisms of the psychoanalytic and behaviorist systems of psychology, in part based on the way they took social categories for granted as real mental kinds, reinforcing the status quo as natural. They sought to provide radically revisionary psychological theory that dispensed with unhealthy and unjust social relations.

On the other hand, their motivations were often far from straightforward, and this raises questions about their scientific work. They did not argue, e.g., that Freud's work was problematic because it was sexist, nor did they make clear their values in their scientific work. Radical value judgments are presented, if at all, as conclusions, not assumptions. In one way, this was a good thing: in many cases, they were able to provide compelling arguments on value-neutral grounds, in much the same way that Gould criticized scientific racists not merely for being racist, but on the basis of methodological, empirical, and technical errors in their work. For rhetorical purposes, this approach is common and often more effective, but the lack of transparency is somewhat problematic. One wonders what decisions lie behind the empirical results they presented.

The academic argument later became an activist project. This, too, was problematic. Interventions as diverse as legal advice, self-help writings, clinical psychology, and creative fiction in popular media are all based on scientific views far from widely accepted in their scientific community, as well as on values that were quite rare in their time. Their psychological views are presented as expert knowledge, but were often quite idiosyncratic. Of Wonder Woman, William Moulton Marston once said, "Frankly, Wonder Woman is psychological propaganda for the new type of woman who should, I believe, rule the world."<sup>7</sup> One can respect the Marstons attempt to use their scientific work to have a beneficial impact on society without completely admiring their propagandistic approach.

Feminist science is largely another case of values having a beneficial

<sup>6</sup> The work of the Marstons is discussed in detail in Matthew J. Brown, "Love Slaves and Wonder Women: Values and Popular Culture in the Psychology of William Moulton Marston," *Feminist Philosophy Quarterly* 2, no. 1 (2016): Article 1. William Moulton Marston is usually assigned sole credit for most of his work, but much of his work was actually collaborative, as argued by Jill Lepore, *The Secret History of Wonder Woman* (New York: Alfred A. Knopf, 2014). I here attempt to correct that problematic attribution.

<sup>7</sup> A letter to early comics historian Colton Waugh, quoted in Karen M Walowitz, "Wonder Woman: Enigmatic Heroine of American Popular Culture" (PhD thesis, University of California, Berkeley, 1974), 42.

influence on science, but we can see here that there are better and worse ways to do it. Ideally, we would like to have a world where scientists are transparent about their values and its influence over their decisions, though misconceptions about the relationship between values and science often make hiding value commitments more rhetorically effective. Likewise, finding ways to use science to the benefit of society is highly desirable, but using propagandistic techniques to forward idiosyncratic and uncertified views is problematic.

### 1.1.3 *Stem Cell Research*

Research on human embryos has often been a hot-button political and ethical issue. Today, the controversy is on CRISPR gene editing of human embryos. But for years the central controversy concerned human embryonic stem cells. In the US, bans on using federal funds for research on human embryos go back to shortly after the legalization of abortion in 1973. Some moves were made towards lifting the ban and authorizing the use of federal funds during Bill Clinton's presidential administration, but the blocks were never fully removed. The greatest controversy over the issue came during George W. Bush's administration, with Bush ironically considered the greatest opponent of embryonic stem cell research, despite the fact that Bush actually authorized the first federal funding for research on 19 embryonic stem cell lines; nevertheless, many restrictions remained in place and more were added, and most embryonic stem cell research had to seek private funding. The second major liberalization of funding for stem cell research came with Barack Obama's executive order of March 9, 2009.<sup>8</sup>

The motivation for restricting research on human embryos is clearly a matter of religious and ethical values. The question concerns what is and is not permissible to do to an embryo, and support for banning such research came from the right-wing Christian religious groups that command significant political power in US politics. The values in question are controversial, and some would argue inappropriate, grounds for public policy in a pluralistic, secular democracy. Whether or not you agree with the policy, there is no ground for calling it "anti-scientific." Ethical restrictions on research because of impact on human subjects, animal subjects, or the environment are common and unremarkable. What counts as a morally considerable subject and what is permissible to do to that subject may depend on scientific information, but are straightforwardly questions of ethics and values.

As a result of the funding environment from 1973-2009, there was limited funding for exploratory research on stem cells. Such funding is largely provided by the federal government, as private funders prefer to support research that is more clearly and immediately commercially

<sup>8</sup> For more on the history of stem cell research funding and politics in the USA, see D C Wertz, "Embryo and Stem Cell Research in the United States: History and Politics," *Gene Therapy* 9, no. 11 (June 2002): 674–78, doi:10.1038/sj.gt.3301744; Varnee Murugan, "Embryonic Stem Cell Research: A Decade of Debate from Bush to Obama," *Yale Journal of Biology and Medicine* 82, no. 3 (September 2009): 101–3.

viable, and charitable and state funding is in relatively shorter supply. While there was never an outright ban on embryonic stem cell research, it no doubt was slowed considerably by the funding bans.

One unanticipated result of the funding restrictions was innovation in the area of *adult* stem cell research and the development of induced pluripotent stem cells. The restrictions spurred the imagination of some of researchers, who went on to develop these techniques for deriving stem cells without involving embryos. Constraint is a spur to creativity; the values-based limitations on funding spurred scientific innovation and progress. Though adult stem cells are less versatile, they also have their own virtues. It is doubtful that as much progress would have been made as fast in the US on adult induced stem cells without the ban in place.<sup>9</sup>

Values need not only be a hindrance to science, even when they create constraints and limitations on what science can do, and even when we disagree with the values or how they were applied. The silver lining in the stem cell case shows that values can interact with the imagination to push science in beneficial new directions.

## 1.2 *The Argument of the Book*

Contingency and choice are ubiquitous throughout the research process. Scientists, engineers, and biomedical researchers face choices of what to investigate and how to investigate it, what methods to use, what hypothesis to test, how to model phenomena, what data to collect, when to stop data collection, and what conclusions to draw based on the evidence. Funding bodies decide to fund this grant application and reject that one. Committees decide to hire or tenure this scientist but not that one. Likewise, institutions have evolved in one direction but could have evolved in another; individual researchers have certain levels of talent and skill that could have been otherwise; sometimes researchers are in the right place at the right time, but other times they are not. Many of these contingencies are out of the control of individual choices, but others are matters of explicit decisions, and many things that are decided by habit, luck, or institutional practice could be made explicit and decided differently.

On what basis are scientists to decide what to do in the face of these contingencies and choices? Some would say that they must be decided *objectively*, by the evidence, by logic and statistics, by scientific standards (sometimes called “epistemic values”) such as simplicity or “Okham’s razor.” But right away, we can see that this answer is inadequate for many scientific questions, such as which question of the infinity of possible questions we should study, or what methods are ethical and humane to use on animals or human subjects. In order to make these decisions, we must also consider our *values*, what we care about, our goals, ethics,

<sup>9</sup> Gretchen Vogel and Constance Holden, “Developmental Biology. Field Leaps Forward with New Stem Cell Advances,” *Science* 318, no. 5854 (November 2007): 1224–5, doi:10.1126/science.318.5854.1224; Mahendra Rao and Maureen L Condic, “Alternative Sources of Pluripotent Stem Cells: Scientific Solutions to an Ethical Dilemma,” *Stem Cells and Development* 17, no. 1 (2008): 1–10; Murugan, “Embryonic Stem Cell Research”; Frederick Grinnell, *Everyday Practice of Science: Where Intuition and Passion Meet Objectivity and Logic* (Oxford: Oxford University Press, 2009), 95.

duty, responsibility, what is right and good.

This book argues that few, if any, of the decisions scientists face can, in principle, be decided by logic and evidence alone. Values are relevant throughout the research process, and scientists have an ethical responsibility to weigh values and make value judgments in the course of the research process, even when dealing with data and drawing conclusions. Each contingency in science could, in principle, become an explicit choice. Any such choice could have foreseeable consequences for what we value; to find out for any particular case, we have to think about values, exercise moral imagination to determine the consequences of each option, and exercise value judgment as part of the choice. We cannot always foresee the consequences; the choices may sometimes be irrelevant to our values, but we cannot determine that ahead of time without looking at the details of the case. Thus, scientists have a responsibility to make value judgments about scientific contingencies, and thus science is value-laden through and through.

I call this general argument “the contingency argument.” This argument is meant to undermine the ideal of science as value-free (or *the value-free ideal* for short), according to which, science should be impartial and should work independently from and be neutral for our values. The value-free ideal is motivated by the thought that it will minimize the bias, subjectivism, and potential for wishful thinking that values would bring into science. Science, after all, is supposed to be objective. And yet, as the contingency argument shows, scientists have an ethical obligation to bring in values. While this may appear to create a conflict between the scientists’ responsibilities, I argue that the apparent conflict is based on a mistake, an implicit view about values—that they are necessarily biasing, subjective, arbitrary, or, as I will put it, that they have no *cognitive status*. To deny that values have cognitive status is to deny them meaning, warrant, credibility, and truth. To insist, as I do, that values can have cognitive status means that they need not be biasing or subjective, that they need not lead to wishful thinking, that they are meaningful and can be warranted and credible. Indeed, we cannot make sense of human practices, human passions, of heartfelt disagreement over values, or the genuine difficulty of moral quandaries, without attributing some cognitive status to our values.<sup>10</sup>

If values have their own cognitive status, then they need not necessarily lead us to subjectivism and wishful thinking. On the other hand, we still need to know how to manage values in science. Attributions of “cognitive status” are no panacea against wishful thinking. Nevertheless, there is no general reason to think that value-laden science is deficient or necessarily leads us to wishful thinking.

What we need is a better theory of values, one that avoids the simplistic idea that values necessarily lead to unacceptable bias, one which allows

The **value-free ideal** holds that values should play no role in the internal processes of science.

<sup>10</sup> This claim is consistent with the sophisticated contemporary philosophical positions of metaethical “non-cognitivism” and “anti-realism,” which do not support the view that values are necessarily biasing.

us to acknowledge the cognitive status of values, one that can help us distinguish the legitimate roles for values in science from those that lead to dogmatism and wishful thinking. This theory of values should be “science friendly,” neither presupposing some mysterious, supernatural realm of values, nor removing values from the realm of evidence altogether. Science allows no unmoved movers. I propose a *pragmatic pluralist* theory of values, according to which values are inherently connected with action, come from many sources in human life, practice, and experience, and come in many different types according to the many different roles they play in our activities. On this view, there is a crucial distinction between unreflective or habitual values and reflective value judgment, where the latter is understood as a type of empirical inquiry into questions of what to do. The cognitive status of values tracks both their success in guiding human activities and the quality of the inquiry that warrants their evaluation. This theory of values may not be the only one for the job, nor does it necessarily satisfy the deeper questions of metaethics and ethical theory, but it has many benefits as a practical theory of values.

Central to the pragmatic pluralist theory of values is the concept of moral imagination. Value judgment requires considering stakeholders and the various implications and consequences of various courses of action connected with values. As such, it requires exercising imagination via empathy, dramatic rehearsal, and creative-problem solving. The exercise of moral imagination is not mere fantasy but a part of all evidence-based inquiry. The emphasis on imagination is an important feature of this theory of values, one compatible with any ultimate ethical theory.

Based on this account of values, I define a new ideal for values in science, a replacement for the value-free ideal, which has been undermined by the contingency argument. I call this ideal, “*the ideal of moral imagination*,” defined as follows: *Scientists should recognize the contingencies in their work as unforced choices, discover morally salient aspects of the situation they are deciding, empathetically recognize and understand potential stakeholders, imaginatively construct and explore possible options, and exercise fair and warranted value judgment in order to guide those decisions.* This is an open-ended ideal to strive for, difficult in principle to satisfy, just as the value-free ideal was. It is not a minimal criterion for all inquiry to satisfy, but it is a genuine ideal.

**the ideal of moral imagination**

The ideal of moral imagination, in turn, allows us to recognize two kinds of irresponsibility in scientific research: 1) *Misconduct*: When scientists violate clear minimal constraints on responsible research (e.g., fabricating data, plagiarism, experimenting on human subjects without consent). 2) *Failures of moral imagination*: Failing in one way or another to live up to the ideal of moral imagination, e.g., by failing to consider a reasonable range of options (including the superior option), or by not considering the impact on relevant stakeholders. The second is the new

form of evaluation that the book defines and advocates. It is generally a matter of degree, where misconduct is usually an all-or-nothing question.

While the ideal of moral imagination allows us to identify a distinctive failure of responsibility, its emphasis is on the positive, on what values and value judgment can contribute to scientific inquiry. The ideal of moral imagination gives scientists something to strive for and tools for responsibly making the choices that pervade the research process. It can guide decisions about research agenda, methodology, and framing hypotheses; it provides guidance on the questions that arise in the conduct of inquiry, of gathering data, of testing and refining hypotheses; it can improve the way that scientific results are presented and applied.

### 1.3 *The General Orientation of the Book*

While this book aims to give generally accessible arguments for the views it lays out and to engage closely with previous ideas about values in science, inevitably it is shaped by my own philosophical orientation and personal perspectives. I believe it is helpful and somewhat more honest to lay bare my personal commitments and assumptions. While I believe each viewpoint is defensible and well-defended insofar as it has an impact on the book, none is entirely uncontroversial, and it will help you as a reader to know ahead of time where I am coming from.

#### 1.3.1 *Normative Pragmatism*

Normative arguments are central to this book; the goal of the book is to guide scientists and to inform our evaluation of science, particularly with respect to the ethical responsibilities of science. The general philosophical viewpoint of the book is *normative pragmatism*, in two senses. The first is that its approach to normativity is *pragmatic*. This means that the norms are engaged with practice, and ultimately evaluated by their impact on the practice. All normative claims are claims about how we should act, and nothing prior to actual action—no a priori arguments, no nonnatural facts, no process of value judgment—can ultimately determine the truth of such claims. Only the impact on action and practice consequent to adopting a value judgment can be the test.

The second is that *pragmatism* itself is taken as a normative framework for scientific practice and value judgment. Thus, scientific inquiry is conceived as properly practical inquiry, and the theory of values is considered according to a framework of pragmatic pluralism. I do not claim that pragmatism adequately captures the folk understanding of knowledge or truth, nor that it best explains what scientists are thinking about or trying to do when they engage in scientific practice. Nor do I claim that folk conceptions of ethics, or conceptual analysis of folk

**Normative pragmatism** is the view that (1) norms are practical, and (2) pragmatism is the normatively best philosophical framework.

beliefs about values, will deliver a pragmatic pluralist theory of values and value judgment. Rather, I claim that our practices and beliefs should be revised to be more pragmatist, because pragmatism is the best normative framework for science and ethics. In concert with the first sense of “normative pragmatism,” I think this second sense of normative pragmatism is justified (1) by the recurrent problems that arise in current scientific practice as well as in accounts of science and of values (and especially of their intersection), and (2) that the ultimate test of the claim is the improvement of scientific and ethical practice.

The normative pragmatist approach is consistent with and supportive of two growing trends in philosophy of science and ethics, respectively. In philosophy of science, it is the best framework for bringing to fruition the increasing focus on and responsiveness to scientific practice, without allowing philosophy of science to collapse into a merely descriptive enterprise. In ethics, the increasing focus on the complexities of our moral lives and frameworks of practical ethical deliberation, over foundational, principle-based moral theorizing is best accommodated by a pragmatist, pluralist theory of values. Many, though not all, of the elements of the argument in this book are independent of the pragmatist theory of inquiry and the pragmatic pluralist theory of values. Nevertheless, the latter two theories are the best way to fulfill the ambitions behind these current trends, and provide the most robust normative ideal for the interplay of values and science.

### 1.3.2 *Moral Imagination*

A central concept, at the heart of the positive recommendations of this book, is that of “moral imagination.” Moral imagination plays a central role in the theory of value judgment laid out in Chapter 6, and thus a central role in the ideal for values in science laid out in Chapter 7. Moral imagination means a few different things, each of which plays a role in the book. In one sense, moral imagination is about the role of imaginative and creative thinking in ethics and value judgment. Our capacities for empathy and compassion depend on our understanding of the perspectives, feelings, and values of others, and are thus acts of imagination. Likewise, integrating values through creative thinking about moral problems is an important element of ethics that is undervalued and sometimes positively undermined by the philosophical literature, especially its focus on clear-cut dilemmas. In another sense, moral imagination represents a special constraint on our decision-making: we should judge our actions in part by thinking expansively about their implications and consequences beyond the here and now, beyond our inner circle, and these considerations require imagination.

The third sense of moral imagination has to do with the formation of

**Moral imagination** concerns the roles of imagination and creativity in the moral life.

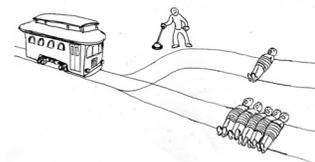


Figure 1.1: **The Trolley Problem.** An example of the kind of clear-cut and wholly artificial dilemma that the philosophical literature in ethics is obsessed with. (Credit to Jesse Prinz for the original drawing.)

our ends and ideals. In my view, our highest ethical and social calling is to create new ends or goals and to strive for more complex values and a more intentional life, not to live habitually, unthinkingly, or for some purpose conceived remotely from ourselves. The horizon of our ethical life should not be the way things are, now; we should imagine ways the way could be better, should be better, in light of the problems we face now. Our current situation is a starting point, not a destiny.

We cannot fulfill this calling alone; our ethics must be a democratic social ethics. As Jane Addams wrote:

[I]f in a democratic country nothing can be permanently achieved save through the masses of the people, it will be impossible to establish a higher political life than the people themselves crave; that it is difficult to see how the notion of a higher civic life can be fostered save through common intercourse; that the blessings which we associate with a life of refinement and cultivation can be made universal and must be made universal if they are to be permanent; that the good we secure for ourselves is precarious and uncertain, is floating in mid-air, until it is secured for all of us and incorporated into our common life.<sup>11</sup>

What's more, no good can be adequately chosen for us from without. As the slogan goes, "Nothing about us, without us." Though ends do not become worthy merely by being chosen by us, no end can be entirely worthy of us unless we choose it freely and intelligently, rather than having it imposed upon us.

What we need is an ideal for values in science that is not concerned with merely policing a minimum boundary of acceptable conduct, nor a concessive *Realpolitik*, but an ideal that guides us to strive for a better world. Minimal bounds must sometimes be outlined and policed, when we're in real danger of violating them, but it can also be counterproductive, insofar as it leads us to think of all ethics as a negative force, a restriction rather than a higher target to aim for. *Realpolitik* has a role to play in the short-term assessment of means to ends; it has no place in the determination of ends. There is a strong anti-idealism in certain quarters of philosophy of science and practical ethics today, which justifies itself in a mistaken reference to being realistic and practical. But there's nothing unreal about the ability of ideals properly formed to guide us towards improving the world, and there is nothing less practical than allowing bad actors and unjust systems to limit your hopes and your aspirations.

### 1.3.3 Pervasiveness of Evaluation and the Contingency of Science

On my view, *evaluation* is a pervasive feature of intelligent practices generally, and scientific inquiry particularly. This word, "evaluation," carries a lot of freight. It means both making a judgment about something and determining the worth of something. Judgments are not mechanical, but as in a "judgment call," require the careful exercise of intelligence, wisdom, and wit, and still it is often the case that equally wise experts

<sup>11</sup> Jane Addams, *Twenty Years at Hull-House with Autobiographical Notes* (New York: McMillan, 1910), Chapter 6.

*Realpolitik* is a German term literally meaning "realistic politics," but it typically connotes cynical and amoral politics focused on immediate problems and interests. *Realpolitik* assumes most conditions and behaviors are fixed and is uninterested in ethical arguments that they should be otherwise.

judge the same case differently. This suggests open options, a contingency to the direction of evaluations. Making a judgment call generally requires determining the relative worth of the options to the situation at hand. If we are making a decision about how to act, the worthiness of the actions (their meaning and their consequences) is what we judge. If we are deciding between theories, their worthiness to explain, predict, or control the phenomena in question is perhaps foremost.

Science is hard; it cannot be reduced to a set of rules. Also, there are many potential paths to success in science. Some move piecemeal and conservatively, others make wild leaps and suggest radical changes. Sometimes novel discoveries depend on opportunities that arise—right place, right time; others depend on whether the right confluence of training, techniques, ideas, and technologies are available to make the leap—the right tool (or person) for the job. For all these reasons, the direction of science is highly contingent.<sup>12</sup> As such, evaluation, or judgment, is necessary at many steps of the way. Any account of science must wrangle with these features of scientific practice.

#### 1.3.4 *Avoiding Extreme Optimism or Pessimism*

My introduction to the philosophy of science came through William James, Thomas Kuhn, and Paul Feyerabend. As a result, I am highly skeptical of pollyanna theories of science as everywhere rational, comprehensive, cumulative, and authoritative. The authority, objectivity, and beneficence of science have always been an open question for me, and I think careful research on the history and nature of scientific practice shows that it really is a mixed bag. Among the successes are examples rank bias, exploitation, skullduggery, and obvious mistakes. No more so that any other human endeavor, however, especially others that are the traditional province of the privileged, as science is and has been.

On the other hand, I have always been fascinated by science and technology, and I acknowledge that it is easy to take skepticism about science too far. It is not plausible to hold that science is *inherently* sexist and racist (even if most of its institutions have been), that it is mere politics (power struggle and clash of opinion), that it has no epistemic authority of its own. Again, it seems to me that careful research on the history and nature of science shows that something special has happened on the historical occasions when the active, experimental methods of knowledge production and the speculative, theoretical methods of knowledge production work together. While each has a long history of separate development (as the active, experimental tradition of the artisan and technician and the speculative, theoretical tradition of the mathematician and philosopher, respectively), their combination is more historically rare and is what makes modern science so productive.

<sup>12</sup> Some scientists and philosophers of science deny that science is really so contingent. They point towards things like simultaneous discoveries and argue for the inevitability of certain conclusions. They would explain this fact on the basis of the constraints provided by reality. But note that “contingency” does not mean absence of constraints on successful science. See Ian Hacking, *The Social Construction of What?* (Cambridge, Mass: Harvard University Press, 1999); Allan Franklin, “Is Failure an Option? Contingency and Refutation,” *Studies in History and Philosophy of Science Part A* 39, no. 2 (2008): 242–52; Lena Soler, Emiliano Trizio, and Andrew Pickering, eds., *Science as It Could Have Been: Discussing the Contingency/Inevitability Problem* (Pittsburgh PA: University of Pittsburgh Press, 2015).

There is a difference between having a critical attitude and a skeptical one. I recommend and try to teach my students how to have a critical attitude towards science. To uncritically accept every bit of scientific information would be foolish, as is the wholesale rejection of science or even areas of science common in certain segments of modern society. It is not difficult for the well-equipped layperson to evaluate science, to tell the difference between the novel results in a single study and something established by a large literature, to recognize potential conflicts of interest and sources of bias, and to identify failures to check potential harms to society. I find providing the tools for such evaluations a much more satisfying than providing a partisan defense of (or attack on) science.

### 1.3.5 *The Unity of Science, Engineering, and Medical Research*

For some purposes, we may want to distinguish science proper (or “pure” science) from engineering and medical research (or “applied” science). For example, we may want to reserve a certain percentage of funding for “basic research” that has no obvious or immediate application to technology, medicine, or policy, based on our sense of past successes of such research or its intrinsic worth, especially in an environment where such research is undervalued by granting agencies.<sup>13</sup> For the purposes of this book, namely, understanding the general nature of scientific inquiry, the ethical responsibilities of scientists, and the impact of science on society, there are no significant differences among the three.<sup>14</sup> Likewise, I see no significant differences between natural and social sciences with respect to these questions. Of course, the different sciences have different subject-matters, different relations to society, and different values relevant to their inquiries. But as such, when writing in general about “science” or “research,” you should know that I have all of these things in mind. “Science” throughout the book can generally be read as shorthand for “STEM” or “natural and social science, engineering, and biomedical research,” and “scientists” for “STEM researchers” or “scientists and engineers.”<sup>15</sup>

### 1.3.6 *A Heuristic Focus on the Individual and Small Groups*

I will present many of the ideas and arguments in this book, at least at first, from the point of view of the individual scientist in the midst of research, or from the small scale research collaboration. This is not because I think science or scientific knowledge is fundamentally individualistic, nor because I think the influence of society is fundamentally ineliminable. Rather, my reason for presenting things in this way serves three related, heuristic purposes.

First, I think the place where we most need guidance, where there is the greatest gap between the way things ought to be and the way things are, is

<sup>13</sup> Whether we are in such an environment at present is another question.

<sup>14</sup> For more on the interdependence of science and technology, and the history of the boundary between them, see David F. Channell, *A History of Technoscience: Erasing the Boundaries Between Science and Technology, History and Philosophy of Technoscience* (New York: Routledge, 2017).

<sup>15</sup> Medical practice (what doctors do) has many aspects that are distinct from the research activities covered in this book, and should not be understood as covered by the arguments herein.]

the individual level. Individual scientists and small groups in the lab have a great degree of power over the shape of the scientific process. While the larger social processes of peer review, funding, extended controversies and their settlement in the scientific community, and the codifying of knowledge for application, textbooks, etc., are also extremely important, many important decisions take place within the research process itself, which is governed mainly by individuals and small groups; unlike their results, those decisions are often not open to scrutiny of the scientific community. Science involves a lot of trust—we trust researchers to report their results honestly and accurately, to follow the protocols that have been approved for their use of research subjects and sensitive materials, to evaluate the work of other scientists on the merits. We trust experts to give us an accurate representation of the state of scientific knowledge. Social checks and balances themselves are not enough if the conduct of scientists is not responsible. Yet the guidance we provide to science on what it means to be responsible is woefully narrow and inadequate.

Second, I follow thinkers like Ron Giere and Nancy Nersessian in thinking that the larger social processes can be treated as cognitive processes, and that there is a unified framework for describing the work of the individual thinker and for describing groups, even large groups, thinking together.<sup>16</sup> As such, I think it is possible to read individualistic-sounding language of “choice,” “decision-making,” and “judgment” literally even when the processes in question cannot in principle be done by an individual, but are the product of the whole scientific community.

Third, there are many issues of values, ethics, and politics that appear at the larger social level that are intentionally outside the scope of this book. For instance, the commercialization of science has huge impacts on the larger workings of science today, impacts that are largely negative, that have led to unreliability and fraud in whole areas of research, especially certain areas of biomedical, environmental, agricultural, and nutritional research. There are practical limits to what individuals can do here. The recommendations in this book may help, but they are admittedly insufficient to resolving the problem. Also, there are large-scale religious, conservative, and populist attacks on the authority of science that are incredibly difficult to fight, and focusing on those attacks has led to reactionary responses that distort our understanding of science. Frankly, I am not only at a loss personally to provide useful guidance on these issues, I am not optimistic that they can be addressed at all without significant social, cultural, and political-economic change. Thus I focus on the level where I think we can make some real progress in ameliorating science and its impact in the midstream of the research process.

<sup>16</sup> Ronald N. Giere and B. Moffatt, “Distributed Cognition: Where the Cognitive and the Social Merge,” *Social Studies of Science* 33 (2003): 301–10; N. J. Nersessian et al., “Research Laboratories as Evolving Distributed Cognitive Systems,” in *Proceedings of the 25th Annual Conference of the Cognitive Science Society*, 2003, 857–62.

## 1.4 *The Structure of the Book*

Before concluding this introductory chapter, I will explain the way the book is written, both the unusual structure of each chapter, the grouping of chapters, and the nature of the argument. There are different ways to read the book, depending on your interests and backgrounds.

### 1.4.1 *The Structure of Each Chapter*

If this were an ordinary academic book for specialist audience of philosophers of science, each chapter would probably be structured in a familiar way:

1. Review previous work on the topic, arranged according to the structure of the dialectic or debate.
2. Identify the need for intervention through arguments showing the limits of what has come before.
3. Provide a general argument for an alternative view.
4. Examine a case study that exemplifies or illustrates the alternative.<sup>17</sup>
5. Respond to potential objections.

<sup>17</sup> Steps (3) and (4) are frequently reversed.

This book is different because it is written and structured with multiple audiences in mind. Each chapter (except this one) is structured in 4 sections as follows:

1. Brief characterization of the problem or question the chapter is meant to address. Intended to be jargon-free and accessible to a general audience.
2. The positive account that addresses the problem or answers the question. Meant to be broadly accessible to those familiar with the nature of scientific inquiry or with philosophical arguments, viz., philosophers, STS scholars, scientists, graduate and advanced undergraduate students in any of these fields.
3. Engages historical sources and the contemporary literature in (mainly) philosophy of science and ethics and defends the positive view in greater technical detail, as well as exploring further related issues. Written primarily for advanced graduate students and experts in the fields of philosophy of science and STS.
4. Briefly reviews open issues and questions and sets up the transition to the next chapter.

### 1.4.2 *Pathways through the Book*

Anyone simply wanting to understand the unique positive arguments and theory I'm proposing, including scientists who want motivation and advice for improving their practice, can focus on sections 1, 2, and 4 of each chapter.

Chapters 2-7 give the general account of scientific inquiry, the need

for values therein, the nature of values and value judgments, and the ideal of moral imagination.

Chapters 8-12 apply the ideal of moral imagination to issues in the planning, framing, conduct, and application and dissemination of science, as well as in the building, presentation, and metaphysical analysis of “the scientific worldview.”

If you want motivation for thinking that values really do matter to science, that scientific knowledge is significantly value-laden, that scientists need to exercise value judgments, Chapter 3 is key. The full argument for the need for the kind of ideal I provide proceeds primarily in Chs 2-4. The argument for the ideal itself is the business of Chs 5-7.

If you want to use the book primarily for practical training purposes in responsible conduct of research, then you can focus on chapters 6-11, reading sections 1, 2, and 4 of each chapter.

### *1.4.3 The Proof of the Pudding*

The proof of the pudding is in the eating, and the proof of a philosophical argument is in the insight it provides when put to use. In my view, the appearance of definitive argument in philosophy on foundational grounds is typically an illusion. Of course, each chapter has plenty of arguments. But as far as I am concerned, the real value of the ideas is seen in their usefulness in making practice more intelligent and responsible. The best philosophical arguments proceed from the careful analysis of a genuine problem, provide arguments that justify betting on a certain way of solving the problem, and then point the way to how that solution will alter our practices and activities and how we can tell if they have been improved thereby. This is an atypical mode of argument in many philosophical traditions, but quite common to pragmatists among others.

The entire structure of the book is geared towards this style of argument. Chapters 2-4 provide background and set up a problem, Chapters 5-7 provide an alternative account and reasons to think it is plausible, while Chapters 8-12 provide details on how to the account to various types of decision. Each chapter to some extent also recapitulates this structure (§1 for problems, §2 for the theory or account, §3 to showing how the account can handle various complexities).

My hope is that the perspicuity with which my account handles specific cases discussed in the latter part of the book will convince you of the plausibility of my account, and give you reason to try it out in your own practices, whether you’re a working scientist or someone who has to be a critical consumer of scientific results. I will not be satisfied however (and neither should you be) until the ideas here defended are put to use and make some improvement in science and in society. All I can do here is convince you to give them a try.