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Introduction

Over the past four decades, and in ongoing dialogue with science studies, the innovative interdisciplinary field of Literature and Science has become a dynamic platform for investigation into the many ways that the humanities and sciences share (1) a fundamentally pluralistic outlook; (2) common cultures, discourses, and practices; and (3) a commitment to expanding the range and capabilities of empiricist approaches. The fourteen essays in *The Cambridge Companion to Literature and Science* supply an integrated set of accounts of this multilevel undertaking through a rich portrayal of the interweaving of theory and practice in recent scholarship as well as of the historical expansion of empiricism to which Literature and Science itself contributes.

The *Companion* is designed, in the first instance, for undergraduates and graduate students in an academic setting where students increasingly major in the sciences, especially the life sciences, and often specialize earlier. Also nonscience majors are more likely to be exposed to introductory biology courses, which, it has been argued, are assuming the unifying role in the curriculum formerly played by core humanities courses.[1] The volume should appeal to the smart undergraduate in academics at any stage in their careers. Although humanities faculty are likely to be less familiar with the sciences than their students, in a world increasingly mediated by technoscience it may be expected that many will wish to know more about how the sciences and humanities inform one another, and so will want to grasp the essentials of this still emerging field. Much material in the *Companion* will be unfamiliar to most practicing scientists, yet because investigations of scientific practice occupy the central ground of the discipline, they may find themselves pleasantly engaged. Nonacademics are invited to join in the fun – this is your world too!

Because Literature and Science today is not what it was, it is probably not what you think it is. In the first place it both is and is not a branch of another

interdiscipline, science studies or the sociology of science. Understood simply enough as a matter of "studying science" and consequently as being at once "unified (in terms of its object of study) and strongly disunified (in terms of its methodologies, research questions, and institutional locations)," science studies has offered one of the most exciting arenas for academic investigation over the past three decades.[2] Mario Biagioli goes on to emphasize a feature of science studies that accounts for a good deal of the ferment and excitement: "As science studies produces more empirical work, it further 'disunifies' itself methodologically while producing increasingly complex and 'disunified' pictures of science, *a double trend toward disunity that dissolves neither the field nor its subject matter*" (xiv). In the process an enormous range of hybrid approaches and subjects has developed, from feminist science studies to biosemiotics, from complexity theory to the medical humanities, from the ecosocial to the biocultural, from the digital humanities to innovation studies, from affective neuroscience to animal studies and posthumanism – each with a firm place under the science studies umbrella.

Biagioli is also careful to note in *The Science Studies Reader*, the landmark volume he edited, that "practitioners" of science studies are "dispersed over the widest range of departments and programs" and that these expressly include literature departments (xi). Yet it is no less noteworthy that none of the thirty-eight contributors to the *Reader* was actually located in such a department. (G. E. R. Lloyd might seem an exception as a member of the Faculty of Classics at Cambridge; still he held a Chair in Ancient Philosophy and Science.) More recently Biagioli has proposed that "the disciplinary boundaries of science studies ... include the history, sociology, philosophy and ethnography of science, technology and medicine, as well as studies of the relationship between science and literature, science and law, and science and visual studies."[3] No doubt from the perspective of science studies this is about right; all the same, Literature and Science is not quite so readily folded into science studies. For these are actually two discrete fields or interfields. Admittedly, there is a tremendous amount of overlap between them, but as the essays collected in the present volume demonstrate, an adequate sense of the complex imbrications of literature and science historically as well as of recent and ongoing work in Literature and Science cannot simply be conveyed by mapping Literature and Science onto science studies – certainly if the full richness and excitement of the field is to emerge.

The institutional history of Literature and Science, particularly as it has developed in the US, is a complicated enough story but two additional factors complicate it further. In the first place, the establishment in 1939 of what would become the Literature and Science Division of the Modern Language Association – basically taking the form of a subdiscipline of the history of

science concerned chiefly with representations of science in literature and marking the advent of what may be termed first-wave Literature and Science – by no means provides the actual starting point of the story.[4] To take one prominent example, in *Science and the Modern World* (1925), the philosopher and mathematician Alfred North Whitehead had insisted on the need to interpret modern science in a manner that would take no less seriously the criticisms of traditional scientific conceptualization made by the British romantic poets William Wordsworth and Percy Bysshe Shelley than, somewhat less controversially, it would take the patently nontraditional aspects of scientific innovations of the past century or two. Whitehead's alternate conceptualization, discussed in the *Companion*'s final chapter, went against the grain of the positivist history of science that was already being institutionalized as he wrote.[5] As a result, his proposals regarding the imbrications of literature and science were rarely followed through until what may be termed second-wave Literature and Science developed much later in parallel with science studies. Therefore a strictly narrative account of the field's development won't do.

So that is the first complication. The second is that things don't necessarily look the same in England as they do in the US, let alone on the Continent and elsewhere.[6] One striking difference emerges when one compares the annual conferences of the leading US and British organizations devoted to Literature and Science: where the fecund triangulations described throughout the *Companion* dominate the Society for Literature, Science and the Arts in the US (as well as the society's biannual meetings abroad, under the aegis of the European Society for Literature, Science and the Arts), considerably more traditional research sets the tone for the British Society for Literature and Science. One consequence is that in a British context, "Literature and Science" may suggest a mix of first-wave work and of the initial phase of second-wave Literature and Science, while in the US second-wave Literature and Science is more likely itself to have already entered a new phase. In this respect the descriptions offered in the *Companion* of the robust practices characteristic of Literature and Science should be understood principally with US developments in mind, although these practices are by no means limited to any single national tradition.

As an academic field of study, then, Literature and Science has advanced in two waves, roughly covering the three and a half decades between 1945 and 1980 and an equal timespan since. In turn, each wave has unfolded in a pair of distinct phases. George S. Rousseau, in an important 1978 article on "the state of the field" in the US, observed that investigations of the relation between literature and science prior to 1950 were largely philological, a matter of "document[ing] scientific references in literature."[7] (There were

of course exceptions, such as I. A. Richards's 1926 *Science and Poetry* and Edmund Wilson's 1931 *Axel's Castle*.)[8] As such they were increasingly challenged by a more recent constellation of what Rousseau somewhat idiosyncratically labeled "theorists" (584). This cohort of Literature and Science scholars sought to trace the history of scientific concepts within literary contexts as well as the influence of science on literature more generally. The new analytic field, largely the province of "intellectual historians with degrees in history and/or literature," could just as well have been labeled Science and Literature, and often was (584). It constituted the inaugural phase of first-wave Literature and Science.

In a discussion of Darwin scholarship in Chapter 3 of the *Companion*, Devin Griffiths divides Literature and Science into three waves rather than two. Appearances to the contrary, Griffiths's schema is equivalent to that proposed here, as his initial pair of waves corresponds to the two *phases* of first-wave Literature and Science. The first is largely limited, as Rousseau had proposed, to consideration of the influence of science on literature, whereas the subsequent one complicates this stance by emphasizing the influence of literature on science instead. By 1978, when Rousseau released his report, the field was in such disarray that the continued existence of the MLA's Literature and Science Division, which had flourished since the 1950s, was "very much in doubt" (589); yet some thirty-five years later, the same division possessed nearly 3,000 members (as of 2013). It is this reversal in fortune that the essays in the *Companion* exemplify while they also seek to account for it. *What happened in the interim is best understood as the displacement of one field, called Literature and Science, by another, also called Literature and Science*; and one striking consequence is that a disconnect has arisen between what individuals outside the field think Literature and Science is or should be – something resembling what it really was prior to 1980 – and what it now actually is.

According to Rousseau, the impending demise of first-wave Literature and Science was due largely to the entrance of structuralism onto the American scene. The effect of this "structuralist intrusion" was somewhat paradoxical, "typified" as it was by Michel Foucault, "all of whose books inherently deal with literature and science." (In Chapter 6 T. Hugh Crawford assesses Foucault's role in the field's transformation.) In any event, the subfield of intellectual history called Literature and Science was "render[ed] obsolete" insofar as its methodological premises came under withering attack even as the "impression . . . that structuralists were finally turning literary criticism into a science" led to a backlash against prior associations of science and literary study (589). The subsequent emergence of a second wave of Literature and Science (Griffiths's "third"), no longer a subfield but an

interfield, may accordingly be attributed to a pair of factors – the first hinted at by Rousseau, the second unacknowledged in his account.

The missing factor, by no means absent however from the intellectual climate of 1978, was the maturation of theory (in its more customary usage) from structuralist to poststructuralist manifestations. Like its sister discipline, science studies, second-wave Literature and Science has from its inception been a hotbed of theoretical application and testing. The particular disciplinary signature of this new Literature and Science was already suggested by Rousseau, albeit in the register of a possible future for a dying discipline. "There is no reason to disbelieve on logical or epistemological grounds," he proposed,

> that literature and science affect each other reciprocally. That is, that each influences the other in just about the same degree, although conceivably in different ways. It is also probably valid to assume, although it would be practically impossible to prove, that science shapes literature to the same degree that imaginative literature shapes science. [Yet] only the former has been studied in any depth ... The latter is an unexplored territory, probably the one in greatest need of cultivation right now and also the one requiring learning so vast that it is hard to imagine it in a single scholar (587–8).[9]

Another way to put this is that further development of first-wave Literature and Science, and of its second phase in particular, would require changes in the field that effectively caused it to morph into a different field – and the new field also unfolded in a pair of fairly distinct phases. Thus Darwin scholars like George Levine and Gillian Beer, who have tended to emphasize the "one culture" shared alike by scientists and literary figures, may usefully be contrasted with the broad pluralism Griffiths locates in more recent work, thereby exhibiting the alternately monocultural and pluralistic phases of second-wave Literature and Science.[10] Of course each phase possesses multiple distinguishing features, from the emphasis on discourse characteristic of so many phase-one investigations to the rigorous hybridization of theory and practice, and the treatment of *possibility* as an indispensable ontological category (discussed by Isabelle Stengers in Chapter 1), that identify so much recent work in Literature and Science as phase-two products. A nice coincidence links the second phase – by way of the two most junior contributors to the *Companion* – to Levine and Beer, among the most prominent first-phase figures in second-wave study of Victorian literature and science: Griffiths was Levine's last PhD student, and kitt price one of the last to work with Beer.

The Cambridge Companion to Literature and Science offers twenty-first-century readers a roadmap to the many robust developments that have

contributed, at both the individual scholar and community-of-scholars levels, to the emergence of a great variety of approaches to the reciprocity between literature and science – the absence of which Rousseau lamented as a missed opportunity even as he hailed it as a largely unrealized possibility. Yet the reciprocity in question is also more than that. As has become clear, especially in the context of parallel developments in STS (science and technology studies), another moniker for science studies, second-wave Literature and Science, unlike its predecessor, isn't just concerned with literature and science or even literatures and sciences. One effect of the combination of an increasing range of theoretical approaches entertained within the humanities along with an emphasis on practice in science studies and a broad focus on multidirectional reciprocity throughout the academy has been a healthy expansion of the extent of such reciprocity within Literature and Science itself. No longer limited to literature and science as such, the field triangulates any number of foci in the arts, the non- or extra-literature humanities, and the social sciences.

That the resultant field of study retains the name Literature and Science is a matter of some contention, and therefore the designation remains actively in play. One reason for keeping the old name to designate new circumstances derives from that very resonance. Unlike first-wave Literature and Science, the repurposed name is packed with meaning, and the controversies it may provoke – for instance, regarding whether it unduly privileges literature over other arts and humanities – constitute part of its significance, even its allure. When the Society for Literature and Science rebranded itself a dozen years ago as the Society for Literature, Science and the Arts, the gain in clarity, given the strong presence of artists and art historians at the annual conferences, may have come at the expense of such phrasal undertones.[11]

Another reason for sticking with Literature and Science is that the new field emerged against the backdrop of the two-cultures paradigm – the essence of which, as C. P. Snow famously characterized it in his 1959 Rede lecture, "The Two Cultures and the Scientific Revolution," was that "literary intellectuals" and scientists represented opposite poles within a larger spectrum of specialists.[12] Although one may dispute Snow's opposition in many respects, it cannot be denied that in the context of increasingly specialized practices of inquiry, literature and science, speaking very broadly, do appear at considerable variance (to put it mildly). Snow himself came to regret the sharpness of the division, even proposing a third culture, sociological in nature, to bridge it.[13] In Britain his proposal was taken up, if not quite according to his specifications, with the emergence in the 1960s and 1970s of the sociology of scientific knowledge (SSK) at the Edinburgh Science Studies Unit. (This is discussed further in Chapter 8.)

It is in the present context that the distinction between science studies and second-wave Literature and Science is perhaps clearest. Historically, science studies is a successor discipline to Snow's two-cultures paradigm insofar as it developed in response to the project of a sociology of the sciences that Snow himself endorsed. Literature and Science, by contrast, represents a more frontal attack on Snow's initial premise, particularly in the form the field has taken since the 1970s. At the same time, the general position that integrates literature and science as well as the diverse approaches of second-wave Literature and Science long predates Snow's argument (although he pays it no heed). Interestingly, as Tim Armstrong demonstrates in Chapter 12, extended dialogue between fiction and the life sciences already characterized Cambridge University in the 1920s and 1930s – where Snow acquired a PhD in physics and subsequently conducted research in physical chemistry. (For a detailed account of concurrent exchanges at Cambridge between poetry and physics, see Chapter 5.)

One of the chief ambitions of the *Companion* is to present the lineaments of an alternate argument to Snow's as it may be traced in the development of a more expansive empiricism than has generally been assumed by traditional accounts of modern science. As Mary Baine Campbell demonstrates in Chapter 2, this development is already suggested in early modern literary practices that predated the consolidation of modern science in the mid-seventeenth century. (Both Chapters 1 and 2 include descriptions of Renaissance stances more closely aligned with expansive empiricist practices than rigidly empiricist ones.) And it fully comes into its own – see Chapters 3 and 4 – following Darwin's quite literally earth-shattering innovations in the mid-nineteenth century and the gradual ascent of the life sciences in the hierarchy of sciences. In this manner the more expressly historical section of the *Companion* (Part II, "Snapshots of the Past") addresses increasingly expansive empiricist practices as they were introduced into the modern sciences, including Einsteinian physics in Chapter 5 – as does the *Companion*'s final chapter, with its focus on the significance that Whitehead's highly original account of modern scientific development holds equally for second-wave Literature and Science and for science studies.

In sum, Literature and Science as the name for the discipline to which this volume serves as *Companion* conveys the strongest possible position against the radically conservative "two cultures" stance. From the perspective commonly associated with Snow (whether properly or not), literature and science stand at opposite ends of pretty much everything – unlike science and art, for instance – so their direct conjunction represents an especially sharp slap in the face. To the extent that literature and science do not actually represent thoroughly separate cultures (quite the contrary), practitioners of Literature

and Science and adherents of the two-cultures paradigm, including successor formulations such as E. O. Wilson's single "consilient" culture, may well constitute a less navigable divide.[14] This holds true for the monocultural as well as the pluralistic phases of second-wave Literature and Science, both of which define themselves against the dual-culture model. If one work best represents the transition from first-wave to second-wave Literature and Science, it is probably Bruno Latour and Steve Woolgar's 1979 study *Laboratory Life: The Social Construction of Scientific Facts*.[15] Just why this is a key text for Literature and Science and not only for science studies will remain largely unelaborated here, other than to observe that it has partly to do with the challenge posed to claims for the new field's autonomy ("the idea," as Rousseau put it, "of [L]iterature and [S]cience practised as a separate field or discipline")[16], partly with the postpositivist[17] suspicion directed at the fact/value dichotomy (see Chapters 5 and 9 as well as the *Companion*'s concluding chapter), and partly with the attention displayed to the role of writing technologies in laboratory practices (see Chapter 7). Suffice to say, *that* it is a key text for both fields poses a decisive challenge to the two-cultures paradigm.

The many triangulations permitted within the generous embrace of Literature and Science – with theory in general, with particular theories, with science studies, with other disciplines in the humanities and/or social sciences and/or arts, between several literatures and science, or between one or more literatures and one or more sciences – are a source of continuing strength and interest for a tolerably new discipline that, as it advances into its fourth decade, shows no sign of letting up.*

Biography of a Latourian Field

I have just alluded to Bruno Latour's first book, *Laboratory Life*, coauthored with Steve Woolgar. Together with colleagues that include the Belgian philosopher Isabelle Stengers (a contributor to this volume) and the feminist technoscience theorist Donna Haraway, Latour proceeded to upend the still-new sociology of science that in the 1970s had begun to bridge gaps between the sciences and humanities with its emphasis – in the largely Foucauldian manner of phase-one second-wave phase-one Literature and Science – on social, cultural, and discursive factors. T. Hugh Crawford and James J. Bono (in Chapters 6 and 8, respectively) discuss Latour, Haraway and Stengers in the context of science studies, so I won't address Latour's STS work directly,

* The index to the *Companion* supplies a preliminary mapping across the entire volume and consequently a representative sampling of Literature and Science circa 2018. See the entries for empiricism, extended empiricisms, and experience, for example, or those for consequences, construction, practice(s), and pragmatism.

aside from observing in the first place that already in the 1979 collaborative volume, traces may be found of what Haun Saussy and Tim Lenoir in Chapter 7 speak of as *posthermeneutic* attention to *non*discursive aspects of writing practices. (In decades to come such attention would variously characterize the work of many practitioners of second-phase second-wave Literature and Science.) In addition, like Haraway and Stengers and the other contributors to this *Companion*, Latour has positioned his investigations from the start against the feature that the public probably most strongly identifies with science studies, despite its being more accurately associated specifically with cultural studies and the SSK school: "the motto," as Stengers puts it in Chapter 1, of "'only' a representation or construction." (Latour and Woolgar's own use of "social construction" has understandably caused a good deal of confusion, although they meant something quite different from what cultural critics might mean – consequently, in a new edition half a dozen years later, they removed "social" from the subtitle.)[18]

Within science studies, Latour's retooling of sociology as a discourse concerned with the emergence of surprising forms of togetherness rather than the more traditional focus on inhibiting or enabling effects of already established social cohorts and situations has had an enormous effect – especially when coupled with a second major innovation of extending the category of social being to apply not just to the usual human suspects but also to any moderately active *nonhuman* that gives evidence of functioning dynamically within some larger network of beings and becomings. As can be imagined, the combination of these two transformations makes an enormous difference in the sociological analyses that ensue, and science studies has been the beneficiary. In the present context, I want to address, ever so briefly, the related matter, not of Latourian science studies but of the appropriateness and even necessity of bringing the tools and practices of Literature and Science to bear on Latour's almost forty years of sociological inquiry. What can Literature and Science tell us about his work that other approaches, including those of science studies itself, are more likely to miss, or dismiss? I'd like to propose six areas of overlap of Latour and Literature and Science, although I will only discuss the first, more general, one here: (1) the expansion of empiricism in such a manner that it becomes readily available for literary scholarship despite the strong theoretical commitments of many scholars;[19] (2) the significance for Latour of the French philosopher of science Michel Serres;[20] (3) Latour's use of the structural semiotics of Algirdas Julien Greimas;[21] (4) his use of Whiteheadian metaphysics, initially to supplement Greimas;[22] (5) early studies by Latour of the French philosopher and poet, Charles Péguy;[23] and (6) a series of exchanges between Latour and the novelist Richard Powers.[24] Needless to say, elements of Latour's anthropology of science have proven of considerable use to literary scholars as well.[25]

One of Latour's better-known slogans derives from the title of his 1991 work of speculative philosophy, *We Have Never Been Modern*.[26] The modernity in question is described in terms that Latour draws from accounts of the development of the experimental sciences in the seventeenth century. (Some of these are quite familiar: dualisms of body and mind, for instance; or objectivity and subjectivity; or primary and secondary qualities – extension, say, by contrast with color.) In each case hybridization is forbidden, and it is this insistence on purity that makes the associated dualisms *modern*. When Latour proposes instead that we have never been modern, he means that the assertion of modernity, including the implicit contrast with something nonmodern – something chronologically prior (medieval, ancient) or developmentally (primitive, naive) – turns out to rely on practices that involve the very hybridity the claim of modernity had eschewed! Certainly, Latour's counterclaim would seem to run the risk of alienating a key cohort of Snow's "literary intellectuals" who might be expected to provide especially important evidence for him: namely, *early modernists*, as scholars of the sixteenth and seventeenth centuries like Mary Baine Campbell (Chapter 2) and James J. Bono (Chapter 8) call themselves: students of the early modern period.

How can you be an early modernist if the communities you study were never actually modern? In fact, it is relatively easy – insofar as the communities seem to have found it relatively easy to speak of themselves *as if* they were modern. In other words, they embraced the discourse of modernity regardless of how imprecise that discourse might prove to have been. Consequently, inquiry into the "anthropology of the moderns" remains a viable enterprise, perforce an exciting one, despite the early moderns having been no more modern than the early modernists themselves are![27] This still leaves open the possibility that they might have been modern *in a different way*, one more in tune perhaps with what Latour elsewhere calls "matters of concern" by contrast with "matters of fact" – in addition to raising the question of how they were able to pass themselves off as modern in the more usual sense (to themselves first of all).[28] In *We Have Never Been Modern* Latour proposed fairly speculative answers, and since then he has alternated between theoretical and empirical inquiry into the matter – leading some two decades later to the unabashedly philosophical *An Inquiry into Modes of Existence* (2013), which exhibits a process ontology supported by the empirical results of multiple case studies.

One way to rephrase Latour's slogan is *we have never been rigid empiricists*. Despite claiming to derive knowledge exclusively from sense experience – the traditional definition of empiricism – "modern" empiricists never actually succeeded in being the rigid empiricists they said they were.