Introduction

Writing in 1827 for the *Quarterly Review*, geologist Charles Lyell complained about the perception of science in England: "It has been imagined in this country that physical science, as it cannot make known to us the moral principles of our nature, nor point out to us our social duties, so it cannot, like religious instruction, or ethics, or history, or even poetry, contribute to perfect the moral character." Lyell deplored the belief that science is irrelevant to moral principles or social duties: "Nothing can be more erroneous than this kind of reasoning," he declared.[1] While Lyell acknowledges that science does not take up as a subject the moral and social issues that concern such fields as religion, ethics, history, or poetry, he insists that science *can* "perfect the moral character" because of the kind of thinking that it requires. According to Lyell, science uniquely demands "an habitual practice of examining proofs with an unbiased desire of discovering truth," and such a practice has benefits that reach beyond scientific work: "Men acquire independent habits of thought, and just principles of reasoning, which are not limited in their operation to philosophical inquiries alone, but conduce both to the moral and intellectual advancement of society."[2]

These claims appear in an article titled "The State of the Universities" that argues for science's introduction into the educational curriculum. But a conviction that science was equal to the classics as the means of a liberal education was not the only factor behind Lyell's call for enhanced scientific education. The geologist was also motivated by the lack of career prospects for practitioners of science in England – or rather, by the lack of such prospects for practitioners who were not ordained.[3] Lyell's advocacy for scientific education was of a piece with his lifelong desire to establish science as a secular, highly regarded endeavor that could be pursued even by those who did not have independent sources of income. Making science part of the university curriculum promised to create more openings for men of science as professors and to elevate science's status by formalizing specialist

training for scientific knowledge. That is, Lyell's efforts on behalf of science can be described, at least in retrospect, as an attempt to professionalize the study of nature.

These two elements of Lyell's article on the "State of the Universities" – the claim that scientific thinking holds moral benefits, and the impetus towards professionalization – recur throughout nineteenth-century endeavors to promote science, endeavors that, over the course of the century, succeeded in transforming science's social and cultural standing. This book examines fictional responses to these transformations in the work of Victorian novelists including Elizabeth Gaskell, George Eliot, Thomas Hardy, authors of antivivisection fiction, and H. G. Wells. While men of science aligned the study of science with moral excellence, the novel provided a way to explore this alignment, to examine the interaction between scientific practice and the student's personal morality, behavior towards others, and attitudes towards larger social obligations. Eliot and Gaskell engaged with a religiously inflected, pre-professional natural history, accepted science as a moral endeavor, and integrated science into the novel. But as science took on more and more aspects of a profession during the last thirty years of the nineteenth century, novelists came to define it as a domain of knowledge outside of the novel. In so doing, Hardy, Wells, and antivivisection authors emphasized the pernicious effects of scientific thinking on the scientist's moral character and social commitments, even as they laid claim to moral and social concerns as the novel's own area of professional expertise.

Studies of Victorian science and literature have largely focused on scientific theories and ideas about the natural world. This focus is underwritten by the assumption that Victorian science and literature inhabited "one culture" and that therefore ideas traveled readily and productively between them. This view is central to the field's foundational text: in *Darwin's Plots* (1983), Gillian Beer suggests that Darwin's impact is due in part to the accessibility of his books, in which, as in the writing of other leading figures in Victorian science, "there is nothing hermetic or exclusive" because "they shared a literary, non-mathematical discourse which was readily available to readers without a scientific training."[4] Moreover, this common language enabled "shared cultural assumptions and shared cultural controversy."[5] Beer does examine the tensions and problems that arose in the exchanges between literature and scientific writing; one argument of *Darwin's Plots* is that terms that had precise and technical meanings for Darwin and for his fellow men of science – like "race" or "contrivance" – resonated for the lay reader with a host of other assumptions and connotations. Essays that

followed *Darwin's Plots* further complicated and qualified the idea that Victorian scientific and literary practitioners shared language, assumptions, and controversy: Beer argues, for example, that Victorian men of science had to grapple with a conflict between professionalization – which produced a desire for technical specificity and specialist exclusivity – and factors including intellectuals' status as a priestly class and Victorian ideals about knowledge (that it should be widely accessible and that there exist deep and fundamental connections between fields).[6] Yet her overall emphasis has been on the productive exchanges between science and literature.

By and large, studies that followed hers have shared this focus. Indeed, Beer's claim that "the common language of scientific prose and literary prose at this period allowed rapid movement of ideas and metaphors"[7] is even more important for George Levine's *Darwin and the Novelists* (1988), the second founding text of science and literature studies. While *Darwin's Plots* focused on novelists (Eliot, Hardy, Charles Kingsley) who had read Darwin's work, *Darwin and the Novelists* examined the influence of Darwin's ideas on writers (Dickens and Trollope) who had encountered them indirectly, as a consequence of their absorption into the culture at large. "The cultural project of the Victorian novel increasingly appeared to me as a cultural twin to the project of Victorian science," Levine explains; both "aspired to represent the 'real.'"[8] The view that science and literature concern themselves with the same problems – equally critical to Beer and Levine's work – is further developed in *One Culture: Essays in Science and Literature* (1988), a collection co-edited by Levine which extends the study of science and literature's intersection from the Victorian period back to the eighteenth century and ahead to the twentieth. The anthology's title is a rejoinder to C. P. Snow's 1959 lecture "The Two Cultures," whose account of science and literature as fundamentally at odds with one another Levine criticizes in his preface.[9]

The one-culture model has been very important to scholars who followed Beer and Levine in investigating the intersections of Victorian science and literature. Such investigations – especially those published in the first two decades after *Darwin's Plots* and *Darwin and the Novelists* – often begin by acknowledging that it may seem surprising or improbable that literature and science could be mutually influential, but that our contemporary view of the two as distinct and distant from each other is due to the perspective that we have developed from living in a two-culture world. The scholar then explains that, in the Victorian period, science and literature were part of one culture, as demonstrated by the accessibility of nineteenth-century scientific writing, the appearance in periodicals of scientific articles alongside fiction

(and writing from a wide range of disciplines), the use of literary quotations by men of science, and, most importantly, the shared intellectual project of science and literature. That is, work in this subfield usually involves demonstrating that Victorian science and Victorian literature pursued the same questions, employed the same metaphors, and partook of the same ways of knowing; the novel was influenced by developments in science, but science was also influenced by the novel.[10] This approach obtains even when the scholar does not explicitly claim that Victorians lived in a one-culture world. In fact, in the past few years explicit statements to this effect have become rarer – the sign that they have become the doxa of this subfield and therefore do not need to be spoken.[11]

Why has the one-culture model been so successful? The answer lies partly in the relationship of this model to the highly influential narrative that there exist two cultures, a scientific and a literary one, and that they are and have long been in conflict with one another. From Romantic critiques of science and technology, to the debate between T. H. Huxley and Matthew Arnold, to the quarrel between Snow and F. R. Leavis, to the Sokal Hoax, this conflict seems to pit advocates of science and reason against advocates of humanism, art, and emotion. So invoking this conflict gives powerful motivation to arguments about the intersections of literature and science: the scholar who relates *Little Dorrit* to the laws of thermodynamics (as George Levine does) seems to be overcoming a firmly entrenched centuries-old belief in the antagonism of literary works to scientific thinking.[12]

The one-culture model thus benefits the arguments of literary scholars by providing a status-quo view that the scholar can overturn. Furthermore, like any good paradigm, it offers researchers a fresh field of inquiry, providing them with both new objects of study (Victorian scientific writing) and a highly productive method. Scholarship on Victorian science and literature tends to proceed by reading past the surface of a text to show how that text is actually about a scientific issue. So, for example, Beer explains Hardy's emphasis on the individual in his last novels as a challenge to Darwin's theories, which subordinate the individual to the species; George Levine asserts of *Little Dorrit* (1857) that it "enact[s] a conflict between two mythic structures, the progressive vision of Darwinism and the degenerative vision of thermodynamics"; Amy King argues that the ubiquitous story of the nineteenth-century heroine's "blooming" is shaped by a widespread "botanical vernacular" that originates with Linnaeus; Deirdre d'Albertis claims that Gaskell's *Wives and Daughters* (1866) is structured by a tension between classification and variation that mirrors tensions between natural history and Darwinian biology.[13] From Beer onwards scholars working in this

mode acknowledge and examine the ways that novelists "assimilated *and* resisted"[14] [my italics] scientific ideas. Yet emphasis on resistance is less common than emphasis on assimilation; moreover, even studies that show how novels criticize science tend to see that criticism as directed at specific theories or areas of inquiry.[15]

The method I have described scholars of science and literature using – the method of interpreting a text to be "about" something very different from what it seems to be about – is, of course, a method employed very broadly in literary studies. Originating in psychoanalysis and Marxism, it is an approach with a long history and many avatars, some of which – like the one employed in studies of science and literature – are not invariably "suspicious" or attempting to reveal the operation of ideology.[16] Yet the basic view of the text is the same: the real meaning of the text is hidden and can only be recovered through strenuous interpretive work. With the turn to historicism in recent decades – a turn that has been especially important in studies of Victorian literature, especially the Victorian novel – this interpretive work takes place in conjunction with the excavation of a particular historical context: the scholar's interpretation reveals the text to be imbricated with a specific set of historical circumstances.

These tendencies have recently come under critique. Mary Poovey, in *Genres of the Credit Economy*, criticizes the interpretive procedures of New Historicism (including her own previous work) for making anachronistic formalist assumptions the basis for historical arguments. These assumptions include a belief in organic unity – not of a single text, but of the discourse of which individual texts participate. Poovey proposes that literary scholars shift from this mode of interpretation to what Ian Hunter calls "historical description," which comprises "compositional technologies and historical deployments."[17] *Genres of the Credit Economy* focuses on the latter, on "the ways in which various writers tried to differentiate among kinds of writing – so that they could rank them, acquire social authority for some but not others, produce disciplinary norms, and claim for themselves institutional positions (and professional status)."[18] Poovey traces the delimitation of "Literary" writing, economic writing, and money, three genres that emerge from the imaginative writing that, during the seventeenth century, served the purpose of explaining the credit economy.[19]

A second important critique of interpretation has recently been formulated by Sharon Marcus and Stephen Best, who question the sufficiency of "symptomatic reading, a mode of interpretation that assumes that a text's truest meaning lies in what it does not say, describes textual surfaces as superfluous, and seeks to unmask hidden meanings."[20] They propose

instead a method they call "surface reading." Or methods, rather; Best and Marcus, as well as the contributors to their special issue of *Representations*, offer a wide range of approaches that count as surface reading, some more critical of symptomatic reading and some less. One of the more critical versions is Marcus's "just reading," deployed in her study of female friendship in the Victorian novel: against work that sees same-sex relationships as invariably repressed and excluded by the text, Marcus shows that novels openly affirm female relationships, which play a crucial role in advancing the courtship plot (and in transforming Victorian ideas about marriage).[21]

In this book I aim to present an alternative to the reading practices that dominate the field of science and literature. Those practices are akin to the ones criticized by Poovey, Best, and Marcus: they involve showing the hidden scientific significance of a non-scientific element, and they take novels as part of the same discourse as science. My method here will be different: I attend to the science that appears on the surface of the novel – characters who practice or study science, fictional conversations about science, narrative comments on or references to science. By looking at such moments, we can see that Victorian novels were concerned not only with what scientific practitioners were saying about the natural world, but also the claims they were making about science itself – the ways that they were defining the practice of science and promoting its place in society. Furthermore, recognizing this engagement reveals that novels frequently criticize and reject such claims, particularly the alignment of science with moral excellence. Moral cultivation and moral questions more broadly are claimed by the novel as its own domain of expertise. Such a stance points to the limitations of the one-culture rubric as it has been used in the field. Science and the novel are not invariably engaged in a productive exchange of ideas; instead, novels are attempting to delimit science, defining its concerns as distinct from fiction's – and inferior. This is not to say, however, that I think we should see science and literature as two separate cultures; the term "culture" as it is used in such discussions seems too broad to be useful. Poovey's language of genre, discipline, and professionalization is more helpful. This book, then, is not the story of two cultures locked in an agon, but rather an argument about the genre of the novel and the discipline of science in a period when both science and novel-writing were in the process of professionalization.

The one-culture model has come in for criticism by other scholars who similarly resist the terms our field has taken from Snow. In *Darwin, Literature, and Victorian Respectability*, Gowan Dawson demonstrates that Darwin's theories and the work of the scientific naturalists were associated

by their opponents with the sexual immorality and materialism of Victorian aesthetes – an association that Darwin and his allies worked vigorously to repudiate. Such repudiation, Dawson points out, suggests that the intersection between science and literature could also be destructive and antagonistic, rather than invariably creative, as the one-culture model tends to suggest.[22] Dawson arrives at this conclusion by examining not "how scientific concepts have informed various aspects of works of literature, or even how science has borrowed different rhetorical structures and tropes from literary forms of writing," but instead "the actual interconnection of the two."[23] Dawson, in other words, is concerned with the same process of historical ranking and differentiation – for the purpose of securing social standing – that interests Poovey.[24]

Dawson's book is among a number of recent studies concerned with the moral character of the scientific practitioner. Lorraine Daston and Peter Galison excavate the history of objectivity over three centuries, describing objectivity as a moral practice. Steven Shapin and Simon Schaffer describe the importance of gentlemanly character to the emergence of early modern science, while Shapin's *The Scientific Life: A Moral History of a Late Modern Vocation* (2008) insists on the importance of the scientist's character in twentieth and twenty-first-century industry.[25] The significance of moral character for nineteenth-century scientific practitioners has also been emphasized in studies of individual men of science, including Joseph Hooker and Huxley. Among literary scholars, it has received attention from George Levine, most fully in *Dying to Know: Scientific Epistemology and Narrative in Victorian England*. Levine argues that a particular conception of the scientific practitioner's moral character is, in the Western imagination, the precondition for knowledge. The would-be knower must "die" by becoming objective and disinterested, entirely free from desire or arrogance, literally selfless. Levine argues that scientific epistemology is thus inherently narrative: discussing a passage by physicist John Tyndall, Levine characterizes dying-to-know as "a story of a protagonist who by way of 'patient industry' and 'humility' denies personal bias, achieves real knowledge, and instantly finds that unsought for 'elevation.'"[26] As a consequence, the ideal of dying-to-know is readily taken up by other narratives – in particular, the novels and autobiographies that are Levine's focus and that in his reading reveal the "lived incoherences and high costs of the strict philosophical argument."[27]

While Levine is right to identify dying-to-know as a widely circulated Victorian story about science and morality, it was not the only way that the two were linked. Moral excellence was not always described as the condition

for scientific achievement: men of science often claimed the opposite, that practicing science *creates* moral excellence in the practitioner, as Lyell argues in the quote with which this chapter began. At times, indeed, causality drops away altogether, such that moral excellence and scientific practice are aligned with no indication of which comes first. Nonetheless, it is important to recognize that two narrative sequences existed: the dying-to-know narrative investigated by Levine, in which moral excellence is the prerequisite for scientific work; and a narrative in which scientific work has moral effects on the worker. I discuss both in this book, but the second will be especially important to the novels under consideration, which take up the question of how practicing science affects the practitioner's character.

The reason this second narrative is so important to fiction lies in the novel's longstanding concern with moral development – the moral development of its characters as well as the moral development of its readers. In asserting that the novel's special expertise lay in its concern with moral and ethical questions, these writers were drawing on a new conception of fiction that had emerged in the Victorian period. The novel's dubious reputation in the eighteenth and early nineteenth centuries had been largely replaced by a view of it as respectable, even commendable.[28] There is, of course, ample evidence to suggest that the transformation was not complete, and that the conception of the novel as morally beneficial did not originate with the Victorians.[29] Still, the evidence points to a broad shift in perceptions of the novel during the first few decades of the century. This change was registered by Victorians themselves. An article published in *Fraser's* in 1847 reflected that thirty years earlier, "every novel came into the world with a brand upon it," a situation that was revolutionized by "the irresistible popularity of Scott"; in "The Art of Fiction" (1884) Henry James commented that "the old story about fiction being 'wicked' has doubtless died out in England."[30] In many quarters, suspicion of the novel was replaced by a belief in fiction's ability to cultivate moral character. In 1866 *Blackwood's* applauded the disappearance of anti-novel prejudice, because without novels "the greater part of us would be dolts, and, what is worse, unfeeling, ungenerous, and under the debasing dominion of the selfishness of simple reason."[31] One particularly widespread view accounted for fiction's moral power by stressing its ability to develop the sympathetic feelings of the reader.[32] Thus E. S. Dallas wrote in 1866, "I know not who in this generation is better employed than he who – even if he cannot boast of genius, yet with tact and clearness – widens through fiction the range of our sympathies, and teaches us not less to care for the narrow aims of small people than for the vast schemes of the great and mighty."[33] George Eliot, too,

considered that "the greatest benefit we owe to the artist, whether painter, poet, or novelist, is the extension of our sympathies."[34]

By the mid-nineteenth century, then, the novel was seen as cultivating the moral character of its readers. And so, when scientific practitioners claimed that such cultivation could be effected by science, that claim brought science into the territory of the novel. Such a claim was not, in all cases, perceived by novelists as a threat: in the early work of George Eliot, and in Elizabeth Gaskell's *Wives and Daughters*, science (specifically natural history) enhances the moral lessons conveyed by the novel. But the fiction of Thomas Hardy, antivivisection authors, and H. G. Wells claims moral issues as the special province of the novel and represents science as morally deleterious. In so doing, these writers draw a boundary between the kinds of knowledge pursued by science, and the kinds of knowledge pursued by the novel; they place scientific knowledge outside the novel while insisting on science's ignorance of the novel's moral concerns.

What is the reason for this shift in the treatment of science? During the nineteenth century, science and literature both underwent a series of changes that we retrospectively describe as professionalization. Below I will discuss how these changes transformed the relationship of the two fields to one another. But first, it is necessary to explain what the professionalization of science and the professionalization of literature entailed. The question is a complicated one: the process of professionalization is itself invariably complicated, slow, and irregular, and historians give different, even conflicting, accounts of how, when, and why it occurred in literature and science. On a very basic level, in 1900 it was easier to support oneself through writing or through practicing science than it had been in 1800. The dramatic growth of both the periodical press and the market for fiction rendered it possible to earn a living as an author (though it seems that many authors also held other jobs).[35] Census data affirms that by the end of the century, significantly more people thought of themselves as authors, editors, or journalists.[36] In science, the number of university professorships increased steadily throughout the century.[37] And changes in publishing affected science, too, by for example making it more possible to earn a living as a scientific popularizer.

But of course, professionalization involves much more than economic independence. Though its definition is contested, the other features listed by historians and sociologists usually include the emergence of specialized training and credentialing procedures; the formation of organizations that set standards for work and defend members' interests; reward structures; and economic control of the field.[38] These features, too, appear in changes

to science and literature over the course of the century. The foundation of the Society of Authors in 1884 is often cited as a sign that literature was professionalizing. So is the increasing control exerted by authors over copyright: Clare Pettitt, for example, shows that novelists' concern with issues of intellectual property and copyright were part of a wider nineteenth-century debate about mental labor, reading authors' engagement in this debate as part of an endeavor to professionalize authorship.[39] Victorians themselves reflected on the issue: in 1847, G. H. Lewes began an article for *Fraser's* with the declaration, "Literature has become a profession."[40] Such a view was promulgated at the end of the century by Walter Besant, who played a leading role in founding the Society of Authors and who advocated vigorously for writers.[41] Yet such evidence cannot be taken as affirming novelistic professionalization in any straightforward way. As Linda Peterson has demonstrated, Victorian writers did not all agree with Lewes and Besant; the subject of professionalization remained a subject of debate throughout the century. Gaye Tuchman and Nina Fortin argue that novelists cannot be considered professionals because they "did not control their fee structure, training, recruitment, or expulsion" and thus do not meet the sociological definition of professionalization.[42] And almost all studies stress the difficulty of assessing whether writers supported themselves exclusively through writing, and speculate that many held other jobs simultaneously.

The question of science's professionalization is even more contentious. Frank Turner argues in an influential essay that the conflict between religion and science in the nineteenth century should be understood in terms of professionalization, as scientific practitioners attempted to seize cultural authority and positions within the university; Steven Shapin, on the other hand, asserts that the process of professionalization was only getting underway at the end of the century.[43] The difficulties associated with this issue have led some scholars to suggest that professionalization is simply not a helpful concept for understanding nineteenth-century science, because employing it imposes ahistorical essentialist categories, or produces teleological arguments in which nineteenth-century scientific practitioners strive to become modern research scientists.[44] As an alternative method of "mapping the social profile of science" Jan Golinski proposes that science be understood in terms of a process of "identity formation" undertaken by scientific practitioners. Such an approach has found favor in recent scholarly work, including that by Paul White, Jim Endersby, and Ruth Barton. For all of these historians, issues of terminology are paramount: Victorian scientific practitioners did not use the term "professional" to describe themselves; they also shunned the word