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BIOLOGY

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Defined as the “study of living organisms, which includes their structure (gross and microscopical), functioning, origin and evolution, classification, interrelationships, and distribution” (Martin and Hine 2008), biology is a young discipline. The first uses of the term biology go back to the eighteenth- and early nineteenth-century scientists Karl Friedrich Burdach, Gottfried Reinhold Treviranus, and Jean Baptiste de Lamarck, and included comparative anatomy, physiology, and embryology. In the course of the nineteenth century, the field was extended to all disciplines concerned with the study of organisms (Junker 2004: 8). Preceded by Aristotle’s groundwork in taxonomy, physiology, and embryology, biology engages questions that have preoccupied philosophers and scholars from the very moment “science” evolved and that are constantly being reformulated. Inviting easy analogies between social and biological processes, biology has called into question established – religious and moral – values from its very beginnings. Needless to say, this makes biology a wide field, especially if we take into account its history and the shifting perspectives it has taken on its objects. Currently, the discipline’s subdivisions (including morphology, physiology, taxonomy, embryology, genetics, and ecology) approach living things and vital processes either on the level of biological organization (like cell or population) or with the focus on central issues (like structure and function or growth and development). At the same time, biology is divided into branches, including botany, zoology, and microbiology, which examine particular types of organisms.

In a similar way, literature is a complex, “experimental” cultural practice, its products replete with living organisms from all runs of life, interrogating and complementing the “life sciences” with its own particular knowledge of life. Hence, for instance, as reflected in Chapter 22 of this volume, the rise of “animal studies” as a branch of literary criticism. Literature, preoccupied with humans and other biological life forms, “inevitably make[s] biological assumptions” (Slonczewski and Levy 2003: 174). Even more so, (science) fiction – from Mary Shelley, Charlotte Perkins Gilman, H.G. Wells, John Taine, Aldous Huxley, and Frank Herbert to Ursula K. Le Guin, Joanna Russ, Octavia Butler, and
T.C. Boyle – takes up challenges posed by the biosciences and engages sexuality and reproduction, mutation and evolution, environment and biosphere, genetics and genetic engineering, as well as neurophysiology and brain research. Therefore, what follows is not – and could not be – an exploration of all living things and processes of life in literature. Rather, this article raises the question how the natural history of living organisms – which predates writing – has impacted on literature and its institutions and, to a lesser degree, how literature has influenced the discourse of biology. I cannot do so, however, without taking into account that our sense of biology, along with our sense of literature, has shape-shifted with the development of literary studies.

The very concept of a companion to literature and science is an after-effect of the history of knowledge production. In the nineteenth century, as previously interrelated discourses such as philosophy and the natural sciences separated, and the discourse of biology developed against the backdrop of the loosely connected fields of natural history and medicine (Junker 2004: 7), what we now know as literature also took on new shapes. While natural history and Romantic theories of life and evolution – the work of Jean-Baptiste de Lamarck, George Cuvier, and Étienne Geoffroy Saint-Hilaire, among others – still loomed large in early nineteenth-century literature, including, for instance, the historical novels of Walter Scott, the distinction between the realms of organic and inorganic matter was central for the rise of biology and left its imprint on concepts of reading. Accordingly, early nineteenth-century literary criticism adopted the trope of the “organic whole” to distinguish literary criticism from other forms of writing (Poovey 2001: 411), and to invest literature (and lyric poetry, in particular) with inherent principles of life. This laying claim to “foreign” disciplinary territory carries scientific assumptions and terminology along with it, assumptions that inform formalist literary criticism, its “anatomy” (Northrop Frye), and its (self-sustaining) sense of aesthetic autonomy, to this very day. Meanwhile, however, new metaphors – such as Derridean différence – have begun to dismantle the well-worn trope of organic unity.

Literature and science in general and biology in particular have thus remained closely interrelated, even as commentators from Thomas Huxley to C.P. Snow and beyond have denied their kinship. Even Snow took a “second look” at his 1959 two-cultures thesis in 1963 and “regretted” using as his “test question about scientific literacy, What do you know of the Second Law of Thermodynamics?” Instead, he “put forward a branch of science which ought to be requisite in the common culture”: molecular biology (Snow 1963: 72–73). Unlike thermodynamics, Snow explained, this field “does not involve serious conceptual difficulties” and “needs very little mathematics”; “most of all,” it needs “a visual three-dimensional imagination” (73). Snow’s change of mind was, on the one hand, prophetic, in that it foresaw the biosciences’ increasing significance at the turn of our millennium. This rise to prominence partly results from the fact that, unlike the second law of thermodynamics, which is of “universal physical
significance,” the new biosciences “deal ... only with microscopic parts of the cosmos” which are nonetheless “of importance to each of us” (74). On the other hand, Snow’s shift from physics to biology also counts as a major move from “hard” to historical science. According to zoologist Richard Lewontin, biology “is all about unique historical events ... and does not have the kind of universals about which physicists speak” (qtd. in Poovey 2001: 437). And while no science can go about its work “without using a language that is filled with metaphors” (Lewontin 2000: 3), only biology offers “grand universals” or “generalizations” that actually work as “governing metaphors” (Lewontin qtd. in Poovey 2001: 437). Such metaphors, like “adaptation” or “construction,” organize both biology and literary criticism and raise the question of what tropes dominate the field at what time and to what effect.

The biosciences’ growing cultural visibility and prestige is partly due to the fact that they can be narrativized more easily than mathematics and physics. Sarah Franklin writes that the “power of stories about life itself and its Creation lies in their invocation of a global reach, a universal essence of humanity, a shared, primordial ontology” (Franklin 2000: 197–98). This power calibrates itself both at the level of politics, truth, or liberation, and as what Franklin calls “the genetic imaginary” (198). Projected in different ways by H.G. Wells as well as by Michael Crichton, Margaret Atwood, Michel Houellebecq, and Richard Powers, this imaginary resonates with one of the fundamental concepts of biology: the “unity” of basic living substance (all biological organisms are composed of cells) and of its origin (all life originates from the emergence of the same chemical substance, DNA). However, our sense of DNA as information, code, and language is itself a “period piece,” as Lily Kay puts it (Kay 1999: 226), inextricably bound to the rise of the computer, information theory, and semiotics in the 1950s, while echoing both the sense that “in the beginning was the word” and that life is a book to be read, interpreted, and edited. Like the sustainable cultural impact of theories of evolution, the “genetic imaginary” thus foregrounds the persistent interrelation between literary, theological, and biological conceptions of life.

Given all these complexities, how can we even begin to think about the relation between literature and biology in systematic ways? Reading literature and biology as stories about life is one way of shaping the relation between literature and the biosciences; exploring stories of biology and biologists in literature is another. Still, narrative and narratology are narrow lenses, reducing biology to dimensions which can be “narrativized.” Poetry – from the romantics’ preoccupation with nature to C.K. Williams’s poems on Alzheimer’s disease and Ruth Padel’s *Darwin: A Life in Poems* (2009) – forms and deforms our sense of the discipline in its own particular ways. Even more significant are technical terms (such as origin, genus, genre, gender, reproduction, and mimicry) and cultural practices (like classification and taxonomy) which both biology and literary studies employ to their own particular ends.
This chapter therefore traces the conjunctions of literature and biology in three steps. Step one explores some ways in which biology figures and functions in literary texts. Step two, traveling further distance, examines how biology’s concepts and methods have made an impact on literary studies. Step three interrogates, albeit briefly, the question whether there is literature in biology. As it turns out, the crossroads of biology, literature, and literary studies still take us to two distinct modes of knowledge production.

Biology in literature, or: literary history and the evolution of the biosciences

When we speak of the evolution of literature (as we do since the 1920s) we relate a developmental narrative that both acknowledges similarities and overrides fundamental differences between natural and cultural processes. While evolution is often based on random mutations in the genetic make-up of an organism, the “evolution of literature” is a matter of neither chance nor nature. At the same time, literary history has been conceptualized as a series of epochs and ruptures – a functional analogue, perhaps, for extinction and decimation, which, in addition to diversification, map the course of evolution. Separating Romanticism from realism or Victorianism from modernism, we often identify clear-cut turning points, like the publication of a certain text, e.g. William DeForest’s Miss Ravenel’s Conversion from Secession to Loyalty (1867), or the opening of a landmark exhibition like the 1913 Armory Show in New York. Darwin’s theory of evolution by natural selection thus offered models to (re)think processes of both development and mutability, suggesting that, just as nature does not radically transform at singular moments, literary history has its own (dis)continuities. This sense of literary history as an evolutionary process – rather than a series of singular works – was further developed, in different ways, in structuralism, semiotics, and systems theory.

Whereas organisms adapt to their changing natural environments, forms and functions of literary texts change with shifting media ecologies and technologies of reproduction, enabling processes of literary serialization of nineteenth-century novels, for instance, as well as seriality – that is, phenomena of repetition and variation. Still, in search of new descriptive, non-judgmental models for narrative adaptation (novel into film), Gary R. Bortolotti and Linda Hutcheon propose “a homology between biological and cultural adaptation.” Both “are understandable,” they argue, “as processes of replication. Stories, in a manner parallel to genes, replicate; the adaptations of both evolve with changing environments” (Bortolotti and Hutcheon 2007: 444). Coming at the expense of precision, the analytic value of such conceptual homologies remains limited, though.

The same goes for the utility of the term “reproduction” itself: the ability to reproduce and thus to enable the continuity of a species is the most fundamental
feature of life – just as a book’s longevity depends on its serial reproduction, although processes of biological reproduction and literary (re)printing hardly compare. At the same time, reproduction is a crucial, if not necessarily explicit, moment of many, if not all literary texts, irreducible to the so-called “family novel,” and a gender issue which Charlotte Perkins Gilman “solves” in her 1915 novel *Herland* by making her female figures reproduce by parthenogenesis. Adapted to literary and cultural studies, the term resonates with its biological and ideological dimensions and highlights that literature prominently interacts with and substantially contributes to discourses of sexuality and sexology. Sexuality, in turn, is a preoccupation of all cultures (and their literatures), in part, as Ruth Hubbard has it, because “our most fundamental biological theory, the theory of evolution by selection, is constructed around sex and reproduction” (Hubbard 1987: 132).

Representations of natural processes in literature clearly mark the study of living organisms as a cultural practice with its own long history. By projecting nature as (m)other, for instance, literary texts from Romantic poetry to 1970s feminist fiction resonate with outdated beliefs about the origins of life forms. Perennial tropes like “mother earth,” for instance, echo the belief, held by Ionian natural philosophy and elaborated in Lucretius’s *De rerum natura*, that the species were actually born out of the earth. Perceived as “natural objects” by their male peers, female Romantic poets like Dorothy Wordsworth consequently viewed idealist conceptions of the relation between self and nature with the same skepticism that informs perspectives on (life) science taken in Shelley’s *Frankenstein* and Emily Dickinson’s poems. Texts like these expose both the interest women writers took in nineteenth-century bioscience and their exclusion from and critique of the rapidly transforming “horrible” scenes of scientific inquiry. In poems such as “The Brain – is wider than the Sky –,” for instance, Dickinson – although probably unaware of the work of Bichat, Gall, and Sturzheim, who situated mind, memory, and emotions in the brain – acknowledges that our mental universe depends on neurophysiological processes. While Shelley speculated on the ability and future of the human brain, anticipating science fiction’s later preoccupations, and while emotion has meanwhile advanced as a central category for literary studies, Dickinson’s poetry thus marks a moment in the history of human self-consciousness when physiology begins to put pressure on established notions of mind, self, and soul. In turn, Richard Powers’s novel *The Echo Maker* (2006) calls on Dickinson as it challenges current neurophysiology’s supposedly new conception of a human subject that is neither continuous nor whole. Literature and poetry in particular, Powers reminds us, have been offering such insights for a long time.

The impact of Darwin’s sense of evolution is felt throughout literary history, most pronouncedly perhaps in Victorian literature and naturalist narratives of “the survival of the fittest” (Herbert Spencer), and it still figures prominently in T.C. Boyle’s “The Descent of Man” (1974), Gjertrud Schnackenberg’s “Darwin
in 1881” (1985), and Nino Ricci’s *The Origin of Species* (2008). Similarly, texts engaging biological sub-disciplines, such as morphology in William Blake’s 1794 “The Tyger” and botany in the flower imagery of the symbolists and modernists, critically interrogate science’s “state of the arts,” thereby contributing to the field’s historiography, while at the same time evoking its ideological, political, and economic situatedness. Like Darwin’s expeditions of the 1830s, the natural wonders starring in fiction and poetry – be they peculiar flowers and fruits, foreign cats and birds, or far-traveled furs and fossils – enter literary history as tokens of European economic interest and empire building, while calling into question enlightened thinking in general and traditional (biological) classification in particular. Early biology therefore plays a significant part in New Historicism and recent postcolonial studies. At the same time, travelogues such as Margaret Fuller’s *Summer on the Lakes* of 1844 reflect on the threat of extinction of “varieties” of the human species, insisting that what “remains” of the American Indian needs careful preservation in museums. Much more recently, the trained biologist and author of *Birding Babylon*, Jonathan Trouern-Trend (2006) engaged in ornithological observation to communicate with locals and ascertain his own – mental as well as physical – survival as a paramedic during the 2003 Iraq war. Biology, literature, and the impact of globalization have obviously been entangled, in different ways, for a long time.

However, biology is no mere subject matter for literary practice; it is inextricably aligned with transformations of genres and literary forms. This becomes particularly visible in naturalism, where ideologies of natural selection and determinism go hand in hand with the attempt to “objectify” literary representation, that is, to render “life” as if it were a scientific object. Reducing human figures to (stereo-)types, the naturalist aesthetic, characteristic, for instance, of works by Stephen Crane and Émile Zola, in turn reproduces contemporaneous (pseudo-) scientific methodology and the biologization of race and class hierarchies. And as literary texts engaged biology, literary studies themselves transformed.

**Biology and the study of literature: interfacing concepts and methods**

While literary practice and theory have more recently challenged biologistic conceptions of cultural difference, literary and cultural studies have also, during the last two hundred years, evolved some of their central questions and concerns, privileged theories, methods, and concepts from a dialogue with the discourses of biology, and appropriated biological terms as cultural metaphors. And in both fields concepts such as origin and unity trope unresolved questions. How organisms originally emerged and who “authored” the early forms of life have remained open debates in the biosciences (Junker 2004: 10). Likewise, the origins of meaning have preoccupied literary critics even after the linguistic turn and “the death of the author.” Moreover, the accounting of literature’s relation
to its context – or “real life” – is an ongoing debate in literary theory. More recently, theories of evolution in particular have been employed to enlighten our sense of literature’s relation to “nature.” For some critics, literature, just as life, makes more sense in the light of evolution than in neo-Marxist or post-structuralist perspectives.

Dissatisfied with the state of current literary theory, biopoetics and evolutionary aesthetics import elements of evolutionary theory and evolutionary psychology into the practice of literary criticism, arguing that forms and functions of literary texts are highly dependent on the make-up of human cognition. Some critics also engage contested arguments made by sociobiologists, e.g. the idea that literary and cultural forms serve a supposedly progressive evolution. Such arguments create normative ideas about literary practice and interpretation meant to displace poststructuralist and current politically inspired readings. However, approaching literature via evolutionary theory remains problematic. Just as literature does not reflect how organisms interact with the world, as some critics hold, but rather, projects various models about (how to read and represent) the world, the discourse of biology remains at a distance from (human) nature while evolving hypotheses on its processes. It is these models and hypotheses that interrelate as modes of knowing the world.

Taxonomy, hybridity, mimicry, or: negotiating biologisms

The field of taxonomy, most notably the groundwork of Carolus Linnaeus in *Systema Naturae* of 1735, has been dedicated to the systematic classification of organisms into ranks (domain, kingdom, phylum, class, order, family, genus, species) and their subdivisions. Such systematics is echoed when terms like genealogy and generation get appropriated by literary scholars or when narratologists aim at clear-cut distinctions between genres, sub-genres, and other classificatory dimensions of literary-critical practice. Categories such as species (borrowed from “the lexicon of theology and logic”) and genre (imported from biology) played a major role in the discipline’s professionalization (Poovey 2001: 412, 410). Nineteenth-century genre theory tried repeatedly to arrange literary texts in taxonomic systems that distinguish works of higher and lower order. Since culture, unlike nature, evolves not in stable blueprints which transform by genetic mutation or acquisition, but in ever-shifting structures and generic hybrids, biological taxonomy only works as methodological approximation. Even if literary texts can be categorized according to their recurrent patterns, these structures remain abstractions of an ideal generic purity which individual works necessarily violate and transform.

Literary studies consistently adapted terms and methodological moves deriving from taxonomy and evolutionary theory as well as genetics. Julia Kristeva, for instance, employed the conceptual register of genetics in an attempt to refine
structuralist perspectives, and coined the terms phenotext and genotext to distinguish surface and deep structures of texts. Nowadays the vocabulary of genetics recurs in accounts of the “splicing” of genres and generic hybridity. As part of a conceptual complex including heteroglossia and pastiche, hybridity references blends of aesthetic forms and genres, e.g. in postmodern literatures – a tendency which has intensified the desire on the part of narratologists to refine their classificatory systems. Likewise, linguistics as well as early postcolonial critique acknowledged that languages and cultures comeling, making creolization, to recall the older term, a widespread phenomenon of multicutures. In an age of globalization we share the awareness that all cultures and literatures are hybrid, and have been for most of their existence.

As a metaphor of far-reaching cultural impact, however, hybridity still recalls nineteenth-century pseudo-scientific race theories, desires for racial purity, and narratives (and fears) of “miscegenation,” racial contamination, and cultural mutability. Somewhat paradoxically, certain biological terms have thus been instrumental in deconstructing other biological takes on race, ethnicity, and gender which literary and cultural studies inherited and, from the 1960s onward, turned into central parameters of analysis. Engaging in a “strategic essentialism” (the term is Gayatry Spivak’s), both the Black Aesthetics Movement and early feminist criticism insisted that literary and cultural productions are marked by fundamental and ultimately “natural” racial and gender differences. Whereas early black and women’s studies thus unintentionally reaffirmed misleading notions of race and gender as inescapable destinies, gender studies and critical race theories have proceeded to redefine gender, race, and ethnicity as cultural categories which serve to disempower women and “visible minorities.” By the turn of the millennium, such later claims received backing by the Human Genome Project. “Race and ethnicity,” Craig Venter insisted, “are based not on scientific, but on social concepts” (2002). Curiously enough, while biology encourages us to “forget about” race, literary and cultural studies keep celebrating – and selling – ethnic differences. Was C.P. Snow right, after all, when he deemed the “literary intellectual” a racist while cheering the scientist as truly liberal, envisioning a bright future?

Matters are, of course, a bit more complicated. Whereas literary studies have indeed privileged revisionary perspectives on race and ethnicity, their analyses have been emancipatory in their appeal, pinpointing, for instance, how some fiction (by Charlotte Perkins Gilman and Thomas Dixon, for example) has reinscribed, while other texts contested, biological conceptions of race and gender (like much twentieth-century African American and women’s writing did). Whether reinforcing or challenging eighteenth- and nineteenth-century conceptions of “natural” racial and ethnic characters, literary texts acknowledge that even our sense of what is natural or biologically determined is, as Judith Butler argues, discursive, and thus historically specific and variable. At the same time, Butler’s challenge to our binary sense of gender is inspired by our actual
biological make-up. Along with (trans-)gender and queer studies, she stresses that gender often remains ambiguous and not easily determinable, a fact that Jeffrey Eugenides playfully explores in his novel *Middlesex* (2004). Likewise, biologists themselves have intervened in the sex/gender debate, stressing, as Hubbard did in 1987, that biology and society are inseparable. Not only do organisms and their environment dialectically interpenetrate each other, but also, “organisms transform their environments all the while the environment transforms the organism living in it” (Hubbard 1987: 130). So far, biology and literary studies have merely begun to account for this reciprocity.

Organisms also imitate their environment, and the concept of mimicry – a term coined in 1862 by naturalist Henry Walter Bates – has enjoyed a rapid career in literary and cultural studies during the last decades. In turn, mimesis – another biological concept – has lost its appeal in (post)modern times. Employed in literary analysis, mimicry refers to strategies of repetition and citation of established styles and intertexts, such as the persistent use of the sonnet by African American poet Claude McKay, and to the imitation, performance, and parody of gender conventions and ethnic stereotypes whose effects are deemed to be politically subversive (by Luce Irigaray and Homi Bhabha, for instance). How far this deconstructive potential goes remains debatable, as there is no way of measuring or experimentally evaluating the political consequences of cultural practice.

**Re-naturalizing literature? How biology challenges constructionism**

Focused on parameters of difference and issues of the body, one can safely say that, during the last two decades, work in literary and cultural studies has challenged the essentialisms of a “reductive biology” (Connolly 2002: xiii). Meanwhile, though, the tables have turned and the concept of a culturally constructed, gendered, racialized, and class-contoured body which emerged from those theoretical debates finds itself challenged by the biosciences. Evolving from neurobiology, molecular genetics and biotechnology are new insights into our corporeality, projections of a post- or transhuman subject, and novel notions about how our bodies interrelate with the world. Accordingly, during the 1990s – dubbed the “decade of the brain” – concepts like consciousness, mind, will, and belief became “re-naturalized.” Perception, experience, agency, and memory, researchers insisted, are first of all physical matters, challenging central concepts of literary analysis. The major challenge this shift poses to literary and cultural studies, however, is that it privileges the “compositional dimension of body-brain-culture relays” over “cultural representations” (Connolly 2002: xiii). Contesting such social constructionism, it highlights that our readings of literary texts and other cultural practices, aimed initially at escaping a sense of biology as destiny, have in principle remained a hermeneutic
enterprise, limited to interrogating the cultural complexities of meaning making. But what happens, some literary scholars wonder, if we focus less on how and what texts and images signify and more on the biological – or physiological – processes from which meanings of texts and images evolve?

The potential and the limits of such an approach to literary cultures are currently being explored, for instance, at the crossroads of literary and cultural studies and the cognitive sciences. As a part of this larger agenda, cognitive poetics interfaces cognitive neuroscience with classical rhetoric and offers an approach to literature that privileges the mind’s capacity for integration over all texts’ tendency toward dissemination. Alternative models, partly derived from biology, are also projected in Gilles Deleuze and Félix Guattari’s “biophilosophy.” Based on the conviction that art, philosophy, and the sciences provide us with distinct analytical perspectives, all of which are of equal value and in constant interplay, their work is informed by an ethical naturalism which is played out in arguments on “becoming animal,” in appropriations of biological terms for a revisionary philosophy, and in idiosyncratic conceptions of literary and cultural practice. Most prominently, in Rhizome of 1976 and A Thousand Plateaus of 1980, these authors employ the term rhizome as an alternative to the vertical, arborescent model featured in traditional biology (such as the “tree of life” in genealogy) and in transformational grammar. As a cultural metaphor, “rhizome” resonates with a sense of literature and culture as non-hierarchical, decentered, manifold, interconnected, and nomadic. As a deconstructivist political move working across different “plateaus,” ranging from the state to desire, “rhizomatics” is meant to displace established notions of rootedness and territoriality. The success of this model results in part from the prominence of tropes such as network and connectionism in sociology, cognition studies, and information science, and is echoed in the increased use of “mapping” as a new framework for the tools and activities of literary and cultural analysis.

Is there art in nature – or literature in biology?

The question whether natural organisms have or produce art – central, for instance, to the work of zoologist Ernst Haeckel – has also preoccupied literary and cultural theory. It is prominently addressed (again) by Deleuze and Guattari, who put forth the idea that “nature is expressive rather than mechanistic” and take human art as “a subcategory of organic creativity” (Bogue 1997: 468, 474). Likewise, Humberto Maturana and Francisco Varela, who invented the term “autopoiesis” to account for all living systems’ tendency toward self-organization, self-maintenance, and self-reference (Bogue 1997: 476), call into question established notions of control and authority. Rather than accentuating Derridean différence, they downplay the difference between human and other organisms.
while amplifying non-verbal soundings. Evidently, however, whether we hold that there is art in nature or literature in biology depends on our critical perspectives rather than on the truth value of our claims. Even if we acknowledge that life writing, penned by prominent biologists, such as James Watson’s *The Double Helix* (1968), presents us with fictionalized accounts of scientific discoveries and thereby affects our sense of biology, reading biology as fiction does not help the case.

Can literature in turn enhance the study of life forms? The greatest challenge for current biology is to improve our understanding of complex systems, like the central nervous system or the ecosystem. Providing their own knowledge, achieved by their own methods, literature and literary studies refocus our perspectives and project their own variants of these systems; after all, all literature is life writing. And yet, rather than forcing a common ground for biology and literature, and, by extension, literary studies, we may want to acknowledge that each field raises and explores its own (research) questions, uses its own particular methods, and, consequently, creates its own (research) objects in the process. In other words, life in literature and life as formulated in biology remain worlds apart. It is from the interrelation between worlds that both biology and literary studies may evolve adjustments of their own theories, methods, and analyses.

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**Bibliography**


