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Plasticity, Form, and the Matter of Character in *Middlemarch*

GEORGE ELIOT'S 1874 NOVEL *MIDDLEMARCH* is said to both thematize and foster intersubjectivity through its psychologically rich and detailed portrait of human life.[1] To elide the distinction between the human psychology and what I will refer to as its material substrate—character—however, risks overlooking the extent to which Eliot approaches subjectivity as an impersonal structure formed not just through intentional acts such as thought or speech but through physical actions and reactions as well. Deidre Lynch has shown how the protocols of interiority attributed to the novelistic modes of characterization were not endemic to the novel genre, but emerged, rather, in attempts to "validate and naturalize a concept of character as representational."[2] Extending and elaborating upon Lynch's thesis, I show how, in conversation with nineteenth-century materialist science, Eliot pushed back against the interiorized novelistic subject so often attributed to her by producing not only sympathetic and real-seeming minds but also lively and responsive characterological bodies. Tracking Eliot's construction of a layer of descriptions of characters as soft matter—as liquids, polymers, and other types of condensed matter in a malleable state—I elucidate what I call a *physics of character* from within the pages of *Middlemarch*. In so doing, I suggest that even the most notoriously "brainy" of novels—on the level of its descriptions—resists a too-easy alignment of its characters with individual human psychologies.[3]

The characterological bodies that form the focus of this essay are thus not verisimilitudinous human anatomies with faces and limbs. Consider, as an initial example, Eliot's description of Rosamond's persistence as that which "enables a white soft living substance to make its way in spite of opposing rock."[4] Importantly, this description of Rosamond's tenacity relies not only on the reader's experience of human intentionality but also on her

ABSTRACT This essay tracks George Eliot's construction of a layer of descriptions of characters as soft matter—as liquids, polymers, and other types of condensed matter in a malleable state—in her 1874 novel *Middlemarch*, elucidating what Brilmyer calls a *physics of character* from within its pages. In so doing, it suggests that even the most notoriously "brainy" of novels—on the level of its descriptions—resists a too-easy alignment of its characters with individual human psychologies. REPRESENTATIONS 130. Spring 2015 ISSN 0734-6018, electronic ISSN 1533-855X, pages 60–83. DOI: 10.1525/rep.2015.130.3.60.

sensual awareness of the basic properties of matter—in this case, the properties of fluids, which have the capacity to envelop solid bodies due to the sensitivity of their structure to encounter. The descriptive force of the figure inheres in the lively materiality of this "white soft living substance"—its soft texture, malleable form, unexplained animacy. The capacity of Rosamond's intent to overpower, indeed, literally to engulf that of her father is aligned with the potential of a fluid to envelop a rock, no matter how rigid or firm. Much later in the novel, the narrator explains Rosamond's behavior with a maxim that harkens back to her plastic quality:

> We cannot be sure that any natures, however inflexible or peculiar, will resist this effect from a more massive being than their own. They may be taken by storm and for the moment converted, becoming part of the soul which enwraps them in the ardor of its movement. (714)

As we shall see, few natures in *Middlemarch* are so inflexible; most are like Rosamond in their affinity with a soft, amorphous matter. Arthur Brooke, for example, is described as "glutinously indefinite" (8). He is "a very good fellow, but pulpy; he will run into any mould, but he won't keep shape" (65). Sir James Chettam, likewise, is made of a kind of "human dough"; he has but the "limpest personality," furnished "with a little gum or starch in the form of tradition" (20). Taken separately, such descriptors might read as metaphors for particular personality traits (Brooke is fickle; Chettam, lacking in substance). Taken together, however, they develop a vocabulary for the plasticity of character that—while certainly figural in nature—exceeds the metaphorical in its consistent explanation of characterological traits and behaviors with reference to physical laws.

A metaphor sets up a comparison between two distinct concepts or objects, highlighting the similarities between two seemingly unrelated things; Eliot's character descriptions, however, assume no ontological difference between the "stuff" of human character and that of other nonhuman substances.[5] Elucidating what I call Eliot's *physics of character*—a materialist characterology that represents human life in terms of its physical limitations and potentials—this essay tests two hypotheses in two sections. The first hypothesis is that the loose molecular structure of Eliot's characters records the capacity of bodies for relation and, therefore, also change. The second hypothesis is that throughout *Middlemarch* solidity signals the illusion of the autonomy of character—an illusion necessary, however, to the production of realist fiction. Phrased differently, I will argue that where soft matter for Eliot embodies the interactivity and transformability of character as an impersonal structure, solids emerge as rhetorical devices in service to a realist aesthetic in which characters appear like autonomous human subjects with individuated and unified personalities. Aiding me in this endeavor will

be a diverse set of thinkers—from nineteenth-century scientists such as Robert Brown, Michael Faraday, and William James to the present-day feminist materialist philosophers Catherine Malabou and Elizabeth Grosz. If Eliot's descriptors seem to reflect this more recent thinking about matter and materialism, it is not merely because I have emphasized such points of convergence. Close attention to Eliot's language suggests that, whether we have recognized it or not, her physics of character has informed our understanding of character as a material yet plastic phenomenon. My analysis in what follows shows how throughout *Middlemarch* Eliot exploits certain formal elements of descriptive language in order to explore the limits and potential of characterological change as well as to reflect upon the role that character as a literary figure plays in the production of realist fiction.

Plastic Forms

Incorporating nineteenth-century research into the activity of matter into her descriptions of characters, Eliot develops a physics of character in which matter both figures *and* participates in characterological transformation. "Character," the narrator of *Middlemarch* explains, is "a process and an unfolding" (140). This process, I shall argue in what follows, is one of neither passive imprintation nor heroic self-formation, but a process that emerges from the plastic quality of matter itself.

In his 1874 "Belfast Address" to the British Association for the Advancement of Science, the physicist John Tyndall ushered in a new materialist paradigm in which movement and power were understood to be immanent to all matter, rather than the product of some transcendent or vital force. What in 1874 Tyndall referred to as the "structural power of matter" had, of course, been recognized by previous thinkers, most famously, by the Victorian botanist Robert Brown.[6] In 1827, however, Brown's contemporaries were skeptical when he claimed to have observed the "very unexpected fact of seeming vitality" in things that were neither alive nor organic.[7] As a result, his theory that matter was not fundamentally inert, but rather composed of tiny, dancing particles, went unnoticed for more than thirty years, that is, until the late 1860s, when Eliot began composing *Middlemarch*. Setting her novel in 1828 (the year Brown's *Microscopic Observations* was first published), Eliot turns to Brown in order to imply her character Tertius Lydgate's prescience. "I have some sea-mice—fine specimens—in spirits," Lydgate tells Farebrother, "And I will throw in Robert Brown's new thing—'Microscopic Observations on the Pollen of Plants'—if you don't happen to have it already" (163). The term "Brownian movement" was coined in 1871, the year *Middlemarch* first began to appear in serial form.[8] Eliot's novel responds to the

increasingly acknowledged validity of Brown's researches by producing a dynamic material universe. Like Tyndall—whose Belfast address turned to ancient atomism in order to warn against "the error . . . in ascribing fixity to that which is fluent" (380)—Eliot develops a physics of character that accounts for the active and unpredictable force of matter in shaping human existence.

In the nineteenth century the extent to which human character was transformable was a subject of fierce debate. Where pseudosciences like phrenology and physiognomy approached character as a fixed constant or predetermined unfolding of biological matter, political and educational theorists, by contrast, proposed that "character" was a product of the will, a thing crafted through intentional practices.[9] Athena Vrettos has tracked anxieties about the "potential rigidification of human character" in Victorian psychological discourse, suggesting that "biologically based theories of the mind" often called into question the possibility of "individual reformation, spiritual growth, or free will."[10] Where Vrettos paints an industrialized portrait of mechanized minds, minds "driven to repetitive, automatic behaviors in order to conserve energy for more difficult or novel tasks" (400), Sara Ahmed, writing from a different tradition, describes a simultaneously occurring liberal dream of self-transformation in which character was thought to be "amenable to will."[11] In her book *Willful Subjects* (2014) Ahmed traces the notion that we can "by employing the proper means, improve our character" to nineteenth-century educational theory, showing how character was thought to "provide the material that is *given form* by will."[12] Eliot's novel works to circumvent the binary in Victorian characterological thinking elucidated by Vrettos and Ahmed, refusing both the discourse of biological fixity and that of willed flexibility. Her materialist characterology implies that character traits and behaviors emerge neither through the unwilled unfolding of a preformed nature nor through the expression of the individual will, but *relationally*, as a result of bodily capacities like the responsiveness of organic tissue to outside force. Borrowing a term from recent new materialist philosophy and tracking its use backward to contemporaries of Eliot such as William James, I will argue that character for Eliot is fundamentally *plastic*.

In contemporary philosophy, the term *plasticity* has recently resurfaced as a keyword in theories of the brain and body. Such philosophies have aimed, broadly speaking, to conceive of bodily matter as more than a precultural given, a fixed constant that is "inscribed" or passively molded by culture or society.[13] As Catherine Malabou has pointed out, the word *plasticity* implies an active principle. Its etymology can be traced to the Greek *plassein*, which "means at once the capacity to *receive form* (clay is called 'plastic,' for example) and the capacity to *give form* (as in the plastic arts or in plastic surgery)" (5).[14]

Plasticity, in other words, connotes the *active* potential of transformation, that a thing is simultaneously susceptible to *and can cause* change. It does not mean that something is infinitely modifiable, but that impressions and forces coming from the so-called outside are consolidated and transformed to produce desires on the so-called inside.[15] For Malabou, such actions and reactions are not governed by the same causal laws that apply to the inorganic world. Far more complex in structure, life is defined by the potential for discontinuity between action and reaction. Put otherwise, the plasticity of life consists in the ability of an organism to introduce spontaneous delays and shifts into nexuses of force. The turn to plasticity in cultural studies and critical theory, initiated largely through the innovations of feminist science studies, though now unfolding outside of this arena, has afforded thinkers new ways of conceiving of identity formation. Rather than perceiving matter as the passive background to social formations, critics have increasingly come to understand matter, as well as nature, as an active force at work in the production of culture, identity, and agency.[16]

In line with these contemporary thinkers, Eliot challenges our tendency to think of "character" solely as the product of human forces, be they individual wills or sociocultural norms. She challenges them not from the present, of course, but from a historical moment in which the assumption that matter was passive, and culture, active, was increasingly being called into question. Eliot's characterizations prefigure a crucial observation by William James, six years after the first installment of *Middlemarch* appeared, in his essay "The Laws of Habit" (1877), about the fundamental plasticity of character.[17] James begins his essay with the suggestion that "the moment one tries to define what habit is, one is led to the fundamental properties of matter" (104). A basic proneness to habit-formation, he goes on to suggest, seems to be ingrained in the very structure of organic matter itself. A piece of paper, once folded, folds more easily the second time; likewise, an ankle once sprained is more likely to be reinjured; joints once afflicted by rheumatism are more prone to relapse. And so James formulates the hypothesis "that *the phenomena of habit in living beings are due to the plasticity of the organic materials of which their bodies are composed*" (105). For James, *plasticity* "in the wide sense of the word, means the possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once." James's suggestion that human character is essentially "plastic" is more than a metaphor to describe the responsiveness of a personality to influence or willed intent. Rather, as James argues, the basic responsiveness of organic matter, especially nervous tissue, to applied force makes possible characterological transformation as such. Like Eliot, he does not describe humans *as if* they were plastic material substances; his writing explores the nature of the plastic matter of which human as well as nonhuman beings are composed.

Prefiguring James, Eliot attributes the potential for characterological change not to the power of the human psyche or will but to the plasticity of all matter. Consider the example of Dorothea's uncle Brooke, who is described within the first few pages of the novel as "glutinously indefinite," and later, as we have already seen, as "a very good fellow, but pulpy." Such descriptions of the soft matter of Brooke's character assist, on one level, in the characterization of his particular behavioral tendencies. Brooke, we are told, has "an acquiescent temper, miscellaneous opinions, and uncertain vote"; his conclusions are "as difficult to predict as the weather" (8). Despite his wavering opinions on most issues, however, in some things Brooke is fastidious. He is thrifty, for instance, always "spending as little money as possible." The narrator explains what might initially seem a characterological contradiction—Brooke's general fickleness about most things and his extreme particularity about others—with the pithy phrase: "Even the most glutinously indefinite minds enclose some hard grains of habit." On this level of characterization, it seems, the narrator can explain any given character strictly through reference to physical laws.

Closer attention to Eliot's descriptive language here, however, shows that she may have had a particular kind of plasticity in mind: that of the protein gluten. A basic physiological guide from 1869 suggests of "nutritious grains" that "nearly all of them are composed of two principles, the glutinous and the farinaceous, mingled together."[18] In fact, according to the guide, one might reduce *all* organic substances to these two basic principles. For what concerns food, the more farinaceous (or grainy) substances are "*warming*," and those more glutinous (or proteinous), "*plastic*" or "building." An example of the latter compound is meat, which "has a large abundance of albuminous or plastic principle (*the fibre of the flesh*) in a condensed state" (35). Proteins—early examples of which included wheat gluten and albumen (egg white)—are polymers, chains of compounds known for their extreme plasticity. Recognized as a distinct class of molecules in the late eighteenth century, proteins take their name from Proteus, the Greek god who was able change his shape at will. Over 80 percent water and protein, of course, the human body could be described as "glutinously indefinite." We thus might read Eliot's maxim—"Even the most glutinously indefinite minds enclose some hard grains of habit"—more straightforwardly as a description of all minds, which, consisting of proteins (as well as, to a much lesser extent, carbohydrates) are composed of both plastic and rigid molecules. Brooke's mind, in this sense, is literally part glutinous, part grainy, and his capacity for characterological shape shifting is tied to his body's proteinous base.

It has long been a tendency of literary studies to approach references to material substances in literature as projections of cultural meaning or as symbolic of sociocultural shifts. Jules Law's book, *The Social Life of Fluids:*

Blood, Milk, and Water in the Victorian Novel (2010), for instance, considers how developments in the manipulation of fluids produced "fantasies of control and anxieties of identity" within the pages of Victorian fiction, approaching novels as a reflection of shifts in the social meaning of material substances.[19] Law asserts in his introduction: "Victorian obsession with liquids had little to do with the ostensibly intrinsic properties of water, blood, alcohol or milk" (2). But Law's contention that Victorians were little concerned with the "ostensibly intrinsic properties" of fluids speaks less to the actual relationship of Victorians to the fluids they described than to his own critical method, which merely *attends* to the cultural meanings of fluids like blood, milk, and water. *Pace* Law, I want to suggest that the force of meaning of material substances for Eliot emerges not only from how they are arbitrarily made to signify but also from how they more basically *act*. As close attention to *Middlemarch*'s descriptors demonstrates, Victorians were actually concerned with the "intrinsic properties" of matter—and their role in the construction of social and cultural formations. Some, like Eliot, even looked to literature as a mode of exploring their role in the formation of human character.

A certain irreverence for categorical distinctions between specific persons and more general physical phenomena can be seen in Eliot's descriptions of humans as material substances and geometrical forms, which operate both as metaphors for personalities and—more literally—as descriptions of the plasticity of character. Elaine Freedgood has described the "intense commingling of the literal and the figurative" in Eliot's research notebook, which lists under the entry for "m" interests like "Milton, Medusa, moisture, mist," placing persons (real and fictional) on the same plane as liquid states of matter.[20] Following Freedgood in *The Ideas in Things* (2006), I read the material and semiotic as occurring simultaneously and inseparably in Eliot's novel, such that glutinous materiality does not only signify or symbolize Brooke's "fickleness" but also harbors it, makes it possible. As Freedgood reminds us, to reduce nonhuman things in novels to what they tell us about a character's personality is to view them as "indentured to the subject" (12). While things often function as metaphors, she explains, they can also function as metonymies tied to histories outside "the novel's manifest or dominant narrative—the one that concerns its subjects." Where Freedgood cultivates a new mode of historicism that tracks literary objects to their real-world referents and back again, however, I approach Eliot's materialist descriptors more theoretically, as interventions in the history of thinking about the impersonal forces at work in the formation of character. As scholars have often remarked in drawing parallels between Eliot and Darwin, Eliot's century was the first to reveal that species characteristics themselves were not fixed, but rather change over time as the result

of chance variation and encounters with the environment. What Elizabeth Grosz has described as Darwin's "dynamic and open-ended understanding of the intermingling of history and biology" (*Time Travels*, 17) can be witnessed in the opening lines of Eliot's "Prelude," in which man is described as a "mysterious mixture . . . under the varying experiments of Time" (3). Eliot explores the composition of this "mysterious mixture" and its capacity for structural change in her characterizations, which explore the bodily sensitivity, impressionability, and the propensity toward habit formation that produce characterological change throughout time.

As in James, in Eliot habits are described as rigid kernels emerging out of otherwise plastic sets of compounds. Walter Vincy, for instance, "was not a rock: he had no other fixity than the fixity of alternating impulses sometimes called habit" (324). Such descriptions anticipate how James would later theorize changes in habit in terms of changes in material structure. In the natural world, James argues, what we think of as the "laws of Nature" are really "nothing but immutable habits which different elementary sorts of matter follow, in their actions and reactions upon each other" (*Principles of Psychology*, 105). For James, as Philip Fisher has put it, "stones fall by habit, birds build nests by habit."[21] But not all habits are as "immutable" as these low-level flows. As James points out, although the structure of a single particle may be difficult to change, *the structure of larger compounds* is far more plastic. In other words, "either outward forces or inward tensions can, from one hour to another, turn that structure into something different from what it was," James writes, proposing that we think of "each relatively stable phase of equilibrium in such a structure" in terms of the "new set of habits" that marks its change (*Principles of Psychology*, 105).

Like James, Eliot prefers to draw parallels rather than distinctions between the structure and behaviors of humans and those of nonhuman material formations like rocks and poems. But where James sometimes suggests that character, "like plaster," will eventually set, Eliot—here more akin to Malabou—emphasizes the extent to which character harbors unforeseen possibilities (*Principles of Psychology*, 144).[22] In her posthumously published essay "Notes on Form in Art" (composed in 1868) Eliot elaborates a theory of plasticity from within a theory of structure. "What is a structure but a set of relations?" the essay provocatively inquires.[23] In both poetry and life, it argues, form is "a limit determined partly by the intrinsic relations or composition of the object, & partly by the extrinsic action of other bodies upon it" (234).[24] "This is true," the essay continues, "whether the object is a rock or a man." For Eliot, organic forms are temporary compounds, not immutable unities; they are nexuses of relations open to change as their relations change.[25] Where James bases his theory of character in the fundamental responsiveness of organic matter to applied force, Eliot traces the

affective capacity of people as well as things to the fact that they are composed of differentiated, motile parts from which the very possibility of interconnection—and thus also sensation—arises. "The wholeness of the human body," she avers, "is due to a consensus or constant interchange of effects among its parts." As such, the "relations and groups of relations" that constitute a poem "are more or less not only determined by emotion, but intended to express it" (233).

Eliot's "Notes on Form in Art," while little cited, is integral to understanding the quest of both Casaubon and Lydgate in *Middlemarch* for "fundamental knowledge of structure" (*Middlemarch*, 139). Where Casaubon, in his search for "the Key to All Mythologies," hopes to uncover a single underlying unity in his quest for the "primitive tissue," Lydgate, quite differently, imagines a more relational form, a motile, web-like material that renders life itself possible. Scholars have long suggested that Lydgate's researches into tissue are implicitly misguided, pointing to the fact that cell theory had emerged by the time Eliot began composing *Middlemarch*.[26] But Lydgate's attempt "to demonstrate the more intimate relations of living structure" might just as easily be read as tissue cellularly conceived. There is little evidence to suggest that the phrase "primitive tissue" is anything other than Eliot's way of imagining what a good scientist in 1829 would be looking for; "such missing of the right word befalls many seekers," we are told.

Lydgate's quest for the primitive tissue is supposed to build on the legacy of Xavier Bichat, an actual French anatomist who died the year the fictional Lydgate was born.[27] Eliot's characterization of Bichat's innovations in histology is telling, given her own thoughts on form as she expressed them just three years earlier in "Notes on Form in Art." As the narrator of *Middlemarch* explains,

> That great Frenchman first carried out the conception that living bodies, fundamentally considered, are not associations of organs which can be understood by studying them first apart, and then as it were federally; but must be regarded as consisting of certain primary webs or tissues out of which various organs—brain, heart, lungs, and so on—are compacted, as the various accommodations of a house are built up in various proportions of wood, iron, stone, brick, zinc, and the rest, each material having its peculiar composition and proportions. No man, one sees, can understand and estimate the entire structure or its parts—what are its frailties and what its repairs, without knowing the nature of the materials. (138–39)

Like Eliot herself, who understands form as a relational compound, Bichat is said to approach the living body as composed of "primary webs or tissues" as opposed to "associations of organs which can be understood by studying them first apart, and then as it were federally." His line of inquiry is unique in that it jolts anatomy out of its obsession with parts to consider the "peculiar

composition and proportions" of the materials of which those parts (as well as the whole) are made. As the narrator suggests in closing, in order to understand such a complex, compound structure as the body, one must understand "the nature of the materials" of which it is composed.[28]

As emotive, relational compounds, humans—like poems—possess a dynamic structure. The complexity of the body's inner and outer relations translates to its potential to take on different forms. Likewise, in *Middlemarch*, "character is not cut in marble—it is not something solid and unalterable. It is something living and changing, and may become diseased as our bodies do" (694). This line, delivered by Farebrother in reference to the questionable behavior of Lydgate, draws upon the moral valence of the word *character* in the Victorian period. Having taken money from Bulstrode around the time of Raffles's death, Lydgate is suspected of having been bribed by Bulstrode in order to ensure the removal of Bulstrode's blackmailer, Raffles. As a result, as Lydgate puts it, his character is "blighted—like a damaged ear of corn" (719). Blight is a botanical disease "of atmospheric or invisible origin, that suddenly blasts, nips, or destroys plants."[29] It is a bad encounter between the molecules inside and molecules outside the plant that leads plants to produce insufficient chlorophyll; it "arrests their growth, or prevents their blossom from 'setting.'"

Lydgate's run-in with Bulstrode is a similarly bad encounter, a loss of integrity that results in a damage in structure.[30] A close look at the scene in which Lydgate is publically shamed for his connection to Bulstrode shows that Eliot describes Lydgate's loss of integrity not in terms of a moral failure, but as a change in the compound of his character. A term from more recent philosophy is useful to illustrate the distinction. In his small book on Benedict de Spinoza, Gilles Deleuze describes Spinoza's approach to ethics as an *ethology*, an ethics, as he defines the word, less concerned with the difference between right and wrong than it is with the affective relations and capacities of bodies. Where morality tends to foreground individual choices, ethology, as Deleuze writes, tracks the "relations of speed and slowness, of the capacities for affecting and being affected that characterize each thing," as well as how those "capacities can compound" into new relations.[31] Eliot, who translated Spinoza's *Ethics* and *Tractatus*, approaches "human actions and appetites," like Spinoza, "as if it were a question of lines, planes, and bodies."[32] Exploring the changing rhythms of Lydgate's affective connection to Bulstrode, she depicts Lydgate's characterological transformation as a physiological alteration in his constitution.

"Bulstrode's character has enveloped me," Lydgate laments to Dorothea after a fateful scene at the town hall, "the business is done and can't be undone" (719). More than a public defaming, what occurs at the town meeting is the forging of an affective connection through which Lydgate

is overtaken by both Bulstrode's feelings and character. Having been publicly accused, not only of philandering his way into fortune, but also of Raffles's murder, Bulstrode begins to experience "a crisis of feeling almost too violent for his delicate frame to support" (683). Worried for Bulstrode's wellbeing, Lydgate does something unthinkable: he reaches out his arm, guiding the tottering man out of the room. As if enacted by the touch itself, the character of "this man who was leaning tremblingly on his arm" begins to melt into Lydgate's own, as his tender feelings toward the old crook become apparent to a crowd of onlookers (686). In a quick turn of mood, "this act which might have been one of gentle duty and pure compassion" becomes for Lydgate "unspeakably bitter to him." Not only do Bulstrode's wrongdoings get magnetized to Lydgate's moral character in the eyes of those present, but Bulstrode's susceptibility and nakedness also become his. Within the span of a few pages Lydgate's ethological transformation is complete. He goes from feeling like "the Healer which thinks first of bringing rescue or relief to the sufferer" (683) to "the sufferer" himself (695), cringing from a similar "sense of exposure" than that which afflicted Bulstrode's "susceptible nerve" (683).

Deleuze was not the first to turn toward the concept of *ethology* in order to explain how bodies form affective compounds. In 1843 John Stuart Mill used the same word to describe a new science he hoped would gain traction in coming years—"the science of the formation of character."[33] Where psychology was concerned with the universal laws of the mind, ethology, Mill suggested in *A System of Logic* (1843), would attend to the processes through which particular personalities form. Prior to Mill, the word *ethology* had been used to describe works on manners and morals (*ethos*, the Greek word for "character," being also the root word for *ethics*). Mill had in mind a different application. Ethology would investigate the circumstances, experiences, and practices through which human character develops. Where psychology, as well as anthropology and sociology, went on to become institutionalized fields of study, however, ethology, as Mill had envisioned it, never cohered into a scientific practice.[34] In the twentieth century the term would reemerge to designate an observational branch of zoology attentive to the behaviors and emotions of animals. Mill's science of the accretion of personal traits, on the other hand, remained unrealized, becoming "one of the many nineteenth-century proposals that did not pass the test of history."[35]

And yet, although Mill's ethology failed as a science, it survived in the work of nineteenth-century novelists. As a fictional exploration of interactions between human subjects and their environments, the realist novel can be understood to have taken up the aim of ethology to investigate the forces at work in character formation.[36] The aim of the novelist, Elizabeth Gaskell

would write in 1853, was to pay close attention to "the daily life into which people are born, and into which they are absorbed before they are well aware"—to describe "the circumstances which contributed to the formation of character."[37] Deidre Lynch has argued that "novel writing's claim to a singular distinction among the disciplines would be founded on the promise that it was this type of writing that tendered the deepest, truest knowledge of character" (28). Demonstrating "how it came to be that novels, to be good novels, had to be *about* character," in *The Economy of Character* (1998), she contends that in the nineteenth century character cleaved from the body and its physical appearance in a shift situating character as an "inner" rather than an "outer" quality (29). As we have already seen, however, *Middlemarch* resists this cleaving in describing character in terms of the soft matter of which bodies are composed. Representing character not as a hidden or buried kernel of personality, but instead as a socially determined material figuration produced through the accumulation of soft forms or forces, *Middlemarch* can thus be read to complicate the suggestion that as the century progressed the representation of character became increasingly inward-oriented and psychologized.[38] Reading Eliot's 1874 novel alongside the work of contemporary materialist scientists reveals the extent to which late Victorian representations of subjectivity—literary and otherwise—came to portray character as an impersonal ground or substrate, different, if not separate from, personality.

In my second and final section, I explore the aesthetic function of this impersonal, materialist model of character. According to Eliot, "The highest Form is the highest organism, that is to say, the most varied group of relations bound together in a wholeness which again has the most varied relations with other phenomena. It is only in this fundamental sense," she argues, in turning to the aesthetic, "that the word 'Form' can be applied to Art in general" ("Notes," 232). It is not difficult to imagine *Middlemarch* as Eliot's own attempt at this hyperrelational art form, a literary record of the role of material agencies in human lives. The concept of character, I have been arguing, is central to this vision in that it allows Eliot to represent subjectivity less in terms of the individual psychology than in terms of the larger set of physical actions and reactions that compound to produce qualities. Taking a page from James in his study of habit, I thus approach *Middlemarch* in what follows, less as "a chapter in physiology or psychology" than as "a chapter in physics" (*Principles of Psychology*, 105). To understand the important role of character in Eliot's realist aesthetic, I will suggest, entails close attention to the way she engages with the physical and mathematical sciences in order to represent literary characters themselves as relational forms, material-semiotic structures capable of rapidly taking on new shapes.

Irregular Solids

By the time Eliot had composed *Middlemarch* it was clear that solidity was in part illusory. Michael Faraday's experiments with the behavior of forces suggested that objects were not bounded, contained units, but rather concatenations of force that produced a sense of solidity. In the 1840s, Faraday, inventor of classical field theory, called into question the idea of space as an empty container filled with rigid, self-contained bodies. Likewise, in *Middlemarch* what appear to be bounded and singular forms are often shown to be nebulous, relational fields, soft forms whose vague boundaries afford them a greater capacity to affect and be affected.

In her work on Victorian conceptions of space, Alice Jenkins has proposed that when Eliot's novels are critical of the notion that objects have definite form and extension, they are consistent with the most innovative physics of their day. Jenkins is unique in her attention to Eliot's longtime interest in physics, a topic that remains under-researched in Eliot studies.[39] Eliot was deeply engaged with the physical sciences, having read widely in the subject in preparation for *Middlemarch* and having attended a lecture course on experimental physics in Geneva with Arthur Auguste de la Rive (an expert in electromagnetic theory and close friend to Faraday).[40] Expanding upon Jenkins's thesis, I suggest that throughout *Middlemarch* concepts of rigidity and solidity emerge as a way of calling the autonomy of character into question. If, as we saw in the previous section, the truth of character is that it is plastic and relational, then solid, bounded characters must be a kind of illusion. Aligning "the solidity of objects" with "the directness of sense," a mode of perception described as "no longer reflection but feeling," Eliot's novel explores the affective dynamics of realist fiction, which—in producing characters that feel like autonomous and individuated human subjects—likewise turns upon the production of the *sense* of solidity (198).

Throughout *Middlemarch* descriptions of characters as "solid" work to undermine faith in the concrete and the stable as superficial or surface-level percepts. Consider, for example, Casaubon's description of Dorothea in his proposal letter as "a rare combination of elements both solid and attractive" (40). In contrast to fluids, which flow into the shape of any container as a result of their loose, dynamic form, solids are defined by their possession of a rigid, crystalline structure. This is due to the strength of the inter- and intramolecular forces that hold their atoms, molecules, and ions in a stable state of attraction. With this knowledge, we might read Casaubon's description of Dorothea as "a rare combination of elements both solid and attractive" as something of an authorial jest. Given that solids are *defined* by the strong forces of attraction that render them resistant to changes in shape

and volume, the "combination" of these qualities should be anything but rare.[41] The joke is on Casaubon, it seems, as Eliot undermines his authority with the power of her real pen. Were Dorothea not so absorbed in the fantasy of her future life, we are told, she might have looked at Casaubon's flattering description more "critically as a profession of love" (41).[42] Instead, the reader is guided to inhabit this critical stance through Casaubon's confused description of Dorothea as "solid."

Dorothea is again described as "solid" with reference to her uncle Brooke's failed attempts to understand her desire to marry the scholar twenty-seven years her elder—and here again a rift emerges between Dorothea's appearance and her reality. Holding Casaubon's letter anxiously in his pocket, Brooke attempts to subtly dissuade his niece from marrying Casaubon, were he to propose. Faced with his niece's resolve to accept the proposal, however, Brooke reluctantly hands her the letter as she leaves the room. "In short," the narrator closes the chapter, "woman was a problem which, since Brooke's mind fell blank before it, could be hardly less complicated than the revolutions of an irregular solid" (39). As in the former case, ignorance and misrecognition are associated with the identification of Dorothea as solid. Though she does not treat this specific passage, Jenkins has suggested that in Victorian literature generally, geometry tends to crop up in moments of sexual maturation "to signify the clarity and order of the presexual mind which must be lost or renounced if maturity is to be reached."[43] As she points out, within the Victorian education system, the study of Euclid (a staple in the narrow curriculum for boys) often coincided with puberty—a fact that might explain why geometrical metaphors often contrast mathematical certainty with the murkiness and ambiguity of sexual adulthood (83). Along these lines, the description of Dorothea as a woman who "could be hardly less complicated than the revolutions of an irregular solid" could be read as a reference to the increasing maturity of Dorothea as an adult woman. Indeed, both here and in the aforementioned passage, Dorothea's womanhood is the thing of confusion and complexity. Thus references to Dorothea's solidity can be read to signal the misguided perceptions of male characters to whom women especially appear opaque—the masculinist desire for a concrete and totalizing knowledge troubled by the epistemologically disruptive force of the feminine.

But let us further unpack this multidimensional phrase. As we shall see, throughout *Middlemarch* the dialectic between the hard and the soft, the fixed and the motile, produces a commentary on the affective dynamics of realist fiction. A regular solid is a polyhedron (or three-dimensional figure), the faces of which are all identical regular polygons (fig. 1). The number of faces that meet at each corner is also the same. A regular solid is easily described in basic terms—by measuring, say, the length of a side of a cube.

An irregular solid, on the other hand, is defined precisely by the difficulty one encounters in mathematically describing it. Because of their complex shape, irregular solids pose a problem for mathematical description; to calculate such a body in motion would require finding its moments of inertia—which in the case of an irregular solid would be a major challenge without the aid of a computer. The description of Dorothea as more "complicated than the revolutions of an irregular solid" thus not only describes Dorothea's opacity to Brooke; it also signals the complexity of the *process of describing her.*

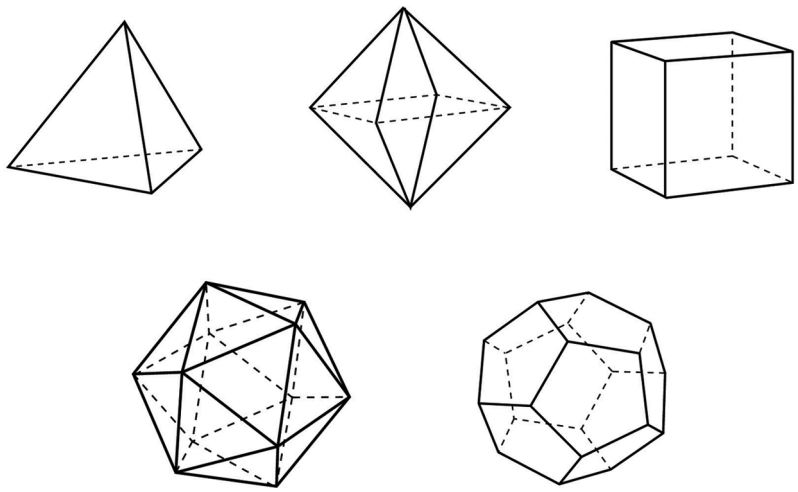

FIGURE 1. The Five Regular Solids. Image created by Jens Nikolaus.

In the history of mechanics, the rotation of rigid bodies (typically modeled by tops) is a classic problem. In 1857 Scottish physicist James Clerk Maxwell suggested that the "problem of the rotation of a solid body" was so difficult "that it had never been thoroughly understood by any but the most expert mathematicians."[44] Of course such difficulty did not stop Maxwell, the physicist who would go on to formulate classical electromagnetic theory. By age twenty-six he had created a "dynamical top" that validated his calculations of the dynamics of a rotating solid body (fig. 2). The creation of the dynamical top had followed on the heels of his groundbreaking work on Saturn's rings. As Maxwell showed in 1856, the rings of Saturn were neither uniformly solid nor fluid, as others had suggested. Rather, they were a rotating mass of *irregular solid* particles. His prizewinning paper "On the Stability of the Motion of Saturn's Rings" (1856) demonstrated the hypothesis that the "theory of an Irregular Solid Ring leads to the result that to ensure stability

the irregularity must be enormous" (289). In other words, what appeared to be the stable, concentric circles of Saturn's rings were really the strange and distant motions of irregular particles.[45] John Bender has suggested that the realist novel is "apparitional" in its "capacity . . . to give us the impression of real things—to use means other than direct, sensory apprehension of the real in order to project a reality."[46] Likewise, one might read Eliot's fiction as performing something like Saturn's rings: her characters might appear like individual humans with particular psychologies, but they are actually loosely structured material systems, concatenations of words that whirr and spin to produce the effect of human life.

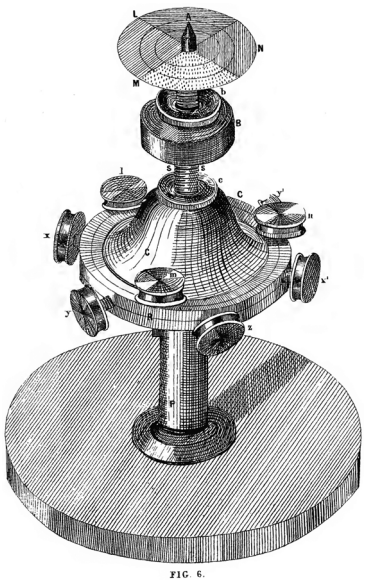

FIGURE 2. Maxwell's Dynamical Top, from *The Scientific Papers of James Clerk Maxwell* (Cambridge, 2011), 1:262.

This apparitional quality of realist character is nowhere more apparent than in the case of Dorothea, who is often initially depicted as unified and solid only later to be dissolved into a much more dispersed and gaseous form. Dorothea's diffusive nature is first alluded to in the "Prelude" to the novel, in which it is suggested that *Middlemarch* will narrate nothing so "coherent" as an "epic life," but will rather tarry with lives characterized by "inconsistency and formlessness" (3–4). This line is typically read to foreshadow Dorothea's failure to achieve the status of a "Saint Theresa," a historically influential figure recognized as having achieved a certain level of success or fame. But it also gestures toward the preoccupation of the novel with figures that are affectively potent because their contours are not too rigidly defined. Privileging the logic of dispersion ("loving heart-beats

and sobs . . . dispersed among hindrances") over the heroic concentration of potential into "some long recognizable deed," *Middlemarch* explores the connection between diffusiveness and affective capacity, between the potential of a substance to loosen or become flexible in form and its potential to affect and be affected. Dorothea's great achievement is thus not (as it might have been in a typical *Bildungsroman*) the solidification of an initially pliable subject into a coherent and particularized identity, but rather her enduring ability to scatter the self in such a way as to widen its field of relationality. As the novel's final lines affirm, "the effect of her being on those around her was incalculably diffusive" (785).[47]

With connotations of the sprawling and vague, the abstract and unformed, the word "diffusive" alludes to the physical process of "diffusion," the process by which molecules intermingle as a result of their kinetic energy. If one dissolves small particles into a solution, the molecules of both substances will mix due to Brownian motion, irregular molecular movements that take place over small distances—a phenomenon to which, as we have already seen, *Middlemarch* elsewhere makes explicit reference. Thus, by the time the reader has reached the novel's final lines, Dorothea's supposed solidity seems to have dissolved into the loose molecular structure of a fluid in which everything is in motion. Her "nature" is described as a "river" having "spent itself in channels," implying a connection between her dynamic, motile form and her high capacity for relation (785). It does not matter, we are told, that these channels "had no great name on earth"; what matters is rather "the effect of her being on those around her." Martha Nussbaum has observed that the ending of *Middlemarch* is "extremely and frustratingly vague," seeming to "parry the supposed claims of realism to presence, solidity."[48] Indeed, as I have been arguing, Eliot's investment in the rigid crystalline structure of solids is in fact limited. Indefiniteness in structure is central to her mode of realism, wherein the sprawling and vague are consistently privileged over the concrete and specific.

Attention to the surprisingly central role of the indefinite and the indeterminate to Eliot's mode of realism allows us to reassess the oft-made claim that Eliot's great innovation as a realist stems from her production of characters as specific and particularized individuals, in contrast to the tradition of presenting characters as ideals or types.[49] In a powerful essay on characterization in *Middlemarch*, Catherine Gallagher argues that Eliot's novel marks an important shift away from the fictional paradigm in which characters were presented as fictional instantiations of classes or species of persons. According to Gallagher, earlier novelists positioned their characters as representative of types of people existing in the world (reversing the commonsense empiricism that presumed that types are ideational and particulars real things-in-the-world); Eliot's characters are presented as "*category*

defiers," instantiations of types that deviate always from the type they are supposed to exemplify.[50] For my part, I want to suggest that what is so distinct about Eliot's characters is not their ability to exceed the type, but their tendency toward vagueness and formlessness in the face of generic novelistic shifts toward particularity and representationalism. *Middlemarch*, as I pointed out at the start of this paper, is often upheld as the paragon of a novelistic paradigm in which characterization corresponds to the representation of the individual human psychology. By contrast, what I have been tracking is a mode of description in which characters appear like loosely structured material formations, softly bounded forms open to reconfiguration or change. This does not mean that there are not aspects of *Middlemarch* that conform to the narrative of the emergence of literary characters as "original, discriminated, and individual person[s]," to cite Sir Walter Scott's famous phrase.[51] Rather, I have simply wished to highlight moments in Eliot's novel in which this transition is resisted, complicated, or reflected upon.

But Eliot's novel does more than mark an important moment in the history of character; it also reveals something about the nature of literary character itself—an aesthetic figure that, irrespective of time and place, attains form in and through its relations with readers. Compare Eliot's description of the fictional Mr. Brooke as a character who "will run into any mould" and her characterization in an 1841 letter to her friend Maria Lewis of a certain "Mr. Henslowe" as "evidently a character made up of natural crystallization instead of one turned out of a mould."[52] In contrast to the fictional Brooke, who is said to be able to take on any shape at any time, this actual person, Henslowe—perhaps John Henslow, the botanist who recommended the young Charles Darwin to sail on the HMS *Beagle*—is said to attain his form though the much more linear and finite process of precipitation or growth. Importantly, Henslowe is not Brooke's structural opposite (had Brooke been described as *produced from* a mold, we might assume the relation between Brooke and Henslowe a relation of type to instance); he is rather a person who emerges according to a different logic and tempo than that of Brooke. Where Henslowe takes shape according to the logic of crystallization, a mode of becoming in which traits accrete along the arrow of time, the consistently glutinous Brooke exists in a much more open temporal space that allows him to remain consistently open to a number of different reconfigurations. Depending upon whom he encounters and when, that is, Brooke can take on an entirely different form.

"Form," Eliot writes, "as an element of human experience, must begin with the perception of separateness."[53] But the appearance of separateness fades, she argues, upon the realization that all "wholes [are] composed of parts more & more multiplied and highly differenced," and thus that all

forms are sites of "mutual dependence." Literary characters, we might then venture in closing, are themselves highly relational figures, dynamic forms capable of engaging readers not because they appear (like humans) to have consciousness or intentionality, but because, as "relations and groups of relations," they are "not only determined by emotion, but intended to express it" (233). Where human beings accrete and express traits due to structural changes in the plastic matter of which they are composed, literary characters are *yet more malleable structures*, material-semiotic figures capable of rapidly taking on new shapes. This special plasticity of *literary* character might be said to emerge from what the narrator calls the "liquid flexibility" of words—a phenomenon Will Ladislaw describes as the capacity of language to create forms strategically "vague" in boundary (510). Reflecting on the difference between painting and literature, Ladislaw suggests that where painting risks presenting its subjects as "mere coloured superficies . . . language gives a fuller image, which is all the better for being vague" (179). Language's strategic vagueness renders it capable of recording how a person changes "from moment to moment," allowing for the possibility of "movement."[54] Eliot's descriptive technique throughout *Middlemarch* affirms Ladislaw's thesis: as a demonstration of the power of language to produce loosely bounded, not entirely individuated figures, the novel exhibits the capacity of language to produce structures highly sensitive to encounter, figures able to be formed and reformed by readers because their natures are soft.

Notes

I am incredibly grateful to Ada Smailbegović, Matt Moss, and Samuel Baker for their sustained engagement with this essay. Thank you also to Sean O'Toole, Elaine Freedgood, Ann Cvetkovich, Tracie M. Matysik, Stephanie Rosen, George Hagstrom, the "first book" working group, as well as my colleagues at the Institute for Cultural Inquiry for their feedback and guidance.

1. According to Kay Young, for instance, the fundamental problematic of *Middlemarch* is "the problem of other minds," and the "solution" it proposes is "a physiology of empathy"; Kay Young, *Imagining Minds: The Neuro-Aesthetics of Austen, Eliot, and Hardy* (Columbus, 2010), 4. In a different vein, cognitive literary critic Alan Palmer has suggested that *Middlemarch* presents readers with a unity of collectively thinking subjects whose communal cognitive processes mirror the readers' own; Alan Palmer, "Social Minds in Fiction and Criticism," *Style* 45, no. 2 (2011): 196–240, and *Social Minds in the Novel* (Columbus, 2010).
2. Deidre Lynch, *The Economy of Character: Novels, Market Culture, and the Business of Inner Meaning* (Chicago, 1998), 3.
3. As Henry James famously remarked, "A marvelous *mind* throbs in every page of *Middlemarch*"; Henry James, *Selected Letters*, ed. Leon Edel (Cambridge, MA, 1974), 104. See Kent Puckett for a wonderful essay on the paradox of *Middlemarch*'s

simultaneous desire for the cerebral and fascination with the visceral; Kent Puckett, "Stupid Sensations: Henry James, Good Form, and Reading *Middlemarch* Without a Brain," *The Henry James Review* 28, no. 3 (2007): 293.

4. George Eliot, *Middlemarch*, ed. David Carroll and Felicia Bonaparte (Oxford, 2008), 324.
5. Rosamond, for instance, is not *compared to* a "white soft living substance . . . mak[ing] its way in spite of opposing rock"; she is said to derive her forcibility from the *very same quality* that allows this plastic substance to envelop rigid structures. To quote the passage in full: "The circumstance called Rosamond was particularly forcible *by means of* that mild persistence which, as we know, enables a white soft living substance to make its way in spite of opposing rock" (324, emphasis mine).
6. John Tyndall, *Address Delivered Before the British Association Assembled at Belfast, With Additions* (London, 1883), 380.
7. Robert Brown, "A Brief Account of Microscopical Observations . . . on the Particles Contained in the Pollen of Plants; and on the General Existence of Active Molecules in Organic and Inorganic Bodies," in *The Miscellaneous Botanical Works of Robert Brown* (London, 1866), 470.
8. *The Oxford English Dictionary Online*, s.v. "Brownian," http://dictionary.oed.com.
9. On phrenology's development of a physiological basis for character, see Shalyn Claggett, "Putting Character First: The Narrative Construction of Innate Identity in Phrenological Texts," *Victorians Institute Journal* 39 (2011): 103–26. On the characterological claims of physiognomy, see Sharrona Pearl, *About Faces: Physiognomy in Nineteenth-Century Britain* (Cambridge, MA, 2010), 93–97.
10. Athena Vrettos, "Defining Habits: Dickens and the Psychology of Repetition," *Victorian Studies* 42, no. 3 (2000): 400, 404.
11. John Stuart Mill quoted in Sara Ahmed, *Willful Subjects* (Durham, 2014), 69.
12. Ibid.
13. See Catherine Malabou, *What Should We Do with Our Brain?*, trans. Sebastian Rand (New York, 2008), and *Plasticity at the Dusk of Writing: Dialectic, Destruction, Deconstruction*, trans. Carolyn Shread (New York, 2009); Elizabeth Grosz, *Volatile Bodies: Toward a Corporeal Feminism* (Bloomington, 1994), and *Time Travels: Feminism, Nature, Power* (Durham, 2005); Pippa Brush, "Metaphors of Inscription: Discipline, Plasticity and the Rhetoric of Choice," *Feminist Review* 58, no. 1 (1998): 22–43.
14. Malabou contrasts the notion of "plasticity" with that of "flexibility," which she views as purely passive. Both Malabou and Emily Martin critique the notion of "flexibility" as it is used in neoliberal economic discourse; Emily Martin, *Flexible Bodies: Tracking Immunity in American Culture from the Days of Polio to the Age of AIDS* (Boston, 1994).
15. Catherine Malabou, "Addiction and Grace: Preface to Félix Ravaisson's *Of Habit*," in *Of Habit* by Félix Ravaisson, trans. Clare Carlisle and Mark Sinclair (New York, 2008), xi.
16. Elizabeth Grosz, for instance, has proposed that we view nature "in terms of dynamic forces, fields of transformation and upheaval, rather than as a static fixity, passive, worked over, transformed and dynamized only by culture" (Grosz, *Time Travels*, 7). Relatedly, particle physicist and gender theorist Karen Barad described a world in which entities, including humans, emerge through interactions between material agencies always already imbued with meaning; Karen Michelle Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham, 2007). For an introduction to "feminist

materialism," see Stacy Alaimo and Susan Hekman, eds., *Material Feminisms* (Bloomington, 2008). On the philosophical movement often referred to more broadly as "new materialism," see Rick Dolphijn and Iris van der Tuin, *New Materialism: Interviews & Cartographies* (Ann Arbor, 2012), and Diana Coole and Samantha Frost, *New Materialisms: Ontology, Agency, and Politics* (Durham, 2010).

17. William James would then revise this essay for inclusion in *The Principles of Psychology*, vol. 1 (New York, 1950), from which I here quote.
18. *Elementary Introduction to Physiological Science* (London, 1869), 34.
19. Jules Law, *The Social Life of Fluids: Blood, Milk, and Water in the Victorian Novel* (Ithaca, 2010), ix.
20. Elaine Freedgood, *The Ideas in Things: Fugitive Meaning in the Victorian Novel* (Chicago, 2010), 111.
21. Philip Fisher, "The Failure of Habit," in *Uses of Literature*, ed. Monroe Engel (Cambridge, MA, 1973), 6.
22. As Malabou explains in her preface to Félix Ravaisson's 1838 treatise *Of Habit*, "If being was able to change once, in the matter of contracting a habit, it can change again. It is available for change to come. Certainly, change generates habit, but in return habit is actualized as a habit of changing" (viii).
23. George Eliot, "Notes on Form in Art," in *Selected Essays, Poems, and Other Writings*, ed. A. S. Byatt (London, 1990), 233.
24. Eliot's remarks here echo Herbert Spencer's definition of life as "the continuous adjustment of internal relations to external relations"; Herbert Spencer, *The Principles of Psychology* (London, 1855), 374.
25. Like many romantic poets and philosophers of organic form, in this essay Eliot suggests that forms emerge as a result of the properties of the materials from which they are composed. But Eliot's theory of form differs in significant ways from the traditional romantic conception of organic form. Samuel Taylor Coleridge, for instance, suggests that organic form is "innate. It shapes, as it develops itself from within, and the fullness of its development is one & the same with the perfection of its outward form"; Samuel Taylor Coleridge, "Shakespeare's Judgment Equal to His Genius," in *The Collected Works of Samuel Taylor Coleridge* (Princeton, 1987), 5:469–71, 495. Not only does Eliot never imply belief in an intrinsic "formative force," she also stresses repeatedly the power of actions "extrinsic" to the body and its biology on the organic formation. On the organicism implicit in Eliot's famous notion of the "web" see Terry Eagleton, *Criticism and Ideology: A Study in Marxist Literary Theory* (London, 1976). In contrast to Eagleton, who suggests that Eliot's web preserves "the essential unity of the organic mode," I read this figure as a difference engine in which the friction between a multiplicity of parts makes change itself possible (120).
26. See, for example, W. J. Harvey, "The Intellectual Background of the Novel: Casaubon and Lydgate," in "*Middlemarch*"*: Critical Approaches to the Novel*, ed. Barbara Nathan Hardy (London, 1967), 25–37; Jeremy Tambling, "*Middlemarch*, Realism and the Birth of the Clinic," *ELH* 57, no. 4 (1990): 939–60; Richard Menke, "Fiction as Vivisection: G. H. Lewes and George Eliot," *ELH* 67, no. 2 (2000): 617–53; and Lawrence Rothfield, *Vital Signs: Medical Realism in Nineteenth-Century Fiction* (Princeton, 1994), 87–102.
27. As Tambling, in "*Middlemarch*, Realism and the Birth of the Clinic," has pointed out, Lydgate is 27 in 1829, meaning he was born in 1802.
28. Almost twenty years earlier, Lewes had described Xavier Bichat's "grand philosophical device" as "decomposing the organism into its various elementary tissues." As he wrote, "*We must commence with the study of the tissues, and thence proceed to*

the analysis of the laws of their combination into organs, and finally, to the consideration of the grouping of those organs into system"; George Henry Lewes, *Comte's Philosophy of the Sciences* (London, 1853), 180, 101 (emphasis in original). Not only does it seem unlikely that Eliot would be mocking Lydgate's quite similar approach but, as Ian Duncan has pointed out, one of the founders of cell theory, Theodor Schwann, had himself also "acknowledged Bichat's tissue theory as laying the foundation for his identification of the nucleated cell as the fundamental unit of life, so a commitment to it would not necessarily disqualify Lydgate's project"; Ian Duncan, "George Eliot's Science Fiction," *Representations* 125 (2014): 23.

29. *The Oxford English Dictionary Online*, s.v. "blight," http://dictionary.oed.com.
30. Since at least the fifteenth century the word *integrity* has indicated soundness of structure, the "condition of not being marred or violated; unimpaired or uncorrupted." It came to take on its more metaphorical sense of "freedom from moral corruption" a century later. *The Oxford English Dictionary Online*, s.v. "integrity," http://dictionary.oed.com.
31. *Spinoza: Practical Philosophy* (San Francisco, 1988), 125–26. As Hasana Sharp articulates the distinction, for Gilles Deleuze, where morality is "the doctrine of what rational beings *ought* to do," ethology is "the liberation of what 'a body can do.'" Hasana Sharp, *Spinoza and the Politics of Renaturalization* (Chicago, 2011), 211.
32. Benedict de Spinoza, *Ethics*, ed. Stuart Hampshire, trans. Edwin Curley (London, 2005), 69. For more on Eliot's interest in Spinoza, see Moira Gatens, "Compelling Fictions: Spinoza and George Eliot on Imagination and Belief," *European Journal of Philosophy* 20, no. 1 (2012): 74–90; Miriam Henson, "George Eliot's Middlemarch as a Translation of Spinoza's Ethics," *George Eliot Review* 40 (August 1, 2009): 18; Michael Davis, *George Eliot and Nineteenth-Century Psychology: Exploring the Unmapped Country* (London, 2006); and Dorothy Atkins, *George Eliot and Spinoza* (Salzburg, 1978).
33. John Stuart Mill, *Collected Works* (Toronto, 1979), 8:861, http://oll.libertyfund.org/title/165.
34. The efforts of followers of Mill, such as Alexander Bain, to further the project of ethology were by and large unsuccessful. See, for example, Alexander Bain, *On the Study of Character: Including an Estimate of Phrenology* (London, 1861). Certainly, what Mill called "ethology" resurfaced in other guises, in the field of developmental psychology, for instance.
35. David E. Leary, "The Fate and Influence of John Stuart Mill's Proposed Science of Ethology," *Journal of the History of Ideas* 43 (1982): 153. As John Durant, too, points out, "Only for a few years at around the turn of the century did Millean ethology find favor in America, and in Europe it appears to have been almost totally ignored"; John R. Durant, "Innate Character in Animals and Man: A Perspective on the Origins of Ethology," in *Biology, Medicine and Society, 1840–1940* (Cambridge, 1981), 161.
36. Jonathan Arac has drawn similar conclusions about the "correlation between literary characterization and the scientific study of human personality" in the nineteenth century; Jonathan Arac, "*Hamlet*, *Little Dorrit*, and the History of Character," in *Impure Worlds: The Institution of Literature in the Age of the Novel* (New York, 2010), 36.
37. Elizabeth Gaskell, *Ruth*, ed. Tim Dolin (Oxford, 2011), 4.
38. For an elaboration of this argument with reference to Eliot's final published work, see also S. Pearl Brilmyer, "'The Natural History of My Inward Self': Sensing Character in George Eliot's *Impressions of Theophrastus Such*," *PMLA* 129, no. 1 (2014): 35–51.

39. Beyond Alice Jenkins, the most comprehensive treatment of Eliot's interest in physics remains Selma B. Brody's "Physics in *Middlemarch*: Gas Molecules and Ethereal Atoms," *Modern Philology* 85, no. 1 (1987): 44.
40. Eliot's reading list for the years she was preparing for *Middlemarch* (1868–71) included two general physics texts, a biography of Michael Faraday, an essay on the atomic theory of Lucretius, and John Tyndall's *Fragments of Science for Unscientific People* (1871). Both Eliot and her longtime partner, the physiologist George Henry Lewes, were personally acquainted with Tyndall, who began to visit the couple in the 1860s. George Eliot, *George Eliot's "Middlemarch" Notebooks: A Transcription*, ed. John Clark Pratt and Victor A. Neufeldt (Berkeley, 1979), 41.
41. In 1866 an article in *All the Year Round* described the phenomenon as follows: "In imagining the ultimate composition of a solid body, we have to reconcile two apparently contradictory conditions. It is an assemblage of atoms which do not touch each other—for we are obliged to admit intermolecular spaces—and yet those atoms are held together in clusters by so strong a force of cohesion as to give the whole the qualities of a solid"; "Atoms," *All the Year Round* no. 360, March 17, 1866, 236.
42. Casaubon's failure as a lover is likewise explained with reference to physical laws: "It is true that he knew all the classical passages implying the contrary, but knowing classical passages, we find, is a mode of motion, which explains why they leave so little force for their personal application" (78–79). Brody has interpreted this passage as a reference to Tyndall's account of the kinetic theory of gases, which holds that (when energy alternates between kinetic and potential modes) the more motion occurs, the less force remains. In reading too much about love thus, the narrator implies, Casaubon has dissipated his erotic energy; Brody, "Physics in *Middlemarch*," 46–47.
43. Alice Jenkins, "George Eliot, Geometry, and Gender," in *Literature and Science*, ed. Sharon Ruston (Woodbridge, UK, 2008), 83. Eliot attended Francis Newman's lectures on geometry at the Ladies College in January of 1851 (73). Frustrated with geometric traditionalism, Newman argued that the field should move forward from Euclid's "unbending" theories (80).
44. James Clerk Maxwell, *The Scientific Papers of James Clerk Maxwell* (Cambridge, 2011), 249.
45. As Michael Tondre has pointed out, "Eliot had regular contact with Maxwell during these years [the later 1860s and early '70s], and it is likely that she would have heard of his undertakings directly, or from other friends in London such as Clifford and Tyndall"; Michael Tondre, "George Eliot's 'Fine Excess': *Middlemarch*, Energy, and the Afterlife of Feeling," *Nineteenth-Century Literature* 67, no. 2 (2012): 215.
46. John Bender, *Ends of Enlightenment* (Stanford, 2012), 104.
47. Soon after completing *Middlemarch* Eliot composed a notebook entry entitled "'A Fine Excess': Feeling Is Energy." On *Middlemarch*'s dialogue with energy science, see Tondre, who argues that "the language of diffusion in *Middlemarch* represents a moral and aesthetic vision rooted in unproductive expenditure" ("George Eliot's 'Fine Excess,'" 205).
48. Martha Craven Nussbaum, *Subversion and Sympathy: Gender, Law, and the British Novel* (Oxford, 2013), 303.
49. A case made most frequently with regard to Dorothea. See, for instance, Isobel Armstrong, who argues that Eliot "subtracts from Dorothea's situation what is common, what can be recognized, and then goes on to describe what is not, the things which make her situation unique and pitiable"; Isobel Armstrong,

"'Middlemarch': A Note on George Eliot's 'Wisdom,'" in *Critical Essays on George Eliot*, ed. Barbara Nathan Hardy (New York, 1970), 128.

50. Catherine Gallagher, "George Eliot: Immanent Victorian," *Representations* 90 (Spring 2005): 62, 64.
51. Sir Walter Scott, *Lives of Eminent Novelists and Dramatists* (London, 1887), 549.
52. George Eliot to Maria Lewis, June 21, 1841, in *The George Eliot Letters: 1836–1851* (New Haven, 1954), 1:98.
53. Eliot, "Notes on Form," 232.
54. For an argument about the import of vagueness to Eliot's conception of language that dovetails with my own, see Daniel Wright, "George Eliot's Vagueness," *Victorian Studies* 56, no. 4 (2014): 625–48.