CHAPTER 1

What Is Science For?
Modern Intersections of Science and Humanism

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> The great scientific revolution is still to come. It will ensue when men collectively and cooperatively organize their knowledge for application to achieve and make secure social values.
>
> John Dewey, "Science and Society"

Intersections (?) of Science (?) and Humanism (?)

It is uncontroversial that humanistic thought and scientific inquiry have been entangled throughout a very long arc of intellectual history. Beyond this, however, significant challenges await anyone hoping to understand let alone articulate the nature of these entanglements. Since "science" and "humanism" are labels that are commonly applied to traditions of theorizing and practice that predate the eighteenth- and nineteenth-century introduction and use of these terms in their modern senses, respectively, and since both of these traditions have evolved and speciated a great deal from antiquity to the present, any attempt to untangle the many complex relationships between them amounts to a formidable task.

Thankfully, and while endeavoring not to shy away from any of these complexities en route, my focus in this chapter is much narrower. My interest here is in what the history of these relations between science and humanism reveals about the (arguably) peculiar way in which their connection is typically viewed today, as being entirely asymmetrical. If, on a first pass common to dictionaries and encyclopedias, we take humanism to be a worldview emphasizing the interests, capacities, and welfare of humanity, as well as our potential for learning about the world as a means to confronting the challenges we face and promoting human flourishing (e.g., Lacey 1995: 375–376), the importance of the sciences to humanism is abundantly clear and, indeed, this is commonly, explicitly asserted. But what of the complementary relation of the importance of humanism to science? It is striking that while, for most of the more recent history of

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Western societies, this latter relation was often acknowledged as something worthy of praise or criticism, in our times it may seem a strange thing to hold that humanist values and ambitions are at all relevant let alone important to what we think of as science.

Taking the past of both science and humanism as a prelude to a consideration of their connection in the present, my current aim is twofold. First, of historical interest and less controversially, I review certain developments in the intellectual history of the West since the Renaissance that were pivotal to establishing a widespread (though hardly universal) commitment to the idea that the sciences are among our most potent means for enhancing human and planetary flourishing. Also of historical interest but more controversially, I endeavor to illuminate just how strange it is, in historical perspective, that we have now drifted away from a complementary commitment to the idea that humanist ideals could or should be pivotal to our conception of the sciences. Not least given the serious, in some cases existential, crises we have brought upon ourselves and our planet in the relatively short duration of our existence as a species, I argue for a return to these ideals as a plausible basis for a normative conception of the aims of science today. This furnishes a partial answer to one of the three questions tagged obliquely in the heading of this section – the question of how we might best understand the *connection* between science and humanism.

The other two questions concern how, to this end, we should understand the extensions of the terms "science" and "humanism," in light of the historical evolution and speciation of these traditions of theory and practice mentioned earlier. Regarding the sciences, I am somewhat prescriptive. In Middle English the term "science" simply meant something like knowledge, derived from the Old French term, itself derived from the Latin word "*scientia.*" It did not take on something resembling its modern sense until the eighteenth century; subsequently, William Whewell coined the term "scientist" in the nineteenth century. For present purposes, however, I use the term "science" in the anachronistic way it is commonly used when we speak of ancient or medieval science, or when we apply it more specifically to traditions of natural philosophy, the precursors to what we now recognize as modern science. This is to elide modes of inquiry that have been transformed in numerous ways and very significantly over time, as well as substantially different forms of investigation across the highly specialized subdisciplines of the sciences. For my purposes, it suffices to recognize as "science" all that is commonly of interest to scholars of the sciences, past and present, in this looser and less pedantic though anachronistic way.

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Regarding the question of what humanism is, here I attempt to be more descriptive, which occupies the following several sections. I begin by clarifying what "humanism" has come to mean in our contemporary setting, first and foremost in the eyes of the most influential humanist societies and organizations in the public sphere, where the very idea of humanism is intimately tied to the sciences. Next, in the manner of a film that begins, tantalizingly, with an enigmatic glimpse of the last scene, before going back in time to tell the story of how we got here from there, I rewind the clock to consider the history of this contemporary affiliation of science and humanism, and their coevolution, in terms of formative developments in the Renaissance and growing connections during the Enlightenment. Finally, I turn from this synoptic history of ideas to what I take to be a weighty question for today, which should be assessed, I contend, in the full light of the past: What is science *for*, exactly? I conclude with some thoughts about what this assessment entails for the future of both science and humanism.

Contemporary Humanist Invocations of Science

Earlier I described a first pass at humanism in terms of "a worldview emphasizing the interests, capacities, and welfare of humanity, as well as our potential for learning about the world as a means to confronting the challenges we face and promoting human flourishing." Sharpening up and drilling down to the core of the position, one might put a (still) highly abstract and compressed summary this way: Humanism is a worldview emphasizing reason and science as a basis for understanding the world and our place in it, and for making it a *better* place. In various ways, the rest of this chapter is an attempt to elaborate this summary and to make it more concrete, in order to exhibit key relationships between humanism and science.

Against a backdrop of scholarly debates about these relationships – fueled by different philosophical views which, each in its own way, claims allegiance or opposition to one of a number of different characterizations of humanism (more on which later) – in the lay public domain there is, and has been for much of this past century, an impressive convergence on the matter of what humanism is. One easily accessible window into this convergence is provided by an extensive overlap in descriptions of basic principles offered by the largest national and international humanist organizations concerning the worldview they espouse. A number of common themes appear, expressed in terms of variations on central

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commitments to or respect for: secularism; critical thinking; science as a source of knowledge (often associated with a vaguely specified naturalism); ethical deliberation and action; freedom and democracy – all of which, in keeping with the first-pass gloss on humanism given in the previous section, are conceived to play a crucial role in the service of human well-being, broadly conceived.

I cite some of these humanist-society pronouncements as evidence momentarily, but first, let me offer a more detailed, philosophical synthesis of what I am calling here a broadly shared worldview, which I take this evidence to support. It is helpful, I think, to collect the various aspects of the view into two families of commitments, each made up of interwoven domains of philosophical interest:

(1) metaphysics and epistemology; and
(2) value theory (most prominently, moral, social, and political philosophy).

What makes the conjunction of what may appear disparate aspects of humanism so interesting, and what explains the fact that in the history of ideas, it has seemed natural to collect these many, seemingly separable commitments under one heading as a worldview, are the ways in which these two families of commitments were (and are) linked to one another to envision an agenda for improving the human condition. Of course, any such agenda must of necessity extend to considerations beyond humanity, since humans do not exist in isolation but are embedded in the world, which brings human relationships with other life and the planet into the picture. Furthermore, the abidingly aspirational nature of the agenda inevitably renders its completion something of an ideal, toward which one can only work. But with these caveats in hand, let me turn now to what I have identified as two families of commitments.

Metaphysics and Epistemology

It is tempting to address questions of metaphysics (concerning the fundamental nature of the world and what it comprises) and epistemology (concerning the nature of knowledge and how we acquire it) independently. These are, after all, distinct subdisciplines of philosophy. However, in the context of humanism (as in many others), it is difficult to separate them, because the epistemological and metaphysical dimensions of humanism are tightly connected. An emphasis on reason and the sciences as a basis for investigating and understanding the world and our place in it,

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and for making it a better place, is closely associated here with a naturalistic orientation, which manifests as an endorsement of human capacities for substantive inquiry at the expense of supernatural doctrines or revelation. In the limit, this orientation manifests as a skepticism about or a denial of the supernatural altogether. A privileging of human reason and inquiry, with a focus on what observation and interaction with the world can reveal about it, is thereby bound up with judgments about what we are justified in saying, with genuine warrant, about reality itself.

Value Theory

The humanistic worldview is also centrally preoccupied with moral questions and adopts an explicitly ethical stance, promoting goods such as individual and social freedoms, welfare, happiness, and fulfillment, as well as the pursuit of cultural, economic, and other developments that would facilitate the wider distribution of such goods. This emphasis on *improving* the extent to which these desiderata are satisfied in society naturally brings major issues of social and political philosophy to the fore: peace, democracy, civil liberties, decent standards of living, and activism targeting the implementation of such goals and the ethical priorities they embody. This mandate is linked in several ways to the naturalistic orientations in metaphysics and epistemology described earlier. In just the way that a humanistic epistemology has implications for an account of the natural world, it also has implications for an account of the value-theoretic world. Reasoned, rational discourse is regarded as key to setting ethical priorities, not the dictates of supernatural or nonsecular doctrines, and what we learn from scientific inquiry into both the natural and social worlds must inform how we fashion social and political institutions to realize these ends.

Though expressed in different ways and without the philosophical framing I have just given the core commitments of contemporary humanism, the largest humanist organizations today present the worldview to which they subscribe in exactly these terms. According to Humanists International (2023), for example, "Humanists base their understanding of the world on reason and science, rejecting supernatural or divine beliefs"; they "believe in respecting and protecting everyone's human rights," and that "we have a responsibility to respect and care for one another, and to protect the natural world." Similarly, the American Humanist Association (2023) states that "Humanism is a nontheistic worldview with ethical values informed by scientific knowledge and driven by a desire to meet the needs of people in the here and now. At the

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foundation of those values is an affirmation of the dignity of every human being." And in much the same spirit, Humanists UK (2023) holds that "the word humanist has come to mean someone who trusts to the scientific method when it comes to understanding how the universe works and rejects the idea of the supernatural"; a humanist "makes their ethical decisions based on reason, empathy, and a concern for human beings and other sentient animals."

What I have described in this section is, I believe, an accurate summary of the dominant, popular conception of humanism today. Indeed, to extend this claim further, this understanding of humanism in the lay public domain is very much in sync with how it is understood – as a worldview – in recent and contemporary professional philosophy. In saying this, however, it is important to note that there are, in fact, philosophical views that associate humanism with much more specific philosophical claims, and not all of these claims are congenial to the marriage of science and humanism described here (see Chapter 2).[1] I return to this in later sections of this chapter, where I argue that some of these views are confused about the nature of humanism, or about the compatibility of science and humanism, or both. With this promissory note, let me turn now to a crucial clarification of the contemporary humanist worldview just sketched.

Interlude: Science, Religion, and Epistemic Authority

In part because the humanistic worldview is associated with such wide-ranging (albeit interconnected) commitments, across metaphysics, epistemology, and value theory, it is unsurprising that individual humanists are often most interested in or identify most with a proper subset of them. Some are especially exercised by legal issues concerning human rights and social justice, some by political institution-building to establish and protect democracy, and so on. One particular fixation, however, is a source of substantial confusion about humanism and requires separate clarification. It is not uncommon this past century to find humanism labeled as "*secular* humanism," with the intention of giving special emphasis to distinctions between it and other worldviews associated with various religious traditions. This all by itself is unproblematic, but it is often misrepresented in ways that *are* problematic, by proponents and critics of humanism alike, as

[1] It is not uncommon to find antipathies to science also expressed in other humanities disciplines, such as literature, both historically (see Chapter 5) and in the present.

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expressing a blanket opposition to or rejection of religion. As a characterization of humanism, however, this is incorrect both historically and in the present, as well as muddled in ways I will attempt to clarify here, briefly.

Historically, religious identification and even some religious beliefs have been viewed by many as compatible with humanism.[2] The fact that this may seem less plausible now owes in part to a growth in the prominence of naturalistic orientations with respect to metaphysics in the tradition as a whole, but even recently, in the North American context (for example), the growth of humanist organizations was substantially supported by liberal religious groups (Weldon 2020), and there are still those who identify as religious humanists today. The Unitarian Universalist Humanist Association publishes a journal entitled *Religious Humanism*, and the American Humanist Association's Center for Education offers a course with the same title. Given how broadly we now understand, in this era, what it means to be "religious," this should not be surprising. Many who identify with a religious tradition do so primarily for reasons of social, community, or cultural affiliation, or attachment to a heritage. And many who fall under these descriptions do not hold the theological beliefs associated with these traditions or otherwise – an explicit commonplace in many religions including (for instance) Hinduism, Judaism, and Buddhism.

The key to understanding how humanist and religious commitments are sometimes compatible is to take note of an underlying point that is often overlooked: a matter of *epistemic authority*. When there are conflicts here between different traditions of investigation and belief formation regarding the world, where does authority lie – with naturalistic modes of inquiry and knowledge, or with supernaturalistic ones? If our most up-to-date cosmology estimates that the age of the universe is at least 13.7 billion years, but a religious text suggests that it is more like 6,000 years, or if our most sophisticated evolutionary biology gives an account of causal mechanisms giving rise to adaptations, but creation narratives attribute this causation to a God or gods, or if naturalistic descriptions characterize the behaviors of various systems in the world in terms of certain principles or laws, but supernaturalistic descriptions include violations of them in the form of miracles, which way does one lean? What is crucial here, from the

[2] For details on the closely connected question of complex relationships between *science* and religion in the early modern period leading gradually to an epistemically ascendant position for science in modernity, see the extraordinary, four-volume series by Gaukroger (2006; 2010; 2016; 2020). See also Brooke 1991.

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point of view of compatibility, is simply to note that humanism recognizes the epistemic authority of a naturalistic – and ultimately scientific – orientation in cases of conflict.

This, of course, allows for some but not all religious commitments. Peter Lipton (2007) articulated his own "religious atheism" in terms of a commitment to "using the [religious] text as a tool for thought," and more specifically, as a resource to help facilitate independent moral reflection. More broadly, this amounts to belief in the claims of our best science,[3] and "acceptance" regarding contrary religious claims. Acceptance is not belief, but it nevertheless involves a form of commitment in virtue of the instrumental value that something has in relation to an aim or a goal. While not believing the content of Judaic texts that conflicts with our best science, Lipton found it helpful nonetheless to reflect on them in thinking about ethical matters. He elaborated on this with a thought-provoking analogy, citing British astronomer Sir Arthur Eddington's famous example of his two tables: The first, his everyday table, has clearly apparent dimensions, color, and other familiar properties, but the second, his scientific table, is mostly empty space and made up of electric charges with a combined "bulk" of less than a billionth of the everyday table. One might believe in the scientific table, and simply accept the idea of the everyday table for everyday purposes (Lipton 2007: 32; cf. Eddington 1928: xi–xii).

This is just one way of preserving an affiliation with the religious in the context of a humanistic worldview. Other alternatives are familiar. One might reinterpret religious doctrines as needed in such a way as to view their content nonliterally (e.g., as metaphorical) rather than as literal assertions, thereby sidestepping conflict with the sciences. One might, following Stephen Jay Gould (1999), describe science and religion as "non-overlapping magisteria" having entirely different domains of interest – a domain of facts, and a domain of purposes, meanings, and values, respectively – which are thus never contradictory. Given the arguably transparent purchase of both the scientific and the religious in both domains, however, and clear examples of conflict (a few given just a moment ago), the plausibility of this recipe seems dubious unless it can be reworked to integrate further strategies for conflict dissolution, such as

[3] Speaking of belief in relation to "our best science" is commonly associated with varieties of "scientific realism," which typically assert a more fulsome range of warranted beliefs than varieties of "antirealism" (see Chakravartty 2017). Here, however, I speak of scientific beliefs in a way that is neutral concerning philosophical debates between realists and antirealists, since both are, in their own ways, champions of scientific knowledge (see Chakravartty and van Fraassen 2018).

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those just noted. Both scientific and religious worldviews are interpretable as furnishing descriptions of human beings and our embeddings in the world in terms of both facts and values (see Chapter 8).

The upshot of the clarification offered in this section is that while there are strong, natural affinities between humanism and positions that are deeply skeptical of supernatural commitments (e.g., atheism, agnosticism), and strong associations of humanism with secularism, understood as incorporating a rejection of any such commitments wielding untrammeled authority in our epistemic lives or otherwise, there are surely ways of thinking about religion that render it compatible with humanism, thus doing justice to the outlook of those who, historically and in the present, have identified themselves as religious humanists.

Renaissance Rediscovery and Facilitations of Science

I promised at the outset to take a scenic route to raising a question about the aim of science today, backlit by a historical past of connections between science and humanistic thought. Having sketched a contemporary portrait of humanism, which grants significant epistemic authority to the sciences, my aim now is to follow a strand through an evolving rope of humanism over time, during which the importance of science grew steadily. This is intrinsically historically interesting, but also and more importantly for present purposes, it showcases a long-standing tradition of understanding the nature and mission of science itself through the lens of humanism. Let me begin in the Renaissance, associated with the fourteenth century (sometimes earlier) through the early seventeenth century, a period of remarkable intellectual and cultural development leading from the Middle Ages to what we now regard as the early modern period and setting the stage for modernity more generally. While traditions of humanist thought can be identified not only in Europe but in China and India going back to antiquity, and in the medieval Islamicate world, for more proximate influences on the present coinciding with parallel developments in the sciences, the Renaissance is a helpful place to start.

In the Middle Ages, Latin scholars studied (among other things) earlier Arabic and Greek science and mathematics, but Renaissance intellectual culture was largely focused on the humanities, at least initially. This may make the latter seem an unpromising marker from which to begin an exploration of connections between science and humanism. Indeed, the term "humanism" was not yet in use, and the Italian term "*umanista*" was applied specifically to scholars who studied the languages, texts, cultures,

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and thinking of classical antiquity, much of which had been lost or ignored previously, in terms of disciplines we now associate with the humanities. This broad scholarship was facilitated by a rediscovery of Latin texts, with interested parties seeking out and hunting through the libraries of Europe to find them, after which came an influx of ancient Greek texts brought by scholars to Italy after the conquest of Constantinople by the Ottoman Turks. Together this facilitated a fusion of interest in Greek philosophy and Roman *humanitas*: roughly, an esteem for (the nature of) humanity, serving as an ideal in the education of a virtuous person. An education thus conceived took the form of *Studia Humanitatis*, comprising grammar, rhetoric, poetry, history, and moral philosophy.

Conspicuously, this did not include science per se, but these developments did of course have profound influence beyond the curriculum (e.g., in art and architecture), sowing the seeds of an entanglement of science and humanism. One might think of this in two ways, first in relation to the growth of humanism in its metaphysical and epistemological dimensions, yielding fertile conditions for the development of science; and second, in relation to its value-theoretic dimension. Regarding the first, the rediscovery of and engagement with ancient texts showcased values that scholars found expressed there, perhaps most inspiringly an ardent respect for human dignity, exemplified in capacities for self-expression, and for inquiry, fueled by the application of reason. This increasingly placed humanity, not supernatural forces or God or revelation, at the center of an understanding of how we learn about and interact with the world. As Protagoras had asserted in antiquity, "man is the measure of all things," a view which naturally erodes a conception of reality on which humans are epistemologically marginal, and opens the door to a more naturalistically oriented metaphysics.

In addition to being conducive to the growth of science generally, these epistemological and metaphysical developments were instrumental to more specific consequences. The rediscovery of ancient texts included scientific and mathematical works, which, as Pamela Long (2016: 496–498) observes, contributed to transformations in natural philosophy and "changes in the most basic assumptions of cosmology, physics, astronomy, biology, and almost every other branch of the study of nature" (Long 2016: 486; cf. Grafton 1990: 103–105). Anthony Grafton (1990: 103) notes that "humanists discovered and printed the passages in Cicero and Plutarch that showed that distinguished ancient thinkers had been willing to contemplate a heliocentric rather than a geocentric cosmos" – proposing that the sun, not the earth, is located at the center of the universe, and that

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the planets revolve around the former, not the latter – which inspired Nicolaus Copernicus' heliocentrism, bolstered by his own empirical findings (Kwa 2011: 53). This in turn inspired the groundbreaking astronomy of Johannes Kepler (Grafton 1990: 109). These influences were not only theoretical but also practical. The study of geometry in antiquity by Renaissance humanist mathematicians led to major advances in military engineering, including the design of canons, bastions, and fortifications (Kwa 2011: 54).

What is most telling for the moral of this chapter, though, is a striking feature of how science in this period was entangled with the *value-theoretic* dimension of humanism, in ways that go beyond inspirations and affordances for naturalistic orientations in metaphysics and epistemology. As Alan Lacey (1995: 375) suggests, it was "by introducing social, political, and moral questions" that, in the fifth century BCE (and here quoting Cicero), the Sophists and Socrates "called philosophy down from heaven to earth." It is thus hardly surprising that a Renaissance humanist attention to all-too-human concerns should pervade at least some conceptions of the sciences, which were then in the process of substantial development. This took two closely related but importantly distinct forms: an understanding that rational inquiry in the mold of science, given its epistemic authority, may serve as a means to enhancing human welfare; but in addition to this, that it *should do so*. This dual humanist understanding of science is expressed in the idea that "science can and *must* contribute to the community that nourishes it"; Renaissance humanists "had a substantial hand in the development of the notion, widely held by the seventeenth century, that science has profound social impact and *responsibility*" (Grafton 1990: 109, 117, emphasis added).

Sir Francis Bacon's *Novum Organum* (2000/1620) is widely appreciated for its articulation of a method for inquiry in natural philosophy based on observation, experiment, and induction in exactly this period, toward the end of the Renaissance. It is less widely cited for the fuller conception of science that accompanied this, according to which the fruits of such inquiry would benefit humanity in myriad ways, from improved health and longevity, to the development of forms of transportation, to better social relations, to more effective interventions in and control of our environment (see Chapter 9). The potentially negative connotations of "control" in this context – of humans exercising power over nature – are also important to consider, and I return to this in the following section. Independently of how we may think about this today, however, let me conclude this section by noting, once again, here in Bacon's conception of

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science, a further and explicitly *normative* contention that is irreducible to mere power or control. The "true and legitimate goal of the sciences," said Bacon, is not knowledge for its own sake, or profit or recognition, but rather 'to endow human life with new discoveries and resources' so as to improve the human condition (Bacon 2000/1620: 66, Aphorism LXXXI).

Enlightenment Ideals and Deepening Connections

Let us move forward now to relationships between science and humanism in the Enlightenment, the "Age of Reason," associated with the (later) seventeenth and eighteenth centuries or the long eighteenth century (extended at both ends) – a time during which "[t]he humanist mode of thinking deepened and widened" (Kolenda 1995: 341). This is an apt description of humanist conceptions of science in this period more specifically, which deepened in terms of yet more explicit advocacy for naturalistic orientations in metaphysics and epistemology, and widened in the value-theoretic domain, with more fulsome articulations of the relevant values and thus, by implication, the nature and mission of science as seen through a humanistic lens. Regarding the former, many draw tight connections, for example, between methodological prescriptions for inquiry championed by natural philosophers such as Copernicus, Galileo, Bacon, and Newton during the Scientific Revolution (in which the sciences made significant advances toward what we now call modern science), and appeals to the use of reason.[4] But with a normative moral concerning the aim of science potentially in view, let me focus here on the question of values.

The Enlightenment is often presented in terms of an exploration of and a commitment to certain values or ideals, including: human dignity, equality, and rights; freedom and democracy; cosmopolitanism and tolerance; social and political reform in the service of these values and, concomitantly, a rejection of traditional forms of authority including religious authority and an embrace of secularism. An astonishing number of works

[4] See Nola 2018: 47. The Scientific Revolution is typically associated with the late Renaissance and early Enlightenment. More precise dates are sometimes proposed, and the term "revolution" is sometimes contested given the gradual nature of these changes, but I do not consider these issues here. See Cassirer 1951/1932 (especially chapters 1 and 2) on evolving, humanist conceptions of reason and rationality influenced by developments in scientific inquiry and methodology during the Enlightenment, and Bronowski 1968 (36–38; also Bronowski 1956) on the influence of evolving conceptions of humanism on changing conceptions of nature, from something to be dominated and exploited (in the Renaissance) to something of which we are a product and a part (in the Enlightenment).

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discussing these ideals arose in this period, many of which would later become hugely influential in social and political theory, and some representing the origins of sociology and economics. Enabling, epistemic values in the background of this took the form of commitments to reason, evidence, and critical thinking, and even the goal of educating the whole of society – ideals which, combined with greater freedom to question previous doctrine, are commonly cited as the fulcrum of relationships between Enlightenment humanism and science. David Cooper (1999: 7–8) notes that humanism at this time is often identified with "rational subjectivity," the idea that humans have the potential to be autonomous, rational "adjudicators of truth and value," and that "on this characterization, the scientific image is the paradigmatic expression of humanism."

What is perhaps most fascinating about the link between science and humanism during and after the Enlightenment, however, is not related to epistemic values so much as social and political ones. It is important to acknowledge here that in response to the positive, value-theoretic aspirations concerning the promise and proper function of science sketched earlier, some critics of humanism have strongly contested *any* such portrayal as misleading or Pollyannaish. Indeed, it is sometimes held that Enlightenment values were (and perhaps still are) responsible for attitudes, policies, actions, and science that, as it happens, brought about the *degradation* of human dignity and cultures, as well as barbaric relationships with other forms of life and the devastation of our planet. These contentions represent a pressing, prima facie challenge to the reasonableness of any humanist narrative according to which, over a long sweep of intellectual history, the sciences were (and are) regarded as powerful means by which to seek exactly the opposite. This is a crucial issue to which we must now turn.

I suspect some may be tempted simply to dismiss the contentions I have just mentioned as ill-formed. If the humanist conception of science is merely hopeful or aspirational, and critiques of humanism, the sciences, and their applications do not concern hopes and aspirations but rather actual, grievous, historical outcomes, is there a failure here to connect? Granted, aspirations and outcomes are different sorts of things, but this observation alone is unhelpful at best, prevaricating at worst: Articulating the senses in which humanism and these critiques are, in fact, connected is instructive about what is at stake. As a first step in this articulation, let us consider more precisely the relevant concerns.

Earlier I described humanism, conceived as a worldview, as having an explicitly ethical agenda, but various critics have argued that, informed by

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Enlightenment values, humanism has been responsible for a number of clearly unethical consequences. These concerns may be collected, thematically, into three (overlapping) categories of ostensible harms:

(1) *harm to people*, caused by appeals to or implementations of particular ideals of reason (or rationality) that result in human suffering by means of prejudice, discrimination, colonialism, or imperialism;
(2) *harm to other life*, caused by preoccupations with human reason (or rationality) that result in the promotion of only human welfare and flourishing and, concomitantly, a disregard for or cruelty toward other life; and
(3) *harm to the environment*, caused by preoccupations with only human welfare and flourishing and, concomitantly, a disregard for or destructive exploitation of the environment and the planet more generally.

Though the details of specific charges levied under these headings vary substantially, it is fair to say that these categories of harms comprise a fairly exhaustive summary of concerns about humanism, and in cases where the sciences are charged with complicity in these harms, they are subject to these same concerns.

The worries indicated here are serious, but some of the critiques expressing them are not. Some attack views that are not endorsed by humanists nor plausibly described as humanistic. Here, one may justifiably adopt what Cooper (1999: 3) suggests as a constraint that "must be respected for the characterisation to be one of humanism . . . [:] the views criticised must have been described as humanist ones by people who have actually held them." In other words, serious criticism should target views identified as humanistic by self-described *humanists*, not merely by critics of something passed off as humanism for purposes of criticism. Consider, for instance, the polemics of Douglas Ehrenfeld (1981/1978: 5), whose sweeping critique is premised on the notion that humanism is committed to "an unquestioning faith in the power of reason" and an "irrational faith in our own limitless power." It is difficult to imagine how one could even begin to square such proclamations of human infallibility and omnipotence with naturalistic orientations in metaphysics and epistemology, which plainly suggest otherwise.[5] Reasoned discourse and scientific inquiry

[5] Cf. Law (2011: 4) on the error of equating humanism and utopianism. Accounts (such as Ehrenfeld's) that go on to associate humanism with laundry lists of failure and narratives of social

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are inherently critical pursuits, in which beliefs and methods must be perpetually open to scrutiny.

Some critiques of humanism are more charitable, genuinely engaging with claims advocated by humanists in various contexts historically. This is susceptible, however, to spurious conflations in which the positions cited, properly identified with very specific issues or parochial theses, are then mispresented as humanism *simpliciter*. This runs together the more specific and parochial with the broader conception of humanism as a *worldview* described earlier. Since the more specific and parochial are not equivalent to the broader worldview, and since the former are often marginal or rejected as outmoded in the latter, it is specious to cite worries about these specifics as insuperable for the worldview more generally. For example, some twentieth- and twenty-first-century environmental ethics targets views concerning the "essence" of humanity, which aim to explain features of human thought, action, and morality. This "essentialist humanism" is charged with a worrying anthropocentrism leading to harms to other life and the environment (see Snaza 2017: 16–17). It is a mistake, though, to conflate *this* with a humanist worldview. Many have argued instead that human nature is complex, that it has no particular essence, and that the value-theoretic dimensions of humanism must extend beyond humanity narrowly construed, to the teeming world of dependencies in which humans are embedded.

Other critiques are premised on dubious claims of cause and effect between humanist attitudes and dreadful states of affairs. Enlightenment humanism in particular is sometimes blamed for hordes of dysfunctions: epidemics of self-absorption and excessive individualism; brutalities of colonialism and imperialism; exploitations of other humans and nonhumans; catastrophic pollution; anthropogenic climate change; and accompanying all of this, general moral decay.[6] Now, there are aspects of this that must be taken seriously, not dismissed out of hand (more on which shortly); but it is also important to note just how strained some such claims can be. Max Horkheimer and Theodor Adorno (1994/1947), for instance, argued that the Enlightenment was responsible for the rise of Nazism – an extraordinary assertion of causality between a misleadingly selective (and arguably confused) account of the prominence of certain

decline are often dubious (cf. Noonan 2022: 17–18). For the opposite extreme, associating humanism with a laundry list of successes and a narrative of social progress, see Pinker 2018.

[6] See, e.g., MacIntyre 1988 and Gray 1995. For a skeptical commentary on these and other, related critiques, stemming from a broad range of perspectives (conservative, libertarian, liberal, Marxist, postmodernist, etc.), see Badger 2010.

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values and totalitarian mass murder two centuries later. Even if one takes seriously the claim that some of these values were, and perhaps still are, vehicles for dominating people and the planet, the astonishingly reductive leap from humanist values to Nazi terror is difficult to make sense of as anything other than a desperate attempt to grapple with the magnitude of such evil (cf. Nola 2018: 60–64).

All of this, however, leaves at least one class of criticisms of humanism intact – criticisms that engage with actual exemplifications (not uncharitable reconstructions) of widely shared humanist principles (not parochial theses) that have played plausible, concrete (not farfetched or ineffably abstract) roles in causing harm. These criticisms share a common ground: Humanist values are *themselves* abstract; in order to act on them, they must be spelled out and operationalized. Translating even well-intentioned but abstract principles into precise policies and concrete actions is inevitably shaped by the particular, spatiotemporal, cultural contexts in which these translations occur. This yields value-driven attitudes and practices that from later or other perspectives may seem terribly confused or even appalling: notions of equality, rights, or freedoms that exclude Indigenous people, otherwise racialized people, women, or some sexual orientations and identities; notions of toleration that exclude people belonging to certain linguistic, social, sectarian, or cultural groups; and so on. The very notions of reason and rationality, at various times and places, have been conceived in ways that have fueled discrimination, exclusion, incarceration, conquest, and slavery.[7]

Where does this leave a fair assessment of Enlightenment humanism? I submit that any such assessment must involve serious engagement with apparently conflicting perspectives. Failing this, humanists risk a blindness to historical and present wrongs done in the name of their own values, and critics of humanism risk seeing nothing else. Both extremes of partial perspective are undermined by a failure to do justice to a crucial aspect of the humanist worldview, noted earlier (initially) in connection with Renaissance humanism: a critical attitude toward received claims, doctrine, and dogma. Immanuel Kant (1996/1784) famously described enlightenment in terms of an emergence or a liberation from an immature state in which one is unable to think for oneself; in line with this, many apparently

[7] Furthermore, this is hardly exclusive to the distant past. See Chapter 11 for a more recent history of "scientific racism," "scientific sexism," and, pivotally, redemptive contributions by later scientists, often women, that "awaited the political and social changes that brought women, who asked new questions and noticed new phenomena, into the natural and social sciences."

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conflicting perspectives on humanism are reconcilable upon reflection. A charitable and defensible conception of humanism must incorporate an assiduous understanding of its value-theoretic dimension: one on which humanist values have a dual nature. At a certain level of abstraction, they are goods to be sought, but their contextual operationalizations must be subject to sustained vigilance, critique, and reformation.[8]

Perhaps some will find this combination of resolute aspiration and amelioration intolerable. After all, in some cases, words or concepts become so infused with harmful connotations that the best way forward is simply to discard them. (Consider now discarded terms once used to describe mental illnesses, sexual orientations, or racialized groups.) Many values, however, conceived in ways that transcend particular historical manifestations, are not sensible candidates for disposal. Conceived more abstractly, their positive senses are too deeply entrenched; this *makes* them goods to be sought and *drives* criticism and reconstruction of their concrete manifestations. In this spirit, postcolonial theorist Edward Said (2004: 9–10) rejected "dismissive attitudes" toward ideals such as justice, equality, and liberty – powerful inspirations for liberation movements this past century – found in postmodernist criticism, and rebutted attributions to humanism of a strict, "totalizing and essentializing" emphasis on individual thought and reason (e.g., by Marx, Nietzsche, Freud, Saussure, Lévi-Strauss, and Foucault), in contrast to embeddings of individuals in "systems" (e.g., Marx's "capital," Freud's "unconscious") that exert controlling influences on them. Surely, the capacities of both individuals and systems must be part of any compelling study of reason and rationality.

Let us take stock. Having considered how Renaissance intellectual culture facilitated the development of science, humanism, and relationships between the two, this section has given substantially more attention to the humanist side of the equation. This is not to downplay connections of humanism and science during the Enlightenment – which, as I mentioned, deepened with respect to naturalist orientations in metaphysics and epistemology, not least in light of articulations of methods of reasoning and inquiry furnished by natural philosophers during and after the Scientific Revolution. Also, as noted earlier in passing, concerns about harms done in the name of Enlightenment humanism to

[8] Views advocating criticism as a means to reformulating humanism in practice include various angles of approach, much like the unsparing critiques of humanism mentioned earlier. For recent examples, see Simpson 2001 on engaging postmodernist criticism, Pierce 2020 for a discussion of Black humanism, and McAleer and Rosenthal-Pubul 2023 for a defense of conservative humanism.

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people, other life, and the environment are not obviously or uncontroversially separable from concerns about the sciences, which were in some ways integral to enacting many of these harms. Looking forward now, the emphasis on certain values and, in particular, on what I have called their dual nature, is essential to understanding why they persist, and in what forms, in ways relevant to science in the present.

In the third and most recent iteration of the "Humanist Manifesto" (originally published in 1933 and updated in 1973), the American Humanist Association (2003) extends a concern for human welfare "to the global ecosystem and beyond," asserting "a planetary duty to protect nature's integrity, diversity, and beauty in a secure, sustainable manner." Likewise, in the third and most recent statement (earlier ones appearing in 1952 and 2002) of "fundamental principles of modern Humanism," Humanists International (2022) asserts a "duty of care" that extends beyond humanity to "all sentient beings" and a responsibility "for the impact we have on the rest of the natural world," and seeks – perhaps implicitly reflecting on past wrongs – not "to impose our view on all humanity," but "to cooperate with people of different beliefs who share our values, all in the cause of building a better world." Most telling for present purposes, after advocating for "the application of science" to these ends, there is a qualification: "remembering that while science provides the means, human values must define the ends." Let us turn now, from Enlightenment values in historical context, to their extension in the relationship of science and humanism leading up to today.

Modern Intersections of Science and Humanism

I began this chapter by reflecting on contemporary humanism and its invocations of science before proceeding to sketch a synoptic history of the evolving entanglements of these two traditions, all with the ultimate goal of motivating a question about the *aim* of science in the present. What is science for, fundamentally – what is its *telos*, or end? Throughout the chapter I have been concerned to highlight not only the idea that the humanist worldview, in its various incarnations over time, has incorporated an appeal to science as a means by which to realize humanist aspirations, but also the idea that it is part of the very nature of science that it should play this role. Though the former idea is contestable, it seems uncontroversial that many subscribe to it, even with the addition of qualifications borne of healthy caution and an attentiveness to the maturity and rigor of any given domain of scientific inquiry and practice. My focus

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in this final section, however, is the latter idea, about the aim of science, which I suspect many people today may find strange or even unsettling.

As we have seen, this was not always the case. Indeed, tracing the history of science and humanism now closer to the present, in the nineteenth century and during the first half of the twentieth century, it was not at all strange among scientists and philosophers to think that the function of the sciences is to aid in making the world a better place (see Chapters 4–6). By way of illustration, let me mention two major philosophical traditions in this period, both of which counted philosophers as well as scientists among their proponents and discussants. The first is logical empiricism, which crystallized with the birth of the Vienna Circle, a highly interdisciplinary, scholarly collective that took shape in Austria in the 1920s and 30s, whose thought (together with that of allied colleagues in Germany, the United Kingdom, and elsewhere) came to represent the founding movement of the philosophy of science as a self-aware discipline.[9] Many influential members of the Circle and colleagues abroad were staunchly dedicated to social, political, and economic reforms, in line with what they later described as "scientific humanism" (Carnap 1963a: 83).

In their manifesto, "The Scientific Conception of the World," Otto Neurath and other founding members of the Circle noted that while "questions of life" were not in the forefront of their scholarly discussions, there was nonetheless substantial agreement on such questions borne of their shared worldview (Neurath et al. 1973/1929: 304–305): "endeavours toward a new organization of economic and social relations, toward the unification of mankind, toward a reform of school and education, all show an inner link with the scientific world-conception; it appears that these endeavours are welcomed and regarded with sympathy by the members of the Circle, some of whom indeed actively further them." The paramount objective was "unified science" (Neurath et al. 1973/1929: 306): "to link and harmonise the achievements of individual investigators in their various fields of science. From this aim follows the emphasis on *collective efforts*." The idea, in essence, was that in order to leverage the sciences to address "questions of life," there must be effective collaboration between different areas of inquiry and expertise, and by developing the means to this end, "The scientific world-conception serves life" (Neurath et al. 1973/1929: 318).

[9] See Stadler (2015: 7, 31, 47, 281) on the cultural context of Austria in the background of humanist commitments in the Vienna Circle. Sadly, I cannot engage here with many important figures in the wider background, such as nineteenth-century French sociologist Auguste Comte (to mention just one).

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Herbert Feigl (1949: 136) identified this overarching preoccupation with value-laden aims of science with a confluence of philosophical approaches during this period, including not only empiricism but also pragmatism and others, converging in "a broad movement that one may well be tempted to regard as the twentieth-century sequel to the enlightenment of the eighteenth century." It involved "a synthesis of the scientific attitude with an active interest in the whole scale of human values" (Feigl 1949: 137) – a goal championed by the foremost figure of American pragmatism at this time, John Dewey. (For connections between logical empiricism, pragmatism, and discussions of values, see also Frank 2021.) Given the growth of the sciences into tools of previously unimaginable power, Dewey (1985/1931: 201) posed a question: "Here is the instrumentality, the most powerful, for good and evil, the world has ever known. What are we going to do with it?" His answer, not least given that science itself "has created a new social environment," is that science must "face the issue of its social responsibilities" (Dewey 1985/1931: 202; cf. Morgan 2016): systems of insurance to spread risks; preventative medicine; public hygiene; reduction of superstition (e.g., supernatural causes of plagues, famine, disease), and so on.

It is natural to wonder here whether this view of science, as crucially working toward humanistic ends, is relevant only to applied science as opposed to "pure" or "basic" science. Certainly, more applied science was and is a principal focus for some, but it would be a mistake to think that basic science is thereby excluded. Leaving aside the tenuous status of the distinction to begin with (scientific practice classified as "basic" or "applied" typically incorporates a great deal of both), on a common rendering of it – basic science targets "knowledge for its own sake" and applied science targets knowledge intended to facilitate previously envisioned applications – basic science is entirely consonant with humanism. For creatures like us, with an impressive capacity for and (often if not always) an ardent desire for knowledge of the natural and social worlds in which we live, knowledge for its own sake is already, all by itself, something that can be profoundly fulfilling and constitutive of well-being. It helps us to understand and to appreciate the world, ourselves, and relations between the two. "Knowledge for its own sake" is not, after all, an expression that can be taken too literally. Knowledge does not have sakes, but people (and other agents) do.

Another possible concern about prospects for a humanist understanding of science stems from the charge that an important form of humanism is actually *antithetical* to science. Cooper (1999) argues that there is an

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opposition between the "scientific worldview" and the dominant, contemporary form of "philosophical humanism," which he calls *existential* humanism. On this view, not only our descriptions of the world but, indeed, the world itself are products of human thinking and agency (Cooper 1999: 10). Many versions of what I earlier (note 3) called scientific antirealism do in fact suggest this, rejecting the common realist idea that the sciences describe a world that is independent of our conceptions of it. As an exemplar, Cooper cites William James, who identified humanism with pragmatism, contending that truth and reality are, for us, inextricably interwoven with experience; truths reflect how we "make" the world by carving it up so as to facilitate our purposes (see "Pragmatism and Humanism" in James 1995/1907). But while the *nature* of truth is disputed among philosophers, this is independent of the question of whether science generates *truths* – antirealism is not anti-*science*. Typically, realists and antirealists agree on scientific descriptions of the world that serve as a basis for action, even if they disagree about how best to analyze the concept of truth.[10] The alleged opposition of existential humanism and science is thus a non sequitur.

Given that normative accounts of the aim of science generally and humanist accounts more specifically were widespread for hundreds of years leading up to the recent past, our present situation seems highly irregular. In the present, and despite recent interest in the roles values may play in several aspects of scientific inquiry, the notion that we should take seriously the thought that the aim of science is ultimately normative has effectively disappeared from view. Where did it go? Partial answers to this question have been given, especially relevant to academia in the United States (home to American pragmatists and many leading logical empiricists, who had earlier fled fascism in Europe): shifting political winds and McCarthyism in the 1950s, which were hostile to any advocacy of social or political reforms branded as progressive, left wing, or socialist (Reisch 2005); changing priorities for research funding after the successful launch of Sputnik 1, the first artificial Earth satellite, by the Soviet Union in 1957 (Howard 2003); the strict separation of discussions of values from discussions of the cognitive content of science, on the part of some logical empiricists (Vaesen and Katzav 2019; cf. Dewulf 2021).

[10] For a discussion of the variety of philosophical understandings of truth associated with different approaches to thinking about scientific knowledge, none of which are opposed to science or incompatible with humanism, see Chakravartty 2018.

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All of this said, and acknowledging the often heavy weight of historical inertia, answers to the question of why humanist conceptions of the aim of science effectively disappeared do not themselves appear to answer the further question of why, after all this time, they have not regenerated. Today, in the philosophy of science, discussions of the aim of science give the impression of being premised on an implicit assumption to the effect that questions about aims are appropriately – and exclusively, it seems – to be answered descriptively, by reflecting narrowly on the immediate, proximal functions of scientific theories and models. This is to suggest that if we study these things carefully enough, we will *see*, or at least be well equipped to theorize about and contest, the proper end or ends of science. Hence a contemporary focus on what seem purely epistemic features of successful theories and models: prediction, explanation, understanding, empirical adequacy, truth, knowledge, etc.[11] Advocates of these views argue about which are correct, or which is primary, or whether contextualism or pluralism regarding these views is tenable in application to different parts of science. None of this, however, is well suited to giving an account of the ultimate aim of science, or so I will now suggest.

Prediction, explanation, understanding, and so on are *instrumental* features of science. Prediction, for instance, is always the prediction of something *to* some end, an end we care about; lacking this motivation, we would have no use for it. It is what we do with predictions, guided by our reasons for making them, that illuminates our more distal aims. When we bring theorizing and modeling to bear in making predictions about global mean surface temperatures, or the effects of synthetic compounds on human physiology, we do so with intentions – for example, to facilitate planetary health or human health. Furthermore, as mentioned earlier, these intentions pertain not only to existential threats and everyday challenges but also to explanations and understandings we may hope to possess for the sake of nothing more nor less than a profound sense of longing. There are uncountable numbers of truths we *might* seek, but only some we do seek, and in some cases this is simply a matter of aspiring to forms of awe and contentment that can only be experienced in terms of a better understanding of ourselves and the world, as revealed by science. All of this, from the more practical to the more transcendent, may be part of a humanist conception of the ultimate aim of science.

[11] I am unable here to explore the full range and content of these views, but an impressive number of them are considered in discussions of scientific progress; see Niiniluoto 2024. See also de Regt 2017 and Potochnik 2017.

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The distinction between more immediate, proximal aims of science and more distal, ultimate aims makes room for a humanist account of the latter, but it also invites us to consider the urgency of reviving such an account. Scientific inquiry, like any human endeavor, is driven by hopes and desires for certain outcomes. The question here is not whether there *are* such ends, but rather what they should be. The humanist worldview furnishes an answer to this question, but others are clearly possible. For instance, setting humanism to one side, we might instead establish an increasingly free market of science in which, to a large extent, the most powerful (often private) interests and corporations set the agendas of inquiry. As it turns out, this has already happened, significantly improving the welfare of certain members or strata of society and certain peoples or parts of the world, but with often alarming consequences for others.[12] The choice to make the sciences de facto servants of unfettered commercialization (and supporting ideologies) as opposed to humanist values has, it seems, been made, or largely made, in the present. But this choice could be unmade. Rather than forgetting a rich heritage of humanistic aspirations for science, unfolding over hundreds of years up to the recent past, we might consider resurrecting these ideals instead.

Going this route, however, will require significant courage of conviction. As argued in the previous section, humanist ideals are by their nature abstract, admitting of more concrete conceptions and operationalizations that inevitably reflect the historical and cultural contexts in which they arise. If the actions they guide are to yield something better than what has come before, they must be subject to stalwart questioning and rethinking. In this spirit, briefly and in conclusion, let me describe three of what I take to be the most pressing desiderata for remaking a humanist conception of science for the twenty-first century. The first concerns how we think about the bounds or scope of science itself; the second, relatedly, concerns relationships between Western science narrowly construed and other forms of systematic inquiry; the third concerns a constellation of practical issues raised by the ambition to implement a humanist agenda for the sciences.

One major obstacle to renewing a humanist conception of science is a growing suspicion of science in the public sphere (Kennedy and Tyson 2023). Some of this may stem from a perception that the fruits of scientific labor benefit only some and not others (more on which momentarily), but

[12] For just a few recent studies, see Krimsky 2003, Brown 2008, Oreskes and Conway 2010, and Wylie 2022. Cf. Sarewitz (2004: 400): "it is only after values are clarified and some goals agreed upon that appropriate decisions about science priorities can emerge."

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some is surely attributable to a growing view that the sciences have no special epistemic authority. In some quarters, science is even described as something akin to a religion, equally well characterized in terms of dogma and faith. Of course, this is facile; it fails to reckon with the epistemic potency of empirical evidence and reflexively critical investigation. That said, such views are often concomitant with and conflated with a rejection, not of science per se, but of *scientism*: an especially strong endorsement of the epistemic authority and jurisdiction of the sciences. Scientism is quite reasonably taken to be a bad thing when the strength of its endorsement is excessive, amounting to a kind of hubris regarding the certainty and scope of scientific knowledge. Scientism is thus a much more plausible target of suspicion than science, and it is correspondingly crucial that humanists understand this distinction and take it seriously.

Certainly, lacking an awareness of the stage of an inquiry, the strength of the evidence, and the confidence of scientists in their own results, mindless deference or unthinking assertions of the truth or finality of scientific claims fails to grasp the nature of most scientific work as work-in-progress – even if it is, generally, our best bet epistemically and for acting in the world. Moreover, the notion that all questions are *in principle* answerable by the sciences alone is justifiably controversial (see Chapters 3 and 4). For example, though the human sciences (psychology, anthropology, sociology, etc.) investigate and contribute to our understanding of the nature of value, morality, and meaning, it is at best a promissory note that they will, one day, be capable of doing so comprehensively or exclusively, and it is unclear why taking a stand on this should be important to the epistemological dimension of humanism, which prizes both reason *and* science. Both are key and, presumably, not all reasoning is scientific reasoning. Or more neutrally still: There is nothing about humanism that entails that it is or should be.

This openness to uses of reason that transcend the sciences is critical to the possibility of renewing a humanist conception *of* science. Consider, for instance, domains in which scientific expertise overlaps with traditional or Indigenous expertise (see Chapter 10 for the case of global agriculture), where a failure to bring reason to bear in connecting different sources of expertise productively threatens epistemic injustice, and even the oppression of those with genuinely systematic knowledge falling outside the narrower remits of Western science. To complicate matters further, the broader remit of reason includes more expansive contexts in which science and technology, as well as social, economic, and political relations, are inextricably mixed. In these inevitably complex settings, competing goods and values are the norm, and we must think about how to prioritize (cf. Holman and Wilholt 2022). Vannevar Bush (1945: 10–12), the

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director of the US Office of Scientific Research and Development during World War II, argued that if science were supported and scientists given complete freedom to do as they pleased going forward, huge benefits to society would result. This view, however, enormously influential in its day, has few if any adherents today. A laissez-faire attitude is *compatible* with societal benefits, but it is also compatible with massive inequities.

What, then, is the alternative? Is it what Dewey (1985/1931: 203) described as a "Baconian ideal": "the systematic organization of all knowledge, the planned control of discovery and invention, for the relief and advancement of the human estate"? From a humanist perspective, there is no alternative but to face up to the task of marshaling our collective reason to grapple with the practical challenges of implementing a fairer and more just administration of the sciences, not to mention their complex embeddings in technology, industry, commerce, and culture. This includes not only a transparent, conscious, resolute focus on placing science in the service of the good but also on directing it away from the service of harm (cf. Kitcher 2001: chapter 8; Kourany 2016; see also Chapter 12). It requires that we engage our highest capacities for reason, critique, discovery, and invention to make good on a humanist conception of science.

In his defense of humanism, in response to critics who questioned his advocacy of it given his scholarship on the cruelties of colonialism and postcolonialism, Said (2004: 28) observed that

> there can be no true humanism whose scope is limited to extolling patriotically the virtues of our culture, our language, our monuments. . . . humanism is not a way of consolidating and affirming what "we" have always known and felt, but rather a means of questioning, upsetting, and reformulating so much of what is presented to us as commodified, packaged, uncontroversial, and uncritically codified certainties.

These same observations apply in equal measure to the sciences, for there can be no true science whose scope is limited to extolling dogmatically the virtues of our current methods for gaining knowledge and the outcomes of inquiry. Science too is about questioning, upsetting, and reformulating, and it would be a mistake to think that unlike all other human practices, the sciences are somehow insulated from being shaped by and having consequences for the social, cultural, economic, and political dimensions of the societies in which they are practiced. The *modi operandi* of an evolving humanism and an evolving science are complementary, in ways that do justice to their long association, and which hold out hope for a conception of science on which, not merely by accident but by design, it is an engine for positive change in the world.

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