CHAPTER 9

The Present Plight of Science, and Our Plight

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We need the help of the sciences now more than ever, what with the various coronavirus pandemics and other global diseases; repeated economic downturns; environmental pollution and global warming; racial, ethnic, and other sources of social unrest; the ever-present threat of cyberattacks; and much, much more. Yet the sciences these days are suffering from their own set of problems, and have even contributed in significant measure to many of these problems that now beset us (cf. Chapter 10). Are the sciences, therefore, up to the job we need done right now, or can they be helped to be up to that job, and if so, how? These are serious questions that a socially relevant science studies should take up. What might be philosophy of science's role in that endeavor? This is my topic. But the scene is extremely complex. So it is best to start at the beginning.

The Way Science Was Supposed to Be

Let us begin, therefore, at the dawn of modern science. For it was then that a promise was made: If society would but support the new enterprise, society would be richly rewarded not only with unprecedented insights into the workings of the universe but also with all the benefits such insights would provide. Indeed, Francis Bacon, one of the chief architects of the new experimental science of the seventeenth century as well as one of its more exuberant press agents, promised that the knowledge science would offer would "establish and extend the power and dominion of the human race itself over the universe" for the benefit of all humankind (1960/1620: 117–119). What did Bacon mean? The problem, as he saw it, was that the human race had been thrust into "immeasurable helplessness and poverty" by the Fall from Eden and needed to be rescued. And science would be the rescuer. In other words, science would provide a solution to the plight of humankind (Bacon 1964/1603).

To explain how this would go, Bacon offered a blueprint for the new science, a blueprint that was later adopted by the Royal Society as well as other early scientific societies and that is still in effect today. In it he included illustrations of the benefits he expected from the new science. Science, Bacon suggested, would make possible the curing of diseases and the preservation and prolongation of life; science would produce the means to control plant and animal generation; science would lead to the development of new materials, including new building materials and new clothing materials; and science would provide new modes of transportation ("through the air" and "under water") and even new modes of defense (Bacon 2008/1627). In all these ways and others too, science would make humans once again the masters of nature as they had been in the Garden of Eden, and hence once again "peaceful, happy, prosperous and secure" (Bacon 1964/1603).

True, religion would have to play an important role in this achievement. In fact, Bacon emphasized the theological dimensions of the scientific activities he supported. For him the study of nature, the study that would bring all manner of practical benefits, would also be the study of the Creation, thereby increasing human knowledge and glorification of the Creator and thus adding to the justification of the study. Moreover, this study would require spiritual as well as intellectual discipline, and would involve spiritual as well as intellectual purpose. "We have certain hymns and services," Bacon had the scientists in his utopian *New Atlantis* report, "which we say daily, of Lord and thanks to God for his marvellous works: and forms of prayers, imploring his aid and blessing for the illumination of our labours, and the turning of them into good and holy uses" (2008/1627). So religion was to be a necessary complement to the new science (McKnight 2005), but a religion very much reformed – "purified" – by the dominant intellectual movement of the day: humanism. Indeed, Bacon's promise regarding what science would achieve for humanity incorporated central tenets of Renaissance humanism: that humans were essentially good, or at least deserving of the benefits that God had placed in nature for their use (the benefits that Bacon's science would uncover and further develop); that God had given humans vast intellectual and creative powers, powers that should be cultivated to the fullest (just the powers that Bacon's science would require); and that such powers should be used to improve the lot of humanity – their intellectual and physical worlds as well as their moral and social ones (which was at least a good deal of what Bacon's science was about). Without these humanist tenets, in fact, Bacon's promise would not have been nearly as compelling (see for further details Sargent 2002; 2005; 2012).

At the dawn of modern science, then, Bacon promised all manner of societal benefits if science were supported. And over the next four centuries many other distinguished representatives of the scientific establishment made that same promise. One of the most famous of these in the twentieth century was Vannevar Bush, the engineer and inventor who headed the United States Office of Scientific Research and Development during World War II. At the end of that war, Bush sent a report to President Franklin D. Roosevelt that became the basis of US science policy for much of the twentieth century. In it Bush promised that, if science is supported by society but also left free of societal control, its advances will bring

> more jobs, higher wages, shorter hours, more abundant crops, more leisure for recreation, for study, for learning how to live without the deadening drudgery which has been the burden of the common man for ages past. Advances in science will also bring higher standards of living, will lead to the prevention or cure of diseases, will promote conservation of our limited national resources, and will assure means of defense against aggression. (1945: 10)

What's more, Bush added, such advances in science will be crucial for attaining these benefits. "Without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world" (1945: 11).

So, here was Bacon's promise again. The seventeenth-century theological infusions were gone, to be sure, but so much else, including so much of Renaissance Humanism, remained. Indeed, where Bush now promised "health, prosperity, and security" for people as a result of science, Bacon had promised that they would be "peaceful, happy, prosperous and secure" as well as healthy; where Bush now promised that science would banish the "deadening drudgery" of their pre-science existence, Bacon had promised that science would end the "immeasurable helplessness and poverty" of that existence; and so on.

Bush's promise did depart from Bacon's in one respect, however. It had to do with what counted as *legitimate* science and how social benefits would arise from it. For Bacon, scientific research was all about – *should be* all about – attending to the needs of society:

> Lastly, I would address one general admonition to all – that they consider what are the true ends of knowledge, and that they seek it not either for pleasure of the mind, or for contention, or for superiority to others, or for profit, or fame, or power, or any of these inferior things, but for the benefit and use of life, and that they perfect and govern it in charity. For it was from lust of power that the angels fell, from lust of knowledge that man fell;

> but of charity there can be no excess, neither did angel or man ever come in danger by it. (1960/1620: 15–16)

If such research (inspired by humanism as well as religion) were supported, Bacon promised, science's social benefits would result. For Bush, on the other hand, the most important kind of scientific research, the kind on which other scientific research depends, was all about freely pursuing "the truth wherever it may lead." "Scientific progress on a broad front results from the free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown" (Bush 1945: 12). And only if society supported *that* kind of research would science's social benefits result.

By the end of the twentieth century, however, "the free play of free intellects" was no longer considered "the best precondition for maximizing the utility of science" (Rohe 2017: 745; see also Gibbons 1999; Guston 2000a; Krishna 2014; Sarewitz 2016). Science had just gotten too big and too costly, with no end in sight to its continued and ever-increasing demands for support. As a result,

> The sheer size of the system and its need for sustainable allocation of funds is finally unbalancing Bush's claim for the "free play of free intellects." . . . To continue feeding the science system, a broad societal consensus is needed, in which legitimization is increasingly, often tightly, linked to performance measures and other demonstrable evidence of contributions to social welfare, economic growth, and national security. (Rohe 2017: 746)

No matter. Whether the free play of free intellects was what yielded the social benefits of science (as Bush had claimed) or whether they resulted most reliably only from research explicitly aimed at them (as Bacon had suggested), Bacon's promise – that such benefits *would* result if science were supported – was still very much taken for granted.

The Way Science Is Now

Today, well into the twenty-first century, Bacon's promise has never been more important, what with the problems mentioned at the outset: global diseases such as COVID-19; repeated economic downturns; environmental pollution and global warming; racial, ethnic, and other sources of social unrest; and all the rest. And yet, the obstacles to the fulfillment of that promise have also never been greater, even with the support lavished on science by society. Of course, there have always been obstacles. Bacon himself recognized obstacles – such as the "idols of the mind," the various

sorts of errors in human reasoning (whether innate or acquired) that are part and parcel of the human condition, and "the dullness, incompetency, and deception of the senses," "by far the greatest hindrance and aberrations of the human understanding" (1960/1620: 52) – and Bacon sought ways to overcome them (Sargent 2002). Still, those obstacles seem modest in comparison to the obstacles that now confront scientists. If we are ever to be "healthy, happy, prosperous, and secure" as a result of science, as Bacon promised, the current crop of obstacles must also be addressed.

Consider, then, the current obstacles to the fulfillment of Bacon's promise – or at least some of the most pressing of them – and consider, in particular, the scene in North America, the place I know best. There, during the last decade or so, those in the science and science studies communities have been anxiously discussing a variety of problems within the sciences – actually a variety of *sets* of such problems – that they say are of great consequence for society. Indeed, taken together these problems may very well undermine the possibility that science will be able to help us deal with the global challenges that now confront us.

The War on Science

Start with one of the oldest of these current sets of problems. It is said, by science journalists and even many scientists, to involve nothing less than a *war* on science, a war that has been going on for *decades*. Take, for example, Pulitzer Prize-winning *Washington Post* science reporter Chris Mooney's 2005 book *The Republican War on Science* and science writer and filmmaker Shawn Otto's 2016 book *The War on Science: Who's Waging It, Why It Matters, What We Can Do about It*. They describe the war in the United States, while science writer Chris Turner's 2013 book *The War on Science: Muzzled Scientists and Wilful Blindness in Stephen Harper's Canada* describes the war that has taken place in Canada. These books have been supplemented by documentaries on the war, such as one by the BBC in 2006 (BBC Horizon 2006) and one by CBS in 2020 (CBS News 2020), and they have been supplemented, as well, by a continuing stream of articles on the war in such venues as the *New York Times* and the *Washington Post*, *Scientific American* and the *National Geographic*, and the *Guardian* and the *Globe and Mail* – a continuing stream of articles that turned into a torrent after Donald Trump was elected.

The details contained in these war reports are jarring: how, starting in the 1980s, influential Republicans, first in the US Congress and then in

the White House, joined forces with corporate interests and fundamentalist Christians to challenge scientific findings in a wide range of areas, including health, education, and the environment. Particular issues concerned, for example, the efficacy of condoms in preventing the spread of sexually transmitted diseases, the efficacy of abstinence-only sex education programs, the status of creation science and of evolution, the status of endangered species, and, of course, global warming. Their tactics included misrepresenting scientific debates to the public, exaggerating scientific uncertainty, preferring outlier scientific views to the views of recognized experts while attacking the integrity of those experts, and stacking government agencies and advisory committees with partisan individuals who could and did hold back or alter scientific reports with which they disagreed.

Not to be outdone, Canadian prime minister Stephen Harper, starting in 2011, not only engaged in these same kinds of practices but also instituted sharp cutbacks in basic research and the overall funding of climate, energy, and environmental research, leaving thousands of government research scientists out of work and hundreds of scientific research institutions and more than a dozen federal science libraries shut down. And after he took office in 2017, US president Donald Trump tried to outdo even this, with an average of two administration efforts to restrict or misuse science per week at the federal, state, and local levels – over 400 in all, as documented by the Silencing Science Tracker, a joint initiative of Columbia University's Sabin Center for Climate Change Law and the Climate Science Legal Defense Fund.[1]

Harvard University science historian Naomi Oreskes and California Institute of Technology science historian Erik Conway, in their 2010 book *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, have explained how even well-placed academic scientists have contributed to this ongoing war on science. Referring to strategies that Stanford University fellow science historian Robert Proctor called the "tobacco strategies" in an earlier war book of his own (*Cancer Wars: How Politics Shapes What We Know and Don't Know about Cancer*), Oreskes and Conway detail how these strategies were intended to produce doubt and confusion in the American public regarding such serious problems as acid rain and the hole in the ozone layer as well as global warming and secondhand tobacco smoke. The

[1] See NowThis Impact 2020 and, for further information about the Silencing Science Tracker, https://climate.law.columbia.edu/content/about-silencing-science-tracker.

strategies included: supporting decoy research to distract from critical questions, thereby "jamming the scientific airwaves"; organizing "friendly research" for publication in popular magazines and even setting up scientific "front organizations" to advocate for their friendly conclusions; producing divergent interpretations of scientific evidence and also misinterpretations as well as engaging in suppression of such evidence; forever calling for more research and more evidence and setting standards for proof so high that nothing could ever satisfy them; and exploiting or actually producing divergent expert opinions (see also Michaels 2008; 2020). The scientists involved included such luminaries as Fred Seitz, past president of the National Academy of Sciences and of Rockefeller University; Robert Jastrow, founding director of the Goddard Institute for Space Studies; William Nierenberg, past director of the Scripps Institution of Oceanography; and Fred Singer, first director of the National Weather Satellite Center and founder of the Science and Environment Policy Project in his home state of Virginia. In each case, Oreskes and Conway tell us, what motivated these scientists to work against the existing strong consensus within the international scientific community were anti-regulation, market fundamentalist political commitments rather than interests in safeguarding industry profits. Still, the activities of Seitz and the others were backed by major conservative think tanks that were, in turn, backed by the US fossil fuel industry, particularly ExxonMobil.

All of these activities constituting the ongoing war on science are only the first set of problems currently confronting science – a set of problems, to be sure, specifically confronting *North American* science. But since that science is a major part of the international scientific scene, these problems have had significant effects, as well, on the rest of the world's science. This should be quite apparent even for those not especially engaged in science-watching. Trump's denial of climate change and his dismissal of, interference with, and finally extraordinary actions to undermine US climate science, for example, together with his withdrawal from the Paris Climate Accord, put definite strains on international collaborative scientific efforts to limit climate change. Add to this Trump's attacks on the science as well as the scientists dealing with COVID-19, his strident criticism of the World Health Organization's handling of the pandemic, and his plans to withdraw its US support, and you have another example of the relevance of the North American scientific scene to the rest of the scientific establishment. As these events indicate, we are all in this together!

The Failure of Incentives

A second set of problems, currently confronting US science in particular, is newer than the first. But it is widely considered to be even more troubling right now to the scientific community – and here the relevance to the larger scientific community is even more apparent. This second set of problems has at least two components. One is what scientists have been calling the "perverse incentives" now prevalent among US scientists, perverse incentives that result from the way science is currently funded here. The story goes like this. Academic researchers in the US require outside grants (in addition, for example, to start up funds provided by their universities) to cover most of their research expenses, including even much of their salaries. But since the number of academic scientists in the US has been increasing while the supply of such grants (mostly from the federal government) has generally been decreasing, competition has become particularly intense, a situation difficult for all but especially so for younger researchers. Moreover, since the term of these grants is usually quite limited – only three or so years – scientists are discouraged from pursuing the more challenging, more significant, long-term projects that produce the big gains for science when they pay off, but which may not pay off. What the present funding situation encourages, instead, are small, safe projects that can be completed in short time spans, the kind of projects that will ensure publications, tenure, promotions, and still more grants. And success tends to be measured by quantity – the number of grants awarded, the number of publications achieved, the number of citations gained – rather than quality, depth, and rigor. In short, what is being encouraged, say scientists, is large quantities of mediocre work (Belluz, Plumer, and Resnick 2016; Roy and Edwards 2017a; 2017b; Ioannidis 2018; Boyle 2018).

This is the best-case scenario. At worst, what is being encouraged is work that cuts corners, takes liberties, and hypes up results, either consciously or unconsciously. Of course, researchers can always turn to private, for-profit sources of funding instead of the public funding that invites all these problems, but private funding comes with its own perverse incentives: conflicts of interest and pressures to deliver the kind of research and results that will be favorable to the sponsor. The cases on record of this, involving the food industry and the pharmaceutical industry, for example, are chilling (see, e.g., Welch, Schwartz, and Woloshin 2011; Dumit 2012; Moss 2013; Nestle 2018).

The second component of the current research scene that is especially troubling to scientists – one that complements the prevalent perverse

incentives – is the just as prevalent *nonincentives*. Take replication: the successful reproduction of experimental results. Called the cornerstone of scientific method, it is an absolute requirement for the proper grounding of science. Yet, in recent years, even attempts at replication in science have been relatively rare.

The reasons are many. For one thing, replication studies are not normally viewed as major contributions to their fields; hence they have received less funding and less attention from both scientists and the media. What's more, they are harder to publish since journals prefer original research to replications of previous research. And they take time and resources away from other projects that reflect scientists' own original research ideas. So there has been little incentive to attempt replications. And when they *are* attempted, and especially when the results are negative, there has been little incentive to even try to publish them since journals have a strong disinclination to publish research concerning any kind of negative or failed experiments (Price 2011; Anonymous 2013a; Sheldrake 2015; Engber 2016; Hastings 2017).

A similar situation holds of peer review. On the one hand, peer review is meant to weed out poor quality work before it reaches publication, again a crucially important requirement of successful science. But on the other hand, researchers are not paid or otherwise rewarded for the time they put into reviews, and the work takes time away from their own projects (and don't forget that these researchers are also endlessly applying for grants to support that research, so they have little time to spare). The result is that researchers have not been motivated to do the really careful reviews that are needed, and to do them in a timely manner (Anonymous 2013b; Balietti 2016; Belluz, Plumer, and Resnick 2016).

All this has yielded an unsettling outcome – a current "replication crisis" across all of science, but especially psychology and biomedical research, precipitated by spectacular failures to replicate even "landmark" studies done by the best scientists using the best methods and published in the best journals (Begley and Ellis 2012; Open Science Collaboration 2015; Baker 2016; Nosek et al. 2018); and epic cases of fraud and even years-long runs of fraud wholly undetected by peer review together with epic cases of exemplary work, even Nobel Prize-winning work, that had been rejected by peer review (Altman and Broad 2005; Altman 2006; Balietti 2016; Harvey 2020). When added to the perverse incentives that, as noted earlier, also characterize science, the conclusion is particularly depressing. Arizona State University's Consortium for Science, Policy, and Outcomes codirector Daniel Sarewitz (2016: 5–6) lays it out well:

> Scientists are more productive than ever, pouring out millions of articles in thousands of journals covering an ever-expanding array of fields and phenomena. But much of this supposed knowledge is turning out to be contestable, unreliable, unusable, or flat-out wrong. From metastatic cancer to climate change to growth economics to dietary standards, science that is supposed to yield clarity and solutions is in many instances leading instead to contradiction, controversy, and confusion. Along the way it is also undermining the four-hundred-year-old idea that wise human action can be built on a foundation of independently verifiable truths.

In short, this second set of problems with science, when added to the war on science covered in the first set, suggests that science is unlikely to help us deal with the important global challenges that confront us – global diseases, repeated economic downturns, and global warming and environmental pollution.

The Taint of Social Bias

But what about the racial, ethnic, and other sources of social unrest currently rocking the US and many other regions of the world (see, e.g., Haynes 2020)? Might science yet help us deal with that? In the US, the social unrest especially concerns Black Americans and their supporters and their response to the repeated killings of Black men and women at the hands of police officers. But other factors also enter the picture and help to explain the deep anger, despair, and frustration that Black Lives Matter protests display. For one thing, Black Americans were harder hit by the coronavirus pandemic than other Americans; for example, they have been nearly three times as likely as White Americans to be infected with the virus, nearly five times as likely to be hospitalized, and more than twice as likely to die, a death rate far higher than all other racial and ethnic groups (Soucheray 2020; cf. Ford, Reber, and Reeves 2020; Gould and Wilson 2020). For another thing, Black Americans were especially hard hit by the economic downturn, harder hit than most other Americans (Coleman 2020; Hardy and Logan 2020). And then there is the continued racism that Black Americans confront on a daily basis – fewer employment opportunities than other Americans, lower pay than other Americans, poorer housing options than other Americans, less of everything than other Americans, especially respect (see, e.g., Shelby 2016; Porter 2021).

When we turn to science to help deal with the situation, however, the resources available are disappointing. Black economists have pointed out, for example, that mainstream economics (neoclassical economics) seems

simply to deny that discrimination exists (see especially the analyses by Howard University economist William Spriggs appearing in the days after the murder of George Floyd, especially his 2020). That Black Americans have fewer employment opportunities or lower pay, the mainstream seems to suggest, must be a matter of Black Americans' inferior educational backgrounds or lower intelligence or greater likelihood of involvement with crime or the like, or their potential employers' statistically based understanding of Black people's lesser reliability and promise. Or it has simply to do with their potential employers' *taste* in job applicants. For no other possibility makes sense for rational, competitive employers, according to mainstream economics. So, the varieties of facts relevant to understanding and coping with discrimination against Blacks are simply not sought by mainstream economists. Between 1990 and 2018, for example, less than half of 1 percent of all peer-reviewed papers in the top five economics journals even took up the issue of race/ethnicity – that is 29 papers out of a total of 7,567 (Francis and Opoku-Agyeman 2020).

Nor have the relevant facts generally been sought by medical researchers regarding Black Americans' greater vulnerability to COVID-19 and other global diseases such as cancer and heart disease, or their lesser propensity to be helped by standard treatments. For Blacks tend to be left out of clinical trials and medical research more generally (Oh et al. 2015). Of course, there are exceptions. The gathering of facts about Black people has traditionally been extensive in some areas of medical research, such as those associated with promiscuity (including sexually acquired diseases), antisocial behavior (including drug abuse, violence, and sexual assault), and underachievement (Osborne and Feit 1992), and there are all those facts energetically gathered in other areas of science such as the psychological and genetics research associated with intelligence deficits (see, e.g., the past and present research scene detailed in Evans 2018 and Saini 2019). But such research efforts have seemed to offer little help to Blacks.

True, *Black* researchers have been seeking other sorts of facts, the sorts of facts that *are* helpful to Black people as well as other disadvantaged groups. For example, the major professional associations of Black scientists – such as the National Medical Association (formed in 1895), the Association of Black Psychologists (formed in 1968), and the Caucus of Black Economists (formed in 1969 and later renamed the National Economics Association) – have all had, as part of their mission, the production and distribution of knowledge that improves the quality of life of native and immigrant African Americans, Latinxs, and other people of color. And other organizations, such as the National Black Child

Development Institute, have been pursuing projects with the same aim – such as the "Being Black Is Not a Risk Factor: A Strengths-Based Look at the State of the Black Child." That project, for more than forty years, has focused on achieving positive outcomes for vulnerable children who suffer from the dual legacies of poverty and racial discrimination.[2]

But these Black researchers represent only a tiny proportion of their fields. For example, according to National Science Foundation figures for 2019, Black people are only 3 percent of US economists, less that 7 percent of US psychologists, and an indefinite percentage of US health researchers.[3] At the same time, Black researchers face massive amounts of discrimination in these fields. Black psychologists, for example, have reported that "[the specialty of] Black psychology was born from the struggle of Black psychologists who were constantly exposed to messages of Black deficiency, pathology, and inferiority" (Cokley 2020). And just recently the American Economic Association released a statement that said, in part: "We recognize that we have only begun to understand racism and its impact on our profession and our discipline. We have learned that our professional climate is a hostile one for Black economists" (AEA Executive Committee 2020; cf. Blanchard, Bernanke, and Yellen 2019). In short, Black researchers have had a very small voice in their disciplines, a voice not frequently listened to. Small wonder that the facts these researchers have uncovered, the facts that are so helpful to Black people, have not had a powerful effect on their fields, the media, and the social surround. This, then, is the third set of problems currently confronting science to which I want to draw attention, a set of problems of far longer duration than the other two. Of course, other marginalized groups in American society, such as Native Americans, Hispanic and Latinx Americans, and Asian Americans, face many of the same challenges as Black Americans. Science has been largely unresponsive to their needs too.

A Role for Philosophy of Science

The foregoing concerns three sets of problems currently at the forefront of discussion. These are not the only obstacles to the fulfillment of Bacon's

[2] For further information about these organizations, see their websites at www.nmanet.org (for the National Medical Association), www.neaecon.org (for the National Economics Association), https://abpsi.site-ym.com (for the Association of Black Psychologists), and www.nbcdi.org (for the National Black Child Development Institute).

[3] See NSF's figures for "Women, Minorities, and Persons with Disabilities in Science and Engineering" for 2019, table 9.6, at https://ncses.nsf.gov/pubs/nsf21321/data-tables.

promise now facing the sciences, of course. There are also the problems of androcentrism, sexism, heterosexism, and a variety of related LGBTQ issues that feminist scientists and philosophers and historians of science have been discussing for decades (e.g., Harding 1986; Creager, Lunbeck, and Schiebinger 2001; Kourany 2002; Fausto-Sterling 2020). There are the problems regarding the science carried out in the private sector – problems of so-called commercialized or commodified science – that have also been the subject of discussion for decades (e.g., Mirowski and Sent 2002; Krimsky 2003; Radder 2010). And there are the problems more recently under discussion – the now mostly unfulfilled need for interdisciplinary collaboration to solve multidisciplinary problems sometimes called the *silo problem*, the problem of so much science kept secret by government or industry or locked behind paywalls, the problems stemming from the public's distrust of science, and so on (see, e.g., Galison 2008; de Melo-Martin and Intemann 2018; Worthy and Yestrebsky 2018; Brown 2020). Still, the foregoing three sets of problems are thought by many to connect more closely than any of these others to our present most pressing global challenges, the challenges for which we need science at its best to help us (witness just the terms – the *war* on science, the (replication) *crisis* in science, the *hostile climate* of science with its messages of (Black) *deficiency, pathology, and inferiority*, etc. – used to represent these problems). And this makes our three sets of problems especially worrisome, and their resolution especially urgent. Might philosophers of science have a role to play in this effort? The problems, after all, concern threats to science as a knowledge-producing activity, threats so serious that scientists are now devoting considerable attention to them. But the focus of philosophy of science is precisely on science as a knowledge-producing activity. So, these threats to science should claim attention from philosophers as well. What contributions might we make to deal with them?

Fortunately, we don't have to start from scratch. The current discussions that take up these problems also offer solutions to them, or at least strategies to consider. Science journalist Shawn Otto, for example, ends his 2016 *War on Science* book with fourteen "battle plans" to "beat back the war." These include such initiatives as science-informed policy debates for candidates for public office, pro-science pledges for the successful candidates, religious institutions that integrate the results of scientific investigation rather than function at odds with them, and the formation of chambers of *progressive* commerce (or boards of progressive trade) for business leaders. Historians of science Naomi Oreskes and Erik Conway end their war book with what amounts to an historically informed tutorial

for the public on how to recognize the legitimate scientific experts on an issue, so that the public will be able to tell whom to listen to and whom to ignore when it comes to issues such as global warming. And scientists have sought to beat back the war on science in still other ways, such as by galvanizing public sentiment and public pressure against the war. Recent examples of this strategy are impressive: the march Canadian scientists organized in 2012 that involved 2,000 scientists, a coffin, tombstones, and a mock funeral on Ottawa's Parliament Hill to commemorate, as they said, the "death of evidence" brought about by funding cutbacks and other actions of the Harper administration (for accounts of it, see Pedwell 2012 and Smith 2012), or the "March for Science" American scientists organized post-Donald Trump in 2017 that took place in Washington, DC (where 100,000 people gathered) and more than 600 other cities all across the globe – the largest science demonstration in history (March for Science 2017; Smith-Spark and Hanna 2017). Examples also include ongoing statements by the Union of Concerned Scientists and other scientific organizations, public letters of protest signed by hundreds of scientists from all over the world, lectures and interviews on the internet, and other public outreach activities by scientists, all in response to the war on science (especially memorable was the open letter to Canada's Prime Minister Stephen Harper signed by more than 800 scientists from 32 countries; see Chung 2014).

Scientists have directed their attention to the scientific community rather than the public in their response to the second and third sets of problems discussed in this chapter. Regarding the second set – more specifically the "perverse incentives" currently pervading science – scientists have suggested such possibilities as a funding system for science that, lottery style, randomly determines which of a group of acceptable proposals should be funded, or that funds particular scientists or particular labs for specified periods, perhaps especially excellent ("rigorous," "efficient," "effective" as well as "original" and "innovative") scientists or especially well-run labs, independently of their announced projects, or that privileges new fields or fields that are high risk, or that leaves it up to research to determine the best way to fund research. To combat the "replication crisis," on the other hand, scientists have suggested ways to make replication studies easier, such as by requiring authors of publishable papers to be more detailed and transparent about the methods used in their research, by encouraging them to share their data, and even by encouraging them to have engaged in at least one replication study themselves before publication. And to combat what some have called a

"broken" peer review system, scientists have suggested such possibilities as posting "pre-prints" of articles to be evaluated by a wider audience before formal peer review, "post-publication" peer review to continue the peer review process on the web even after publication, and either a more anonymous system of peer review in which reviewers don't know authors or a less anonymous system in which authors also know reviewers (see, e.g., Alberts et al. 2014; Baker 2016; Belluz, Plumer, and Resnick 2016; Munafò et al. 2017; Ioannidis 2018). To these suggestions of scientists, moreover, a number of science policy analysts have added ways to steer science specifically to solve socially important problems (e.g., Sarewitz 2016, Korte 2019).

Finally, to deal with the third set of problems discussed here – the racism both in and outside of science – scientists, particularly Black scientists, have suggested such possibilities as research programs in psychology that investigate the nature of racism in all its forms, its wide-ranging effects, and the most successful methods to eradicate it,[4] funding programs in economics that commit to multiyear or recurring support for actively anti-racist science initiatives,[5] and outreach programs in biomedical research that encourage and enable those in various minority communities to join research efforts (such as clinical trials) that can improve their health and well-being.

These proposals from the science and science studies communities offer a wide range of strategies to (in the words of one of the contributors) "save science." But do they save *Bacon's* science, the specifically humanist science Bacon promised? Certainly, some of them do, or at least try to – such as the third set of proposals supporting research efforts to fight racism and increase the health and well-being of minorities, and the proposal from the second set supporting organizational efforts to resteer science more efficiently toward socially important problem solutions. But many others do not. The second set of proposals supporting such strategies as lottery-type research funding systems, greater transparency in research, and longer peer reviews, for example, may increase the reliability of research results, but they include no commitment to also promote the human flourishing Bacon promised. And similarly for the first set of proposals, the ones aimed at educating the public using such strategies as public policy

[4] See, e.g., Abrams 2020 and the "APA's commitment to addressing systemic racism" at www.apa.org/about/apa/addressing-racism.

[5] Such as the Women's Institute for Science, Equity and Race; see Francis and Opoku-Agyeman 2020 and the WISER website at www.wiserpolicy.org.

debates, history tutorials, and science marches. Those proposals, like the ones of the second set, are intended to loosen the hold on the sciences of a whole battery of values not frequently conducive to widespread flourishing – corporate interests, fundamentalist Christian values, right-wing political values, and anti-regulation, market fundamentalist values (those are the values that loomed large in the war reports), as well as the perverse incentives and nonincentives pervading contemporary science (those are the values of current scientific culture that lie behind the replication crisis, broken peer review system, and inconsequential busywork of much contemporary science). But such proposals do not at the same time strengthen the hold on the sciences of the legitimate social values that are to replace the others, or even help to make explicit what those legitimate social values are.

By contrast, distinguishing between research shaped by legitimate social values and research shaped by illegitimate ones, and distinguishing between the legitimate and illegitimate ways in which such shaping is to occur, are important projects in contemporary philosophy of science – are, in fact, the "new demarcation problem" many philosophers of science are now investigating (e.g., Holman and Wilholt 2022). And feminist as well as other philosophers of science have already made important contributions to the project (for recent contributions concerned with race, or both race and gender, see Fernandez Pinto 2018; Kourany 2020; Biddle 2020; Havstad 2021). At the same time, many other philosophers of science are now committed to dealing with a wide range of other socially important projects connected with this one, as shown by the workshops, publications, and other activities of groups such as the Consortium for Socially Relevant Philosophy of/in Science and Engineering, the Joint Caucus of Socially Engaged Philosophers and Historians of Science, and the Society for Philosophy of Science in Practice.[6] And, of course, all these philosophers of science are especially well equipped to deal with such projects. For normative questions, ethical/political as well as epistemic, and the arguments and counterarguments that go along with them, are emphasized in the training of philosophers of science, as in the training of all philosophers, which is just the kind of background that is helpful here.

So, strengthening the hold on the sciences of the legitimate social values that are now missing from science is a project to which we philosophers of science might very effectively contribute. Done successfully it will help to

[6] For more information about these groups and their activities, see their websites at https://srpoise.org, https://jointcaucus.philsci.org, and www.philosophy-science-practice.org.

prevent the three sets of problems previously described from continuing (hence, call it the *prevention* project). But it will not dispel the damage already done by those problems – the "contestable, unreliable, unusable, or flat-out wrong" (Sarewitz 2016) information that is now part of our accepted scientific knowledge as well as the crucial gaps in information and missed opportunities that are also there. Is some sort of rectification now called for, and if so, what sort of rectification and how might it be accomplished? This is a second project to which philosophers of science might contribute, and it is especially pressing with regard to the third set of science's problems previously discussed: the ones having to do with race. In order to see this, start with a thought experiment.

Imagine a race in which half the runners have been made to carry heavy weights on their shoulders, and imagine that midway through the race there is a desire to make the race a fair one. What might be done to achieve this goal? One possibility would be to stop the race, take the weights off the shoulders of the runners who are carrying them, and then resume the race. This would hardly do the trick, however, for the disadvantage of the weights for the first half of the race would not have been overcome. A second possibility would be to stop the race, transfer the weights from the one group of runners to the other, and then resume the race. This would equalize the disadvantage of the weights for the two groups and thereby yield a fair race, but at the cost of treating the previously unweighted runners in the same cruel way the first group had been treated. By contrast, a third possibility would avoid this problem while still producing a fair race. It would be to give the previously weighted runners a head start for the second half of the race, providing an advantage to compensate for the previous disadvantage without harming the other runners in any way.

This last possibility is the idea of affirmative action elaborated during the US civil rights era in Martin Luther King's 1964 book *Why We Can't Wait* and Lyndon Johnson's 1965 graduation address at Howard University. Both men used a race metaphor to make the justification of their idea clear. King framed it this way: "It is obvious that if a man is entered at the starting line of a race three hundred years after another man, the first would have to perform some impossible feat in order to catch up with his fellow runner." "Something special" needs to be done "for him now to balance the equation and equip him to compete on a just and equal basis" (1964: 165). Johnson framed the metaphor slightly differently: "You do not take a person who, for years, has been hobbled by chains and liberate him, bring him up to the starting line of a race and then say, 'you

are free to compete with all the others,' and still justly believe that you have been completely fair. Thus it is not enough just to open the gates of opportunity. All our citizens must have the ability to walk through those gates" (1965). In other words, to make the race of our thought experiment fair the previously weighted runners have to be given "something special," some kind of head start after their weights are removed – enough of a head start so that they "all . . . have the ability" to win, that is, are all now as likely to win the race as the other runners.

The thought experiment given here helps us consider how we might deal with science's centuries-old treatment of Black people and other racialized groups. It suggests and at the same time offers an assessment of three possible responses. The first response amounts to removing all racist values from science (the weights on half the runners) and replacing them with egalitarian values (all runners free of weights, in other words treated equally). Such a response would dramatically increase the gathering of facts serving the interests of Black people and other racialized groups while still continuing the gathering of facts serving the interests of previously privileged groups. It would ensure that all future research would always generate information helpful to all – the prevention plan described previously. But like the first possible fix in our thought experiment (weights removed after half the race is over), it would do nothing to overcome the disadvantages of the past – the huge inventory of facts gathered over the centuries that continue to serve the interests of only some while they undermine the interests of all the rest. The situation portrayed in this first response, in other words, would exactly correspond to the man in King's metaphor who starts a race three centuries after his fellow runner, though the time difference in this case might be quite a bit longer than three centuries.

But what if the racist values of the past were replaced, now and for the next few centuries, not with egalitarian values but, instead, with values privileging the previously unprivileged, leading to research focused on the previously unprivileged. The facts gathered would then be about *their* needs and experiences, exploits and accomplishments, with methods and concepts and assumptions and questions supporting that aim. Like the second possible fix in our thought experiment (weights transferred from the one group to the other after half the race is over), this *would* overcome the disadvantages of the past for all of these individuals, for it would eventually yield equal inventories of facts serving the interests of all. But it would do this at the cost of treating the previously privileged in the same unconscionable way Black people and the other racialized groups had been

treated in the past (and in fact are still treated now). Such an inegalitarian science, in short, would be as unacceptable as the present and past inegalitarian sciences.

This leaves the third possible response offered in our thought experiment, the affirmative action response, which seems to be the only acceptable response. It calls for an *epistemic* affirmative action program for science, one in which research serving the previously privileged would continue while research serving the others would be given extra advantages (like a head start for the previously weighted runners). The problem is that this leaves the nature of the extra advantages completely undefined. It also leaves undefined the conditions under which such an epistemic affirmative action program would be applicable – whether it would apply, for example, to the first (war on science) and second (perverse incentives and nonincentives) sets of problems confronting science as well as the third (relating to social biases such as racism). So, working all this out is a second project – a *rectification* project – to which philosophers of science might contribute.

At least one additional project might be pursued by philosophers of science: setting out, explaining the merits of, and applauding the many cases of science that *do* fulfill Bacon's promise, especially the heroic work currently being done regarding the most pressing global challenges now confronting us (the speed with which the COVID-19 vaccines were developed, their effectiveness, and the antiviral treatments for the disease now available are especially obvious examples). This additional project, this *celebration* project, would include, as well, an analysis of the political and social (including hiring and funding) conditions under which exemplary science has been enabled. Such a project would be important for a number of reasons. For one thing, it would help to give a concrete understanding of the goal that Bacon defined for science, including real, full-blooded illustrations in contrast to the abstract, utopian characterizations provided in Bacon's *New Atlantis* and other works. For another thing, it would anticipate and help to disarm the possible negative use by current science denialists of the prevention and rectification projects' critical work. For a third thing, it would help to balance the picture of science provided by philosophers of science, allowing science's strengths and successes to be fully appreciated as well as science's shortcomings.

In short, three projects – a prevention project, a rectification project, and a celebration project – would seem to be necessary if there is to be any hope of saving the specifically humanist science Bacon promised. And philosophers, happily enough, can have a central role to play in all three.