

# Lessons from Literature for the Historian of Science (and Vice Versa)

## Reflections on “Form”

*By Henry S. Turner\**

### ABSTRACT

This essay surveys recent discussion of the problem of form in literary studies, identifies several ways in which the notion of form might be expanded, and suggests ways in which such an expanded category of form might be useful to historians of science and literary critics alike.

WHAT CAN THE HISTORY OF SCIENCE learn from literary studies? The question is refreshing to a literary critic because it reverses a flow of influence that has characterized the academy for nearly three decades. Since at least the advent of New Historicism, literary critics have looked to historical method in order to renovate their discipline, and the tendency is no less visible in the recent turn to “literature and science,” to which my own scholarship has contributed. Nevertheless, readers of *Isis* might find it worth their while to eavesdrop on their literature colleagues these days, and if they’re lucky they might hear some new talk on an old topic: the problem of form. So here we find one answer to the questions that motivated this Focus section: as someone who has spent a fair amount of time in the company of historians of science, both in person and among their works, I can say that a renewed attention to the problem of form would lead to fruitful conversation within the discipline, as well as offering a new way to practice “humanities in the field,” as Mario Biagioli has recently put it, by reinvigorating what we usually describe (somewhat too quickly) as “interdisciplinary” inquiry across the academy.<sup>1</sup>

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<sup>1</sup> Mario Biagioli, “Postdisciplinary Liaisons: Science Studies and the Humanities,” *Critical Inquiry*, 2009,

Before plunging into the problem, however, it is worth acknowledging that many historians *have* been interested in the methods of their literary colleagues, notably during the moment of debate that surrounded the “linguistic turn” in historiography of the 1980s and 1990s. And yet when one returns to those debates today, one is surprised to find relatively little mention of “form” *per se*.<sup>2</sup> To be sure, one finds a figure such as Hayden White frankly declaring in the opening pages of *Metahistory* that “my method, in short, is formalist,” where “formalist” means a concern for “deep structure” as well as “poetic” and “tropic” modes of discourse.<sup>3</sup> At the same time, however, we find in the influential work of Dominick LaCapra from this period—and it would be difficult to find a more sophisticated commentator, or one more sympathetic to the theoretical concerns of literary critics—a nearly complete absence of the term “form” and a somewhat obscure but perceptible impatience with “formalist” modes of historiography.<sup>4</sup> Throughout this moment, the polemical heat among historians concerns not form but, rather, concepts of language and “text”; problems of subjectivity and objectivity; notions of poetics, trope, and figuration; the value of structuralist methods and of narrative; and the importance of developing a fully dialogic relation to a historical other.

So what do literary critics mean today when they talk about “form”?<sup>5</sup> Several compo-

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35:816–833, esp. p. 829, where he suggests that “faculty in literature departments could team up with science studies practitioners to train students to analyze the literary construction of scientific claims” and in this way provoke us to “rethink the relationship between the sciences and the humanities outside of a framework informed by traditional notions of disciplines and epistemological hierarchies.”

<sup>2</sup> Representative statements include Martin Jay, “Should Intellectual History Take a Linguistic Turn? Reflections on the Habermas–Gadamer Debate,” in *Modern European Intellectual History: Reappraisals and New Perspectives*, ed. Dominick LaCapra and Steven L. Kaplan (Ithaca, N.Y.: Cornell Univ. Press, 1982), pp. 86–110; and two review essays, the first by John Toews, “Intellectual History after the Linguistic Turn: The Autonomy of Meaning and the Irreducibility of Experience,” *American Historical Review*, 1987, 92:879–907, and the second by John H. Zammito, “Are We Being Theoretical Yet? New Historicism, the New Philosophy of History, and ‘Practicing’ Historians,” *Journal of Modern History*, 1993, 65:783–814, both with extensive bibliography. Also important is a debate in *Past and Present* initiated by a brief comment by Lawrence Stone, “History and Post-Modernism,” *Past and Present*, 1991, 131:217–218. This was followed by Patrick Joyce, “History and Post-Modernism,” *ibid.*, 1991, 133:204–209; a companion statement by Catriona Kelly in the same issue (pp. 209–213); Stone’s own response, “History and Post-Modernism,” *ibid.*, 1992, 135:189–194; and that of Gabrielle M. Spiegel in the same issue (pp. 194–208, esp. p. 203), which contains arguments originally made in Spiegel, “History, Historicism, and the Social Logic of the Text,” *Speculum*, 1990, 65:59–86.

<sup>3</sup> Hayden White, *Metahistory: The Historical Imagination in Nineteenth-Century Europe* (Baltimore: Johns Hopkins Univ. Press, 1973), p. 3. See also the essays collected in White, *Tropics of Discourse* (Baltimore: Johns Hopkins Univ. Press, 1978); and White, *The Content of the Form: Narrative Discourse and Historical Representation* (Baltimore: Johns Hopkins Univ. Press, 1987).

<sup>4</sup> See, e.g., the sections of Dominick LaCapra, *Rethinking Intellectual History* (Ithaca, N.Y.: Cornell Univ. Press, 1983), on the importance of a notion of “text” and “language” to historical method: “Nor does the metaphor [of text] imply that language is now to be seen as a realm of ‘liberated signifiers’ or of autonomous discursive practices—a view that amounts to a new avatar of formalism” (p. 19); and the later discussion of his distinction between a “documentary” and a “worklike” aspect of a text: “The historian who reads texts either as mere documents or as formal entities (if not as Rorschach tests) does not read them as texts” (p. 65). This suspicion of an ill-defined “formalism” (also visible in Zammito’s account of New Historicism) is all the more surprising in that LaCapra explicitly points out that “the interpretive practice of great formalists [who remain unnamed] has often been more intricate and engaging than their polemical rhetoric would lead one to believe,” especially on the questions of text and context that interest him (pp. 14–15). As I explain below, the notion of form I am proposing cannot be separated from LaCapra’s notion of the “documentary” in this way, since form is what allows content (or message or information or meaning or significance or “history”) to become apprehensible, and vice versa; it is impossible to identify a form without a thing formed.

<sup>5</sup> For this essay I draw on several recent studies. Susan J. Wolfson’s discussion of American debates over form in *Formal Charges: The Shaping of Poetry in British Romanticism* (Stanford, Calif.: Stanford Univ. Press, 1997), esp. pp. 1–19, crystallized a growing sense of dissatisfaction among literary critics that formalism had become marginalized and theoretically discredited. Wolfson’s book was followed by a special issue of *Modern Literary Quarterly* (March 2000), edited by Wolfson and Marshall Brown, that has subsequently appeared as a stand-alone anthology of essays: *Reading for Form* (Seattle: Univ. Washington Press, 2006); I have found Ellen

nent ideas stand out, which I will group into the following four broad categories in the interest of clearing some ground for the discussion that follows. I should point out that each category presumes a different sense of the term and that these senses often do not sit easily with one another; indeed, some of the most interesting work on the problem of form results from studying gaps and tensions between the categories.

- *Stylistic* notions of form, tending to “texture” or “small-scale” aspects, including distinctive types of linguistic expression: various kinds of verbal patterning (at the level of both syntax and semantics); figurative, metrical, or otherwise “poetic” language; types and techniques of narration; semiotic properties of all kinds.<sup>6</sup>
- *Structural* notions of form, tending to large-scale aspects: most broadly, the significant parts that make up any meaningful system of expression and the principles of interrelationship that inhere among those parts, as well as among parts and the whole that they constitute.<sup>7</sup> Here I include plot and other event patterns; stanzaic structures in poetry; notions such as “function” in narrative; the “scene” in drama and the frame, shot, or cut in film, and other similar features. We may say that “formalism” begins in the very act of defining a “significant” part and continues in attempts to determine the relation between part and whole, both problems of difficulty and interest.
- *Material* notions of form, or what many scholars working in the history of the book call format, including the physical, concrete mode of appearance for a meaningful system of expression: page size and layout, paratextual material such as headings, table of contents, indexes, and so forth.<sup>8</sup>

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Rooney’s “Form and Contentment” (pp. 25–48) and Catherine Gallagher’s “Formalism and Time” (pp. 305–327) to be especially helpful, but the entire collection repays careful reading. In addition to the works cited in the notes that follow, other recent treatments of the problem include Stephen Cohen, “Introduction,” in *Shakespeare and Historical Formalism*, ed. Cohen (Burlington, Vt.: Ashgate, 2007), pp. 1–27; and Douglas Bruster, “The Materiality of Shakespearean Form,” *ibid.*, pp. 31–48. Caroline Levine has called for expanding the concept of form in ways that are similar to what I propose in this essay; her “Strategic Formalism: Toward a New Method in Cultural Studies,” *Victorian Studies*, 2006, 48(4):625–657, offers clear argument and additional bibliography. See also the helpful responses by Herbert F. Tucker, “Tactical Formalism,” *ibid.*, 2006, 49(1):85–93; Carolyn Dever, “Strategic Aestheticism,” *ibid.*, pp. 94–99; and (following up) Levine, “Scaled-Up, Writ Small,” *ibid.*, pp. 100–105.

<sup>6</sup> I take the terms “texture” and “small-scale form” from Seymour Chatman, “On Defining ‘Form,’” *New Literary History*, 1961, 2:217–228, esp. pp. 219–220, who also distinguishes them from “structure”; W. J. T. Mitchell remarks in “The Commitment to Form; or, Still Crazy After All These Years,” *PMLA*, 2003, 118:321–325, that “the replacement of form by structure, in fact, is one way of telling the whole story of twentieth-century criticism” (p. 321). Chatman warns against equating “style” with “small-scale form,” on the grounds that “style” often involves content rather than form and that it refers to a “process” or distinct way of doing something, while “form” refers rather to objects and things (citing Craig La Drière). I would not draw the distinction between form and content as sharply as Chatman does, nor do I agree with his differentiation between style and form, but I find his taxonomy of scale to be helpful and I would agree with the general notion that “form” tends to be more impersonal than “style.” On the form/content distinction and “form” more generally see René Wellek, “Concepts of Form and Structure in Twentieth-Century Criticism,” in *Concepts of Criticism*, ed. Stephen G. Nichols, Jr. (New Haven, Conn./London: Yale Univ. Press, 1963), pp. 54–68.

<sup>7</sup> Paul De Man, *Blindness and Insight: Essays in the Rhetoric of Contemporary Criticism* (Minneapolis: Univ. Minnesota Press, 1983), defines form as “groupings from which the constitutive parts cannot be isolated or separated” (p. 27).

<sup>8</sup> Among other examples see esp. D. F. McKenzie, “Typography and Meaning: The Case of William Congreve,” in *Buch und Buchhandel in Europa im achtzehnten Jahrhundert*, ed. Giles Barber and Bernhard Fabian (Hamburg: Hauswedell, 1977), pp. 81–123; McKenzie, *Bibliography and the Sociology of Texts* (London: British Library, 1986), esp. pp. 7, 9–20; Roger Chartier, *On the Edge of the Cliff: History, Language, and Practices*, trans. Lydia G. Cochrane (Baltimore/London: Johns Hopkins Univ. Press, 1997), pp. 81–89;

- *Social* notions of form, where “form” is used to describe phenomena that are not textual in the narrow sense of the term (despite of course leaving written traces): coherent modes of lived relationship such as kinship, class organization, economic production, political system, and so forth, a usage that originates outside of literary criticism properly speaking and is especially typical of certain strands in philosophy, history, anthropology, and sociology, notably Marxism (from Marx himself to Levi-Strauss, Barthes, Foucault, and Bourdieu, to name only a few).<sup>9</sup>

In my own work on early modern English drama and its debt to modes of prescientific thought, I sought to combine all four notions of form along with a fifth: *mathematical* notions of form that were typical of geometry in both its speculative and practical varieties.<sup>10</sup> Geometry provides one of the oldest and most enduring ways of thinking about the problem of form (the geometrical “statement” is, in the end, a purely formal one); in the late sixteenth century, mathematical notions of form that were primarily structural, spatial, and quantitative began to compete with rhetorical notions of form that were primarily linguistic, stylistic, and qualitative, with the result that early modern writers began to develop new ideas of form for their poems and plays. I began with what seemed like a simple question—how did early modern poets and playwrights understand their own formal practice?—but I soon found that several different *ideas about form* and several different *examples of form* circulated among groups of people that I never expected to find associated with one another and across domains of activity that literary critics rarely considered. English playwrights, it turned out, were drawing not simply from neoclassical literary theory, as is often presumed of a playwright such as Ben Jonson, nor simply from the legacy of medieval staging and the Tudor interludes, as is often argued about Shakespeare, but from contemporary developments in early modern technology, applied mathematics, and prescientific thought.

To take only a few examples, we find Philip Sidney—courtier, humanist, sometime ambassador, would-be statesman, poet, and author of the first major essay of literary criticism in English—recommending a standard humanist curriculum in a letter to a companion: the Scriptures, Aristotle, Cicero, Plutarch, history writing. But he also recommends cartography, the art of war, arithmetic, and geometry, especially in its practical application; furthermore, he argues that merely *reading* mathematical books is not enough. One must engage in “some practise of Arithmetike, which sportingly you may exercise,” and “you shall doe well to vse your hande, in drawing of a [geometrical] plotte, & practise of Arithmetike,” moving from one kind of reading and drawing to another in a juxtapositional way, all at the same time. “To me, the variety rather delights me, than confounds me,” Sidney writes; he soon found himself called to Dover Harbor to consult

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Margreta De Grazia and Peter Stallybrass, “The Materiality of the Shakespearean Text,” *Shakespeare Quarterly*, 1993, 44:255–283; and David Scott Kastan, *Shakespeare and the Book* (Cambridge: Cambridge Univ. Press, 2001), esp. pp. 4–5.

<sup>9</sup> Among literary critics, the work of Fredric Jameson has been particularly influential in this regard; see *The Political Unconscious: Narrative as a Socially Symbolic Act* (Ithaca, N.Y.: Cornell Univ. Press, 1981), a book that does not, in my view, distinguish sharply enough between “form” and the entirely separate notion of “genre”: strictly speaking, form precedes genre, since the novel, theater, film, and so forth, as distinctive modes of representation, permit many different kinds of works, each with their own generic markers. See also Jameson, *Marxism and Form: Twentieth-Century Dialectical Theories of Literature* (Princeton, N.J.: Princeton Univ. Press, 1971), esp. pp. 327–332, for a classic statement of the neo-Marxist use of “form” to refer to ideological and social phenomena.

<sup>10</sup> Henry S. Turner, *The English Renaissance Stage: Geometry, Poetics, and the Practical Spatial Arts, 1580–1630* (Oxford: Oxford Univ. Press, 2006); on “form” see esp. pp. viii–ix, 16–21.

with English and foreign engineers over fortification projects. Only a few years later, George Puttenham employs geometrical diagrams and recommends surveying techniques—the use of a compass to mark locations for end-rhymes, among others—as a way of teaching the aspiring poet how to create his forms. Carpenters and costumers in the Revels Office employ geometrical techniques to create royal shows, even as the Master of the Revels adapts geometrical ideas of structure and form in his consultation with the Queen, who suggests ideas for the show that the workmen are creating. Thomas Dekker adapts the semiotic principles of artisanal measurement systems into a realistic, referential prose style that he uses to compose an account of a royal progress; Ben Jonson annotates his copy of Vitruvius with English practical geometrical vocabulary, compares the composition of a play to the planning of a building, and adapts builders' techniques to construct *The Alchemist*, one of his most famous plays.<sup>11</sup>

This work has led me to rethink what counted as “form” in the first place for early modern writers, and in my view one of the most pressing tasks confronting literary criticism today will be to expand concepts of form beyond linguistic and textualist models, however subtle these may be. This claim may sound paradoxical to a historian of science, who imagines (with good reason) that literary critics are primarily concerned with problems of language. And so they are: most notions of form in literary theory still do refer to language, especially to artful language rather than everyday language and to complex compositions rather than ordinary ones.<sup>12</sup> But this tendency is precisely what inhibits the project of rethinking notions of form. For the category includes more than written documents (however various) and literary or linguistic examples. *All* meaningful artifacts, of whatever type—written texts, yes, but also physical specimens, instrument readings, photographs, models of all kinds—possess at least a minimal structural complexity and use signifying elements in ways that are conventional and thus formalized. This notion of form is not a static architecture or an immanent, closed idea: it is a constantly renewing, relational network among discernible elements whose “value,” to borrow a term from Ferdinand de Saussure, must be calibrated through a reiterated act of analysis. In this view, “form” should be understood as a verb rather than as a noun, as an active relation among significant parts that are apprehended through a transaction between that artifact and its readers, viewers, listeners, or speakers. This analytic process may be explicit and highly technical, or it may be largely implicit and intuitive; in either case, “form” marks a point of convergence between three distinct moments: the act of recognizing the mere being of a thing, as defined by its form; the act of judging the significance of a thing, as again defined by its form; and the act of coming to some kind of knowledge

<sup>11</sup> *Ibid.*, pp. 97–101 (Sidney; the passages quoted are discussed on p. 98), 118–127 (Puttenham), 127–133 (royal shows), 137–152 (Dekker), 246–278 (Jonson).

<sup>12</sup> One of the primary effects of New Historicism, of course, was to expand radically the kinds of documents that might be read closely for their formal properties and, at the same time, to show how these formal properties were inseparable from a specific social and historical moment. Alan Liu's “The Power of Formalism: The New Historicism,” *ELH*, 1989, 56:721–771, provides an especially detailed and intelligent account of New Historicism as a mode of criticism composed out of a digested New Criticism and Russian Formalism; for Liu, the “formalism” of New Historicism describes an embarrassment “(literally, ‘barred, obstructed’)” with history (p. 744), in so far as the problem of reference appears under the guise of a void between text and context that is finally filled tropically, the signature not of history but of the postmodern critic's own desire for the past. The notion of form that I am proposing is meant as an alternative to the tropic and textualist paradigms of New Historicism as Liu describes them, since “form” is at once more particularizing and differentiated than “text” or “discourse,” more material than “trope,” less linguistic than “rhetoric,” more manifest than the “unconscious,” and more objective than “desire.”

about that same thing—because one can know only what one can recognize and endow with significance.

As literary scholarship has become ever more wide ranging and omnivorous, any critic who wishes to say something analytical about his or her materials can always rely on, *must* always specify, some form: some minimal set of meaningful units and relations that obtain among them, some specific modes of creating significance. Only in this way can one individuate an artifact and explain, in a detailed way, precisely how that artifact communicates. I would make the same claim about the work of any historian, whether he or she works with political treatises, demographic projections, wills and inventories, newspapers or diaries, manuscripts or maps. And the historian of *science*, specifically, seems to me ideally positioned to test out just how analytically powerful a notion of form can be. Francis Bacon provides a superb terrain in which to proceed, not least because the problem of form is so overdetermined in his work. First and most obviously, it is possible to undertake a close study of Bacon's rhetoric and style, "formal" features that have traditionally placed Bacon on a literature syllabus. But Bacon himself thinks and writes in explicitly formal terms. Partition, division, negation, induction, the "rule" and the "direction," the limit and the boundary: all describe formal movements of thought and, even further, formalized ways of "acting" or "operating" on nature and on information gathered about natural processes. The aphorism and axiom, so fundamental to Baconian method, are simultaneously forms of writing as well as forms of thought; they are logical and grammatical forms of generalization, which is itself a recurrent formal habit. "History" is a specific form of political writing that Bacon adapts into a form suitable to natural inquiry: it is the narrative form that corresponds to the graphic, paratactic, list-like form of the "table." Sense perception itself depends on a formal, physical congruence between body and world: "Are not the organs of the senses of one kind with the organs of reflection, the eye with a glass, the ear with a cave or strait, determined and bounded? Neither are these only similitudes, as men of narrow observation may conceive them to be, but the same footsteps of nature, treading or printing upon several subjects or matters." And the final object of Baconian science is, of course, the discovery, collection, and analysis of "forms": "Of a given nature to discover the form, or true specific difference, or nature-engendering nature, or source of emanation (for these are the terms which come nearest to a description of the thing), is the work and aim of human knowledge."<sup>13</sup>

More than other kinds of historians, historians of science can be said to be concerned with explaining problems of knowledge: with the ways in which knowledge tends to become systematized, codified, and legitimated; with ways of defining evidence and of producing explanations about "scientific" topics (however broadly defined) that are typical of a given period or domain of inquiry. And these domains—fifteenth-century alchemy, sixteenth-century astronomy, seventeenth-century mechanics, eighteenth-century natural history, nineteenth-century biology, or twentieth-century physics, to take only the most canonical and obvious examples, with all their particular complexities—will show themselves to be loose collections of forms, of many different kinds and sizes. As I have suggested, these forms will be both linguistic and concrete, abstract as well as material, and each field will be marked out from others in part by the kinds of forms that it encompasses. Consider their variety: printed texts and images, which present knowledge

<sup>13</sup> Francis Bacon, *The Advancement of Learning* (New York: Modern Library, 2001), p. 92; and Bacon, *The New Organon and Related Writings*, ed. Fulton T. Anderson (Indianapolis: Bobbs-Merrill, 1960), p. 121. See also *ibid.*, p. 123: "For the form of a nature is such, that given the form, the nature infallibly follows."



in certain ways; the physical artifacts that a domain endows with significance; the many genres a given domain uses to argue about problems, represent information, and think about fundamental categories (Bacon's "tables," the encyclopedia or "atlas," the periodical article, the lab report, the letter, the chart, the table, each with its own formal characteristics and variations). One of the reasons Steven Shapin and Simon Schaffer's *Leviathan and the Air-Pump* was well received among literary critics is probably that it employs such a diversity of formal categories.

But one of the valuable insights I have gleaned from the history of science is that form is never simply a tool of knowledge: it is an attribute of being, a category of ontology. For this reason, the term "epistemology" is arguably too limited as a way of expanding a concept of form beyond aesthetic or "literary" artifacts. In his entry on "formalism" in *Keywords* (1983), Raymond Williams emphasizes a definition of form as "an essential shaping principle, making indeterminate material into a determinate or specific being or thing."<sup>14</sup> Bacon again supplies innumerable examples of this type of form, but we may choose a more contemporary one. Evelyn Fox Keller has described in detail how the "gene" emerged in early twentieth-century genetics not simply as an object of knowledge but as a concrete entity endowed with a direct, programmatic, almost legislative capacity: the gene was as much a concept, even a metaphor, as it was a thing.<sup>15</sup> Here, the "gene" is a form in Williams's sense, and debates over its status and functions could not have taken place without the myriad modes of formal representation and formal analysis that characterized genetics laboratories during this period. And as the "gene" has in turn grown conceptually and empirically incoherent, other forms have taken its place, "complex," recursive forms (the "genome" and beyond) made up of bundles of entities and characterized by entirely different models of causation. As the history of biology shows us, the very term "form" in the singular tends to reify and render static something that is better regarded both as a *plurality*—as a collection of *forms*, across many different scales—and as an ongoing *process*.

Again we find that if the history of science can teach the literary critic something new about the notion of form, the way a literary critic uses form as a principle of analysis may prove helpful to the historian of science. One obvious method is to look for ideas about form in scientific writers, as in Bacon, above; this is partly the approach I have followed in my own work, but ideas about form play an important role in other historical periods and in other domains of scientific inquiry. We find it running throughout Charles Darwin's *The Origin of Species*, for instance, from the opening pages of its "Historical Sketch," where the category of form announces the novelty of Darwin's hypothesis and, with it, a valuable lesson for anyone who conducts historical inquiry: "Until recently the great majority of naturalists believed that species were immutable productions, and had been separately created. This view has been ably maintained by many authors. Some few naturalists, on the other hand, have believed that species undergo modification and that the

<sup>14</sup> Raymond Williams, *Keywords* (Oxford: Oxford Univ. Press, 1983), p. 138. De Man describes an opposition between "constituting" form, on the one hand, and "signifying" form, on the other (*Blindness and Insight* [cit. n. 7], p. 232), and as useful as the distinction may be, in the end the two notions probably point toward the same idea: if form shapes an object or an idea, providing structure and identity to it, surely it does so only to the degree to which that object or idea is meaningful to us in some way (even if the precise content of that meaning remains to be determined).

<sup>15</sup> Evelyn Fox Keller, *Refiguring Life* (New York: Columbia Univ. Press, 1995); Keller, *The Century of the Gene* (Cambridge, Mass.: Harvard Univ. Press, 2000); and Keller, *Making Sense of Life* (Cambridge, Mass.: Harvard Univ. Press, 2002).

existing forms of life are the descendants by true generation of pre-existing forms.” Change (biological, environmental, historical) is inevitable, and form is one of the best means we have of measuring it—form is *necessary* to all kinds of historical argument, in other words, because it marks something that persists over time and through variation.<sup>16</sup> Or take the section entitled “Extinction Caused by Natural Selection”:

Rarity, as geology tells us, is the precursor to extinction. We can see that any form which is represented by few individuals will run a good chance of utter extinction, during great fluctuations in the nature of the seasons or from a temporary increase in the number of its enemies. But we may go further than this; for, as new forms are produced, unless we admit that specific forms can go on indefinitely increasing in number, many old forms must become extinct. That the number of specific forms has not indefinitely increased, geology plainly tells us; and we shall presently attempt to show why it is that the number of species throughout the world has not become immeasurably great.

These are not mathematical models of symmetry, as in the work of D’Arcy Thompson, where a concept of form also plays a fundamental role, as Stephen Jay Gould has shown.<sup>17</sup> Nor are these forms ideal types, since Darwin uses “form” to refer to a general category of identity—it is nothing less than “species”—that is apprehended through the particular individuals who constitute it. Form is the principle of explanation that mediates between the particular and the general, phenotype and genotype, the concrete and the abstract. It is the particular understood from the perspective of the general and the general understood from the perspective of the particular; it is the concrete that persists in abstraction and the abstract aspect of the concrete. We even find Darwin employing a “complex” notion of form to describe the character of individual animals, beyond their overall exterior shape (form as morphology) or the structure of their different parts (form as function):

with organic beings we should bear in mind that the form of each depends on an infinitude of complex relations, namely on the variations which have arisen, these being due to causes far too intricate to be followed out,—on the nature of the variations which have been preserved or selected, and this depends on the surrounding physical conditions, and in a still higher degree on the surrounding organisms with which each being has come into competition,—and lastly, on inheritance (in itself a fluctuating element) from innumerable progenitors, all of which have had their forms determined through equally complex relations.<sup>18</sup>

<sup>16</sup> Charles Darwin, *The Origin of Species* (New York: Signet, 2003), p. xix. “Form,” in other words, does not sit outside time as an ideal, spectral presence; as De Man pointed out long ago, “the idea of totality suggests closed forms that strive for ordered and consistent systems. . . . Yet, the temporal factor, so persistently forgotten, should remind us that the form is never anything but a process on the way to its completion”: De Man, *Blindness and Insight* (cit. n. 7), p. 31.

<sup>17</sup> Darwin, *Origin of Species*, pp. 103–104. See Stephen Jay Gould, “D’Arcy Thompson and the Science of Form,” *New Lit. Hist.*, 1971, 2:229–258, a study of ideas of form in Thompson’s *Growth and Form* and in evolutionary biology more generally and an excellent example of how valuable a concept of form can be to the history of science; so too is Lynn K. Nyhart, *Biology Takes Form: Animal Morphology and the German Universities, 1800–1900* (Chicago: Univ. Chicago Press, 1995). Darwin has been the subject of pioneering work in the field of literature and science. See esp. Gillian Beer, *Darwin’s Plots: Evolutionary Narrative in Darwin, George Eliot, and Nineteenth-Century Fiction* (London: Routledge & Kegan Paul, 1983); Beer, *Open Fields: Science in Cultural Encounter* (Oxford: Oxford Univ. Press, 1996); George Levine, *Darwin and the Novelists: Patterns of Science in Victorian Fiction* (Chicago/London: Univ. Chicago Press, 1988); Levine, *Darwin Loves You: Natural Selection and the Re-enchantment of the World* (Princeton, N.J.: Princeton Univ. Press, 2006); and Levine, *Realism, Ethics, and Secularism: Essays on Victorian Literature and Science* (Cambridge: Cambridge Univ. Press, 2008).

<sup>18</sup> Darwin, *Origin of Species*, pp. 122–123.



Here form describes a ragged unity, at many scales: it is the unity of a cloud, not that of a stone or of a set. Forms fade away eventually or evolve into a new form through a process that makes it difficult if not impossible to determine where exactly one form ceased to be and another took its place. Darwin's language might be used, with little revision, by a New Critic to describe the immanent "form" of a sonnet or by a New Historicist to describe the external relation between the form of a literary work and the pressures of its cultural moment: the similarity of language and orientation is striking.

If one major problem confronting literary critics is the need to extend our formal models beyond language and written texts, therefore, a second is to rethink the place of the "social" in our arguments, and I suspect that a similar methodological issue concerns many historians of science. Here, too, attention to the problem of form proves fruitful, and it is not a new gesture: extending the notion of form to include phenomena such as institutions or lived "practices" of various kinds (to cite a signature of the anthropological and Foucauldian influence) has been immensely helpful to literary criticism. But these attempts are often handcuffed by a reflexive appeal to the "social" as an undifferentiated, immanent field, an implicit totality that seems finally to explain everything (and thus to explain nothing). Nevertheless, dismissing appeals to the "social" with an impatient wave of the hand is obviously insufficient, since such a gesture immediately reduces the complexity of analysis. So how might we "reassemble the social," to borrow a phrase from the sociologist of science Bruno Latour, into a new notion of collective formations, at many different scales and shapes?<sup>19</sup> Instead of appealing to the "social" as a ground for our explanations, I submit that literary critics and historians of science alike should be undertaking an analysis of the many *networks of forms* that constitute our objects of inquiry and that allow any mode of communication, thought, or collective association to take place. In my own current research on corporations—as institutions, communities, systems of value, and fictional persons—I have begun to test such a method by showing how different forms of writing contributed to the imagination of groups and political collectivities, using aspects of Latour's work, combined with a mode of narrative analysis derived from one of the most inventive readers of literary form, Roland Barthes, in order to do so.<sup>20</sup> My emphasis has been on how formal analysis (and a more creative form of critical writing) can help rethink certain aspects of early modern mercantilism and political theory, but here, too, problems of technology and scientific knowledge continue to play an important role.

Latour's work will be familiar to readers of *Isis*, who will have their own opinions about its virtues and defects. I would simply like to propose that his notion of form is especially innovative and that literary critics and historians of science alike would benefit from engaging with it closely. Latour retains an active ontological, as well as epistemological, dimension to form as a principle of analysis, moving beyond reductive notions of "representation" or "meaning" as the ultimate fulfillment of a principle of form and toward a notion of *function*: form *does* things, it doesn't simply mean things. To put it differently, poetics—*poiesis*, or thinking through making—might suddenly catch the eye of the

<sup>19</sup> See Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford Univ. Press, 2005), pp. 54–55, where Latour employs notions of figuration, drama, and fictional narrative as resources for actor-network theory.

<sup>20</sup> See Henry S. Turner, "Toward an Analysis of the Corporate Ego: The Case of Richard Hakluyt," *differences*, 2009, 20(2–3):103–147.

historian of science in new ways. An especially explicit comment may be found in Latour's recent *Reassembling the Social*:

As soon as we concentrate on what circulates from site to site, the first type of entities to snap into focus are *forms*. Few words are more ambiguous, and yet this is just the sort of topic that the shift in social theory allows us to see in a new light. Usually, form is taken not in a material but in a formal sense. . . . But [in actor-network theory] the notion of form takes a very concrete and practical sense: a form is simply something which allows something else to be transported from one site to another. . . . Such a displacement from ideal to material can be extended to *information*. To provide a piece of information is the action of putting something into a form. But now the word takes a very mundane, practical meaning; it can be a paper slip, a document, a report, an account, a map, whatever succeeds in practicing the incredible feat of transporting a site into another one without deformation through massive transformations. . . . Whatever the medium, a material description of formalism is now possible which takes very seriously the connecting ability of forms—conceived as physically as possible—while shedding the idea that formalisms could themselves be formally described.<sup>21</sup>

Briefly stated, the central methodological principle of Latour's approach to form is the notion of "translation": form is a principle of translation; it permits translation; it is the result of translation in its many varieties. But what is translation? It describes the act of assembling an enduring network of things, substances, persons, ideas, explanations, metaphors, concepts, motives, and many other mysterious entities. "Translation" is a physical, material, and concrete process, but it is at the same time a figurative, rhetorical, and conceptual one; the crucial point is that the physical and the conceptual, the material and the formal, are inseparable from one another.<sup>22</sup>

To take a familiar example from the history of science: when, in his "Letters on Sunspots," Galileo aims a telescope at the sun and then traces on paper the shadowy projection of the spots that the lens produces, and *then* inverts them to compensate for the lens's effect, we have a beautiful example of "translation." The very definition of a sunspot, not to mention any kind of "scientific" argument about it, rests on this chain of translations, which includes things of different kinds and substances, even quasi-physical things, or things that we tend to think of as being immaterial but that always take a

<sup>21</sup> Latour, *Reassembling the Social* (cit. n. 19), pp. 223–226; see also the additional bibliography in the accompanying notes. I take the final comment of the passage to be an antistructuralist (in the classic French sense) gesture that refers to the irreducible plurality and particularity of forms and to the intricate, shifting networks that they constitute, which could only ever be described provisionally, depending on one's point of entry. The footprints of "form" can be tracked throughout Latour's work, but see in particular two essays that will be well known to historians of science: Bruno Latour, "Circulating Reference," in *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, Mass.: Harvard Univ. Press, 1999), pp. 24–79, esp. pp. 69–79; and Latour, "Drawing Things Together," in *Representation in Scientific Practice*, ed. Michael Lynch and Steve Woolgar (Cambridge, Mass.: MIT Press, 1990), pp. 19–68, esp. p. 47. See also the notion of "inscription" in Latour and Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton, N.J.: Princeton Univ. Press, 1986), which is more fully elaborated in Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, Mass.: Harvard Univ. Press, 1987), esp. pp. 243–247, including the challenge to undertake a "careful anthropological study of formalism" (p. 246); and the virtuoso *Aramis; or, The Love of Technology* (Cambridge, Mass.: Harvard Univ. Press, 1996), which, to my mind, provides the single best example of what an expanded, nuanced, intricate notion of "form" makes possible—I find in *Aramis* the most exciting and original example of a methodology that would renovate literary criticism and history of science alike.

<sup>22</sup> As an aside, I am inclined to say that a concept is not a form *unless* it is viewed as a translation. A definition, for example, is a form, since it translates the concept into correlative terms, and a concept can be a form when it is a metaphor—i.e., a translation of another idea. This suggests that all concepts are in fact forms when we see them as what they really are: translations of particular things and of other concepts.

material form: the telescope itself, the paper, the writing instrument, the “angle” at which the paper must be held, the motions necessary to track the sun, the walls of a darkened room, a gap or chink to admit light, the tracings and mathematical calculations scribbled on paper, Galileo’s own publications, his witty style, his international audience, his own ego or self-concept as a “philosopher.” The translation chain transmits the “sunspot” like a network of refrigerated containers preserves a frozen fish, to cite one of Latour’s more colorful metaphors: so long as the chain of translation—so long as the passage through different *forms*, which are fully concrete and particular but also repeatable and thus general—remains unbroken, the ontological status of the object in question remains (relatively) secure and the epistemological claims that can be made about that object (claims that act as additional refreshing translations in their own right) can be, if not fully agreed upon, at least subject to meaningful debate.<sup>23</sup>

Or, to take an especially clear example from Latour’s own work, the soil of the Amazon rain forest passes through an enduring network of translations on its way to becoming a case study of scientific and political importance: a network of *forms*, material and immaterial at the same time, that includes maps and chalk marks in the forest, soil-sampling devices, cabinets and suitcases of specimens, the leverage of entire disciplines, granting agencies, and written reports. Many of these forms are already compatible with one another: they depend on similar structural features or explanatory principles; they have in fact been developed in order to work together; they “fit” one another—despite their differences and the slippages among them—in order to carry along an invariant factor, which in this case is the soil and the explanation or “account” of the Amazon rain forest that assembles around it. Rather than a model of “correspondence” between idea and thing or between words and the world, we find a chain of circulating references constituted by a continuous passage between matter and form in which each makes the other possible.<sup>24</sup>

So what are the advantages of such a method to historians of science? Most obviously, it opens up a greater range of evidence by inviting scholars to examine forms that they might otherwise have disregarded while at the same time giving them a powerful tool for analyzing precisely *how* the forms that they already recognize as significant actually perform their work. It invites them to pay attention to the forms that historical actors themselves identified as significant, no matter how curious or how literal, and to grant them a greater agency and explanatory power. It encourages them to examine the modalities of force involved in moments of translation—for form-as-translation is always a question of force, which is itself never singular, never without form, as the history of science is eminently suited to show us—and thus permits of a more nuanced account of causation and agency: an account of the *why* of form, as well as of its *how*.<sup>25</sup> A renewed attention to form would help historians to move beyond outdated and reductive debates over the nature of “language,” “discourse,” or “text” and its relation to “reality,” and it provides a more persuasive means of addressing a problem that used to be referred to as “context” but that should now be understood as “network,” since formalized texts, objects,

<sup>23</sup> Galileo Galilei, *The Discoveries and Opinions of Galileo*, trans. Stillman Drake (New York: Anchor, 1957), pp. 115–116; and Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, Mass.: Harvard Univ. Press, 1993), p. 119.

<sup>24</sup> See Latour, “Circulating Reference” (cit. n. 21), p. 69, for a representative passage.

<sup>25</sup> I have adapted this point from Gould, “D’Arcy Thompson and the Science of Form” (cit. n. 17), p. 256. The idea that the history of science is particularly well situated to point out the multiplicities of form-as-translation is made clear in the discussion on pp. 239–247, 252.

people, arguments, and ideas are not “in” an immanent “field” but instead form long chains of durable, persistent association, chains that have no *a priori* stopping point and that can lead in surprising directions. This is *not* to say that the historian cannot identify, for analytic purposes and with good reasons, some limit to these chains of association; indeed, a principle of form allows limits to be drawn and explanations to begin, including the limits known as historical “periods” and the explanations that seem to characterize them accurately. For it is always possible to generalize tactfully about a collection of examples—it is the principle of form that makes it possible to do so. But a principle of form also *multiplies* the variables in any historical situation and thus requires a more careful calibration of their relative importance; in this way it works against the tendency to resolve complexity into overly general, black-boxed totalities such as “society,” “class,” “gender,” “race,” the “State,” even the seemingly innocent “institution,” without taking the pains to specify precisely how these entities, too, are bundles of forms, networks of association arranged in a fractal-like composition. If these concluding observations strike some readers as being too abstract—as excessively *formal* and thus dissociated from actual historical analysis or concrete example—then I would simply ask them to suspend their skepticism for the space of an afternoon and return to their own research questions to see just how illuminating a notion of form as I have described it can be. And if they are still unconvinced, then I have found that the form of the “email” is remarkably effective at clarifying ambiguities, adjusting arguments, and resolving disputes.