Introduction

One of the earliest scholarly works to analyze seriously intersections between science and literature in modernism, Ian Bell's *Critic as Scientist: The Modernist Poetics of Ezra Pound* (1981) articulates a particularly enduring and influential construction of relations between modernist literature and modern science. "Modernism's use of . . . science . . . was always at the level of analogy or metaphor," Bell contends, a strategy through which the literary movement "declared its status *as* modern by rhetorical means, with a definite and attention-seeking verbal battle cry" (196; emphasis original). To begin the following study of relationships between science and literature in modernism and the critical reception of those relations, we might consider the following "exhibits," all involving literary modernists now securely canonical:

(1) Gertrude Stein's two earliest publications were not novels, poems, plays, or verbal portraits, but scientific papers; "Normal Motor Automatism" and "Cultivated Motor Automatism" appeared in the *Psychological Review* (September 1896 & May 1898), the journal of the American Psychological Association, and were based on scientific experiments Stein conducted on automatic writing while an undergraduate at Harvard.

(2) In the October 15th, 1913 issue of Dora Marsden's "Individualist Review," *The New Freewoman*, Ezra Pound published the first installment of his essay, "The Serious Artist," which asserts, "The arts, literature, poesy, are a science, just as chemistry is a science. Their subject is man, mankind and the individual. The subject of chemistry is matter considered as to its composition" (161).

(3) In Virginia Woolf's *Between the Acts* (1941), Isa Oliver, recoiling in anger after her father-in-law Bartholomew has called her son "a coward," looks to the volumes in the family library for some consolation. As Isa runs "her eyes along the books," Woolf evokes an exemplary late-Victorian library, its volumes wide-ranging in theme, genre, and

> discipline, including novels, verse, biographies, even county records (19). Isa's eyes come to rest, however, on three volumes by scientists particularly influential for early twentieth-century British readers: Charles Darwin, the father of evolution; astronomer Arthur Eddington; and physicist James Jeans. But these science books offer no more or less relief than the other volumes; as Isa reflects, "none of them" stops her emotional "toothache" (20).

I offer these examples to raise the question of whether accounts like Bell's of modernist literature's use of science as always metaphorical, as chiefly a defensive rhetorical strategy of cultural legitimation, can adequately acknowledge or account for the range of ways that relations between modern science and modernist literature were actually configured. The first example raises the possibility that Stein's literary experiments derive from and revise her early scientific experiments and first-published scientific texts. In the second example, Pound uses science as a rhetorical means to assert literary modernism's "status as modern" to be sure; but he also defies the boundary between literature and science, defining "the arts, literature, poesy," as "a science" that studies "man, mankind and the individual," just as chemistry studies matter. If the Stein example calls into question overly rigid distinctions between modernist writers and modern scientists, the Pound example calls into question overly rigid distinctions between the work of modernist literature and the work of modern science. The third example, a passage from Woolf's final novel, renders modern science books as integral texts of modernity but attributes to them no special priority or status especially in comparison to literature.

Together, these examples suggest that relations between modern science and modernist literature were more various and complex than allowed under accounts that posit those relations as largely or exclusively analogic and metaphorical. Of course, Bell's construction of relations between science and literary modernism as distanced and figurative reflects a broader Western cultural consensus forged during the later twentieth century that science and literature are necessarily antagonistic and incommensurate discourses and disciplines. The view has exerted considerable influence and incited considerable debate over relations – or lack thereof – between modern literature and science at least since C. P. Snow delivered the Rede Lecture at Cambridge University in 1959 that identified and lamented the presence of "Two Cultures" in Western life, "two polar groups" in Snow's formulation (3) – "[l]iterary intellectuals at one pole" and "at the other scientists" – separated by a "gulf of mutual incomprehension," "hostility," "dislike," and "most of all lack of understanding" (4). The authority and

duration of the two cultures consensus is notable, especially in light of the intensity of debate it has generated, epitomized in noteworthy episodes such as F. R. Leavis's scathing 1962 critique of Snow's lecture in the *Spectator* and the so-called Snow-Leavis controversy it provoked (Collini xxix–xliii), and the Sokal affair of 1996 during the so-called science wars, when New York University physics professor Alan Sokal, seeking to discover if a cultural studies journal would publish an article written by a scientist that was "liberally salted with nonsense if it (a) sounded good and (b) flattered the editors' ideological preconceptions" ("Physicist" 62), had such an article accepted for publication by a leading journal of "Postmodern Cultural Studies," *Social Text* (Hess 1–5). While episodes like the Snow-Leavis controversy and the Sokal affair arguably offer significant evidence in favor of Snow's two cultures thesis and its continuing influence, over the past twenty years scholars in science studies, literature and science studies, and new modernist studies have worked diligently and seriously to interrogate and complicate constructions of relations between twentieth-century literature and science as always already separate and antagonistic.

Joining these efforts to demythologize and reassess relations between modern literature and science, *Sciences of Modernism* draws on key assumptions of science studies, science and literature studies, and new modernist studies. It recovers and examines neglected traffic between British literature and science at the dawn of the twentieth century. During these heady years, a generation of artists and scientists were determinedly engaged in fashioning new ways to respond to and represent the complex and disorienting realities of twentieth-century modernity as their respective disciplines competed for the cultural status to render modernity authoritatively and claim thereby the mantle of "most modern."

Sciences of Modernism follows science studies in treating science not as a stable and authoritative discipline, objective and universal, but as a shifting and varied constellation of writers, theories, and texts precisely and complexly "located in its social and cultural context," as L. J. Jordanova explains (20). Convinced, like George Levine, that developments in science are "closely related to developments in culture at large" (25), this study concurs in particular with works of science studies that reflect what Susan Merrill Squier has called the field's "linguistic turn" over the past twenty years ("Omega" 143). Like them, my account understands the "social status of science" as dependent on "the power of the written word to reach audiences, to change their ways of thinking, to persuade people of the value of science and to legitimize the position of the practitioners" (Jordanova 23). Most important, *Sciences of Modernism* joins in the key science studies effort, epitomized in

Bruno Latour's pioneering *Science in Action* (1987), to study not "ready made science" but science "in the making," *before* it has been closed in a disciplinary "black box," its origins forgotten, occluded and disowned (4).

Inspired especially by related developments in science and literature studies, *Sciences of Modernism* follows Squier in adapting Latour's techniques for studying science in action to the study of science and literature; it seeks to open the "black box" around early modernist science and literature in particular. Accordingly, this study moves, as Latour recommends, "in time and space" (4) until it can access not ready-made modernist science or literature but modernism – scientific *and* literary – in the making. *Sciences of Modernism* thus returns to the scenes and texts of *early* modernism, when the gulf between science and literature is still under construction, more passable than the unbridgeable chasm between the "two cultures" that Snow articulates nearly fifty years later. Gillian Beer has argued that in the mid-nineteenth century, "scientists still shared a common language with other educated readers and writers of their time" (6), drawing "openly" in their texts on "literary, historical and philosophical material" (7).

Sciences of Modernism finds that during the early modernist moment of the late nineteenth to the early twentieth centuries such open traffic between science and nonscientific discourses continues, especially between literature and the newer, modernizing "human" sciences of ethnography, sexology, and psychology. As human or social sciences, of course, ethnography, sexology, and psychology are less "hard" – technical, abstract, mathematical – than the "natural" sciences of biology, chemistry, physics, astronomy, or geology. Nonetheless, these sciences examine phenomena of distinct and pressing importance for literary modernists, particularly during the years leading up to and into the Great War: cultures, especially cultural identity, cultural difference, and cultural contact; bodies, especially sexualized bodies, sexuality, and sexual relations; and minds, especially damaged minds, psychological trauma, and interiority. Given these shared concerns, reading modernist literary texts in proximity to contemporary works of ethnography, sexology, and psychology makes especially clear the traffic occurring between early modernist science writing and literary writing. Moreover, the sciences of ethnography, sexology, and psychology develop during the later nineteenth century but are significantly transformed – self-consciously modernized – at the dawn of the twentieth century by an emerging generation of scientists. Not coincidentally, this new generation of scientists' transformative endeavors intersect and resonate with related efforts to transform and modernize literary conventions among an emerging generation of literary writers.

Working to open the black boxes around modern literature and science, to recover and reassess the construction and canonization of their divorce and antipathy, *Sciences of Modernism* finds that early modernist writing in literature and science, especially the human sciences, shares many concerns and obsessions of Victorian literary writing. At the dawn of the twentieth century, modernism in science and literature frequently works to modernize late Victorian literature and literary techniques – to make new its literary genres, narratives, tropes, and themes. Whether writing science books or literary texts, the authors that *Sciences of Modernism* studies build modernism using older, often literary tools; they draw on a shared body of familiar literary sources, evoking, imitating, and adapting adventure fiction, imperial romance, the *bildungsroman*, sentimental fiction, popular romance, metropolitan realism, the dialect ballad, the dramatic monologue, the confessional lyric, the sonnet sequence, even epic poetry. *Sciences of Modernism* seeks in part to restore to understandings of modernism in literature and science the centrality of these literary sources, especially during modernism's early formation. For as the twentieth century advances and modernism's great divides become canonical and iconic, the dense and vibrant early traffic between modern science and modernist literature and between modernist writing and its nineteenth-century precursors is steadily occluded, obscured, and displaced by the concerted, subsequent efforts of literary and scientific writers to deny, disown, and disavow those sources and forms.

In the early modernist moment that *Sciences of Modernism* studies, however, these divisions – between literature and science and between modernism and Victorianism – are in the early stages of construction. The period marks a crucial moment when modern sciences and literature are actively engaged in the foundational work of discipline formation and cultural legitimation, before they and their relations have been reified, hypostatized, and mythologized. Approaching modernism from this vantage allows us better to study interactions between science and literature in modernism in the making, especially what Squier calls the "uninterrogated microprocesses" that contribute to the canonization of modernist literature and modern science and scientific facts: "practices of literary inscription, abstraction, taxonomization, and selective amnesia – that refusal to remember or reexamine origins that science studies scholars call 'black boxing'" ("Omega" 145). *Sciences of Modernism* demonstrates that during this formative, proto-disciplinary moment both fields labor, simultaneously and often along parallel lines, to articulate and legitimize themselves, regularly informing and being informed by each other's knowledges, languages, genres, and tropes.

Sciences of Modernism heeds as well Latour's suggestion that accessing science – or science and literature – in action requires moving not just in time but also in "space" (4); it thus analyzes texts written at modernism's temporal margins by authors at the margins of modernism's scientific and literary canons. The scientists considered here are not the canonical figures Malinowski, Freud, Jung, or Einstein but early modernist scientists now less or little known: the ethnographer Alfred Haddon; the sexologists Havelock Ellis and Marie Stopes; the psychologists Bernard Hart and William Brown. Similarly, the literary authors under analysis are not the modernist giants Eliot, Joyce, Pound, Stein, Woolf, or Yeats but a selection of writers who remain less canonical, more peripheral in histories of modernism: E. M. Forster, Mina Loy, Claude McKay, Wilfred Owen, and Rebecca West. Their less than canonical texts productively decenter and reframe the most familiar narratives and mythologies of modernism, revealing aspects of the movement, its making, and, especially, relations between literature and science in modernism usually obscured or neglected in the wake of modernism's postwar black boxing. Approaching its chosen texts from the margins as Latour recommends, *Sciences of Modernism* sheds productive and unfamiliar light on the making of canonical modernism in literature and science, on literary and scientific modernism *in action*.

As its focus on texts and authors at the margins of canonical modernism implies, *Sciences of Modernism*'s methodology is also distinctly "new modernist" in key ways. The establishment of cultural studies modernism or the so-called new modernist studies – confirmed by the founding of the journal *Modernism/modernity* (first issue January 1994) and the first New Modernisms conference (October 1999) – made viable, some would say compulsory, the study of modernist literature as embedded in culture more broadly construed. Since then modernist scholars have produced numerous culturalist studies of literary modernism's varied relations with modernity in its myriad forms, especially nonliterary documents (music, films, magazines, radio broadcasts, newspapers, pulp fictions and comics) and discourses (politics, religion, journalism and science). As this widening in the variety and range of texts, discourses, and artifacts studied by modernist scholars suggests, the culturalist orientation of new modernist studies has led to a significant "expansion" of the field in "temporal, spatial, and vertical directions," as Douglas Mao and Rebecca Walkowitz have influentially argued (737). Following these trends, *Sciences of Modernism* is determinedly cultural in approach: it pairs literary and nonliterary discourses and reads texts of popular culture, popular science in this case, alongside novels and volumes of poetry; it is pluralist in vision, interpreting modernism as a

multiplicity of groups, movements, and techniques from across a range of late nineteenth- and early twentieth-century discourses and disciplines; it understands modernism as a "literature" of modernity and regards its chosen texts – literary *and* scientific – as constitutively entangled with the realities of late nineteenth- and early twentieth-century life praxis.

Unsurprisingly, given the field's culturalist expansion, new modernist studies of science and literature and of science as literature have proliferated. Over the past fifteen years numerous such studies have appeared, as even a partial list suggests: Bruce Clarke's *Dora Marsden and Early Modernism: Gender, Individualism, Science* (1996); Daniel Albright's *Quantum Poetics: Yeats, Pound, Eliot, and the Science of Modernism* (1997); Lucy Bland and Laura Doan's edited collection *Sexology in Culture: Labelling Bodies and Desires* (1998); Michael Whitworth's *Einstein's Wake: Relativity, Metaphor, and Modernist Literature* (2001); Steven Meyer's *Irresistible Dictation: Gertrude Stein and the Correlations of Writing and Science* (2001); Marc Manganaro's *Culture 1922: The Emergence of a Concept* (2002); Mark Micale's edited collection *The Mind of Modernism: Medicine, Psychology, and the Cultural Arts in Europe and America, 1880–1940* (2004); George Johnson's *Dynamic Psychology in Modernist British Fiction* (2006); Donald Childs's *Modernism and Eugenics: Woolf, Eliot, Yeats, and the Culture of Degeneration* (2007); Craig Gordon's *Literary Modernism, Bioscience, and Community in Early 20th Century Britain* (2007); Mark Morrisson's *Modern Alchemy: Occultism and the Emergence of Atomic Theory* (2007); Carey Snyder's *British Fiction and Cross-Cultural Encounters: Ethnographic Modernism from Wells to Woolf* (2008); Lara Vetter's *Modernist Writings and Religio-Scientific Discourse: H. D., Loy, and Toomer* (2010); Sean Heuston's *Modern Poetry and Ethnography: Yeats, Frost, Warren, Heaney, and the Poet as Anthropologist* (2011). In the main, these studies laudably reread modernist literature in the context of modern science, clarifying relations between literary modernism and the "newer" sciences of physics, sexology, psychology, eugenics, and anthropology. They generally provide keen and illuminating accounts of how discourses of science influenced particular modernist literary authors, texts, and techniques – most often through tropes and popularized scientific concepts such as relativity, repression, the unconscious, and relativism.

While recent new modernist reassessments of relations between modern science and literature usefully render twentieth-century sciences as integral to the broad cultural movement of modernism, a good number also treat science more as cultural context for literary modernism, granting literary texts more historical agency than they grant scientific documents – an ironic

inversion of popular understandings of science as more active, productive, and significant than literature. But as Mark Morrisson points out, in an essay tellingly titled "Why Modernist Studies and Science Studies Need Each Other," such "approaches to science, however insightful, have often been rather asymmetrical as well, taking science as a stable and completed given and a background to the creative and shifting modernist cultural responses to it" (675). Instead, Morrisson urges scholars of modernist literature and science to follow the lead of science studies and resist "a model that assigns science a privileged position of autonomy and purity" (675) and "avoid seeing science as a given, a backdrop against which the real objects of interest – poems, paintings, novels – can be explored" (680). Persuaded by this argument, I find the best recent new modernist studies of literature and science those that abide by Morrisson's principles, treating science and literature more symmetrically, as coeval, mutually implicated, *literary* discourses worthy of close analysis – as do, for example, two recent works on modernist literature and modern anthropology: Manganaro's *Culture 1922* and Snyder's *British Fiction and Cross-Cultural Encounters*.

Sciences of Modernism responds to Morrisson's call by treating literature and science with comparable attention. In this, my account differs from even some of the most illuminating and influential studies of science and literary modernism over the last fifteen years. Unlike Albright's *Quantum Poetics*, for instance, which concerns itself "only with the appropriation of scientific metaphors by poets" (1), *Sciences of Modernism* also concerns itself with the appropriation of literary techniques by scientists. So while Albright studies primarily what he calls the "pseudo-physics of Modernist poetics" (2), I study both the "pseudo-sciences" of modernist literature and the "pseudo-literatures" of modernist science. And unlike Whitworth's *Einstein's Wake*, which is less interested in Einstein's theory of relativity than in "the metaphors which shaped Einstein's theory and the scientific ideas associated with it" (viii) and so reads scientific facts "in literature," à la Bell, "primarily as a rhetorical ploy" because "literary context evacuates" those facts "of their content" (3), *Sciences of Modernism* is as interested in period scientific theories as in their metaphors and understands literary "facts" – genres, metaphors, allusions, and rhetorical ploys – in modern science as integral to the legitimation of scientific theories.

But what most distinguishes the methodology of *Sciences of Modernism* from most new modernist studies of science and literature is that its techniques are also determinedly literary critical in an "old modernist" sense: it provides sustained close readings of individual texts, both literary and scientific, readings particularly attentive to narrative and poetic

aesthetics, to literary form, style, rhetoric, figurative language, and genre. In this, my study follows more the lead of such essential works of science and literature studies as Beer's *Darwin's Plots*, which analyzes evolutionary narratives in Darwin's *The Origin of Species* and the novels of George Eliot and Thomas Hardy, or Squier's *Babies in Bottles*, which analyzes representations of reproductive technology in works of popular science by evolutionary biologists Julian Huxley and J. B. S. Haldane and works of fiction by literary writers Aldous Huxley and Naomi Mitchison. Like the studies of Beer and Squier, *Sciences of Modernism* grants science and scientific texts more agency to respond to and remake modernity than new modernist literary scholarship typically does, similarly reading its chosen science books as innovative texts in their own right, worthy of sustained, close, "literary" analysis. Indeed, *Sciences of Modernism* offers little more – but no less – than close readings of ten exemplary texts written during the years of modernism's formation and legitimation from the turn of the century up through the Great War.

Adapting the "case-study" method innovated in works of early modernist science (a "scientific" genre analyzed in Chapter 3), *Sciences of Modernism* reads closely pairs of less familiar but illuminating modernist texts published between 1897 and 1922, half science books, half literary works. Whether written by scientists or literary writers, these texts seek to account for and represent the impacts of modernity on human cultures, bodies, or minds. Through these paired case studies, *Sciences of Modernism* questions and complicates both Snow's two cultures thesis and Bell's analogy and metaphor thesis by recovering numerous, varied, and complex exchanges, collaborations, and competitions, thematic and formal, occurring between late nineteenth- and early twentieth-century British literature and science.

Despite its theoretical and methodological commitments to historicize, interrogate, and unfix the great divide between science and literature, *Sciences of Modernism* does not – cannot – dispense entirely with the division it probes. It reiterates the science/literature divide at least to this degree: it proceeds by juxtaposing close readings of individual science books with close readings of individual literary texts, one after another, the science books always coming first. By presenting the science text in each pairing first, *Sciences of Modernism* arguably replicates the arbitrary prioritizing of science over literature that the book overall is determined to interrogate and unsettle. Nonetheless, I believe the benefits of alternating close readings of science books and literary texts outweigh the costs. Reading the individual science books before the individual literary texts not only productively dislocates previous readings of the more familiar literary texts, illuminating

in particular how the literary texts draw on, parallel, and compete with period science and science books, but also adds force to my contention that the science books deserve recognition as modernist texts in their own right, worthy of sustained, close, literary analysis.

Accordingly, *Sciences of Modernism* treats comparably all the texts it examines regardless of the disciplinary location they respectively affirm; its sections and chapters read these books primarily as textual artifacts, analyzing in particular their literary and linguistic forms, their strategies of representation. In this regard, *Sciences of Modernism* prioritizes literary analysis, treating its chosen texts as works of modernist literature. So if the methodological decision to read science books before literary texts promotes science over literature, the application of close literary analysis to all the texts promotes literature over science. But because *Sciences of Modernism* understands that traffic between science and literature in the early modernist moment flows in both directions, it should come as no surprise that the following analysis alternately prioritizes science over literature and literature over science. To a degree, these oscillations in emphasis result from my method of alternating close readings of science books and literary texts.

Like many works of science and literature studies, *Sciences of Modernism* subscribes to what Katherine Hayles has called a "field theory of culture" (*Cosmic* 22). Elaborating on the early twentieth-century mathematician and philosopher of science, Alfred North Whitehead's conception of a "climate of opinion" (Whitehead 3), Hayles explains that the field theory conceives culture as a "societal matrix" that "makes some questions interesting to pursue and renders others uninteresting or irrelevant" (*Cosmic* 22). Under the field theory, Hayles continues, cultural "climate, rather than direct borrowing or transmission" is understood as "the underlying force guiding intellectual inquiry" at a particular historical moment. Correspondences between disciplines are thus no longer taken "as one-way exchanges" – whereby any specific "change in scientific paradigms" is viewed as causing a corresponding "shift in literary form." Instead, the field theory of culture interprets interactions between disciplines as "always mutual," for the "cultural matrix guides individual inquiry at the same time that the inquiry helps to form, or transform, the matrix" (*Cosmic* 23). Science and literature studies typically assume that influence between these discourses flows "both ways," science influencing literature and literature influencing science (Levine vii). Given its commitment to a Haylesian field theory of culture and shared cultural climate, *Sciences of Modernism* is never concerned to recover, establish, or argue for direct influence between any of its pairs of