Men and women of science like Roger Boscovich, Humphry Davy, Joseph Priestley, Mary Somerville, and Michael Faraday, and philosophers like Kant and Schelling helped Romantic writers to understand matter not in terms of Newtonian corpuscles or atoms (often referred to as atomism) but rather in terms of dynamic forces. If matter is force instead of corpuscles, one has a greater sense that the world is one in which change and motion are not only possible but inevitable, since, as the hypothesized essence of matter, change and motion are the being of the world. Moreover, where atomism relied on direct material contact between particles, dynamism presumed that space was filled with fields of force. Thus, everything interacted with everything else, thereby demanding an ecological understanding of one’s actions because there were now necessarily multiple centers of activity and influence. Although the things in our life may not change because our knowledge of them changes, the matter of the world becomes dynamic rather than solid and impenetrable, and our sense of how we act and the meaning of the impact of our actions will change accordingly. I argue that Percy Shelley’s figures in *Prometheus Unbound* refer to and mimic the dynamism of matter, making them not so much about a theory of language, as they are often claimed to be. What has not been adequately understood is that his figures proffer ways of thinking about both the forces of matter and their consequences for human action, mental states, and the imagination.

At the center of the Romantic turn to dynamism was the imagination. Changing the understanding of matter from corpuscle to force demands two acts of imagination. First, in accord with the Kantian modesty that abandons claims to know what the essence of matter is, we accept that our thinking about matter must
be imaginative if we are to think about it at all. Michael Faraday, for example, not only used the imagination as a way of indicating such modesty, but he also thereby generated endless objects to be further studied and systematically experimented upon. If he and other scientists thus labeled atomistic theories of matter pure imagination, they also recognized that any ontological claim about matter risked letting the imagination run wild. Thus, second, seeing the world in terms of forces entails seeing it as different than it looks, perceiving it as force in motion with dispersed effects, as opposed to its appearance as solidity at rest. This insistence of phenomenality over ontology makes the matter of the world astonishing, not false, because matter’s status as appearance grants its freedom from the normative force of fact perception even as it registers normative perception as constraint (Terada, LA 39). Orsted and others took great consolation from the fact that “all the different forces of nature can be traced back to those two fundamental forces [attraction and repulsion]” (197).

Such astonishment orients the subject’s imagination toward the things of this world rather than away from them: Coleridge’s phrase for this is “wonder-promising matter” (BL 1: 134). Coleridge elsewhere elaborates, “We cannot conceive even of the merest thing, a stone for instance, as simply and exclusively being, as absolutely passive and actionless. Were it but the act of reflecting the light by which it is seen, or as the sum of the acts of attraction by which its particles cohere, and the stone is” (Logic 21). Such astonishment further proffers the thinkability of things but does not mistake thinkability for knowability. Situated at the gap between human thought and knowledge, Romantic matter is suffused with an irony that makes any uses to which its essence is put ultimately strategic even when it does not look so. That is, because ideas of matter were driven by the need to make matter intelligible, Romantic materiality made no necessary claims to ontology. I am therefore interested in the ways one could think about matter but not know it, making matter necessarily imagined and the imagination about the relation of thinking to knowing.

Within Prometheus Unbound, Shelley’s articulations of the workings of the world and the forces that drive it are (a) depictions of a way science thought about matter and not an imagining that turns its back on reality and (b) part of the Kantian modesty about what imagining matter means. Scientific modesty is underwritten by a superhuman ambition that would demand “the corporate development of prosthetic insight” (Picciotto 20), by which Picciotto means the collective labors of a scientific community. The Romantic imagination of matter was thus far from an escapist idealism. For one, materiality could not be a form of self-evidence, like a slap in the face, but rather had at its core a debate about what counts as
materiality.10 Was materiality to be found in extension or in the dynamic forces of attraction and repulsion that produced extension? Romantic physicists and chemists struggled with how to reconcile electromagnetism with Newtonian concepts of matter, and it was not until James Clerk Maxwell that the new fundamental entity known as charge was added. Because it is not clear whether field, charge, and energy conform to concepts of matter or move beyond them, in physics, physicalism has replaced materialism, since this term captures physical laws in ways that materialism may not. In the name of history, then, historicists have framed the imagination within a debate about its alleged immateriality and escapism that could not be more unhistorical. For another, since it was unclear whether thought necessitated another kind of matter than ordinary matter, the traffic between imagination and matter helped to define the boundaries of both.11

Romantic reflexiveness about materiality serves as a useful warning to the proponents of the new materialism of today, those Deleuzian- or Spinozist-inspired critics who are now enamored with matter because it is understood as vital.12 I will show the new materialism’s Romantic past. From Shelley’s perspective, the new materialists have lost the skepticism that comes with the need to think about matter as necessarily imagined. If materiality is entwined with imagination, then it can neither rescue the imagination from the charge of fecklessness nor serve as a counterweight to imagination. Instead, the force of Romantic materiality lies within the worlds it makes epistemologically available and open to question. The concept of vital matter, furthermore, participates in a category mistake: as Henry Staten argues, “Life is a possibility of materiality, not as a potential that it is ‘normal’ for materiality to bring forth, but a vastly improbable possibility, by far the exception rather than the rule” (34–35). Finally, I worry about such born-again materialism, arising out of the ashes of its exhaustion of our having limited it to constraint. What underwrites this faith in matter to now do everything we once thought it could not do?

My larger aim here is to develop a rationale for materialist possibility, one made possible by the turn to dynamism. Because atomism requires direct contact between corpuscles—there can be no action at a distance—possibility is not real (Harré 14). The turn to force makes possibility itself possible because action no longer requires direct contact.13 I must also ask why materialism is so often coupled with determinism. The material is frequently understood simultaneously as a proxy for reality and as that which conditions it: the idea of solidity and impenetrability makes matter seem irrefutable. Seeing matter as dynamic force frustrates the work of materiality to condition and determine, and, because the various forms that matter might take were imagined as appearances, matter was left with no
necessary determining qualities since it was always changing appearances and since its forces might always be overcome by a greater force. In Shelley’s view, matter as solidity was a form of casuistry. Žižek argues that “no historical Necessity pre-exists the contingent process of its actualization” (212), and this would encompass matter itself under dynamism. In fact, the apprehension of matter as dynamic fueled skepticism about the status quo even as it solidified the imagination’s hold on matter. Because matter is in process rather than finished, materiality cannot condition but instead functions as contingency.

**ROMANTIC DYNAMISM**

Developments in chemistry, electricity, and magnetism, especially the discovery of polarity, led Romantic physicists and chemists to make a concerted effort to reject Newtonian mechanical corpuscles and Descartes’s *Res Extensa*, and instead to begin thinking of matter in terms of the unified dynamism of force.\(^{14}\) Polarity suggested the forces within matter. Dynamism was attractive, moreover, because it facilitated an escape from the determinism of Newtonian physics and from the dualism of Cartesianism, not to mention the epistemological difficulties in postulating imperceptible corpuscles.\(^{15}\) The imperceptibility of atoms made the imaginative practices associated with it irrelevant (they called it delusive).\(^{16}\) In fact, Davy, Kant, Priestley, and Faraday all linked corpuscularity or atoms with a deluded imagination since there was nothing about them that could be seen: Davy warned that “ultimate particles or atoms are mere creations of the imagination” (*Consolations* 9: 363).\(^{17}\) Scottish scientist Mary Somerville explained how Thomas Young’s 1801 double slit experiment demonstrated that light had to be a wave, thereby further undermining the theory of corpuscularity since light as wave could not be made up of atoms. Waves, after all, needed a medium of propagation (Dear, *Intelligibility* 120). Somerville concluded that “Newton and most of his immediate successors [had] imagined light to be a material substance” (161). They argued that a properly disciplined imagination, by contrast, would recognize matter to be composed of forces, not bodies. A corpuscular theory assumes both “local motion and a particulate matter as the basis for explaining the physical world” (J. Edwards 96). Quite simply, the Romantics thought of matter not as dead or inert impenetrability but in terms of active forces, and they did so to allow imagination and matter to interact through forces that were not just passive.\(^{18}\) Kant himself praised “dynamical natural philosophy” on the grounds that it does not regard material bodies as “machines, that is, mere tools of external moving forces” (cited in Modiano 142). Hence Blake has Tharmas insist, “I am like an Atom/A Nothing left in darkness” (*FZ* N1 E302: 61), and in *Urizen* the void is referred to as the negation
of “globes of attraction” (N3 E71: 36).\textsuperscript{19} Forces, moreover, facilitated the ultimate unity of matter because it brought together such disparate phenomena as electricity, light, magnetism, and matter.\textsuperscript{20} While Kant’s definition of matter in terms of the powers of attraction and repulsion led Goethe to develop a concept of the fundamental polarity of all beings (R. Richards, \textit{Conception} 429), Orsted credited the dynamical theory of matter with leading him to the discovery of electromagnetism (Gower 340–43; Stauffer 37–38).

Why did Romantic scientists so often call upon the imagination in order to rethink matter as essentially dynamic? Under dynamism, matter is or has superadded within it an interplay between attractive and repulsive forces (J. Edwards 99). Two questions ensue. What counts as human action, since the forces of matter act? And if matter as force becomes a genuine source of causality, why could not mental activity have force and causality?\textsuperscript{21} In the cases of Humphry Davy and Michael Faraday, because the idea of merely mechanical forces did not sit well with their theology, dynamism offered the possibility of God’s active management of the things of this world.\textsuperscript{22} Davy, in fact, considered time in terms of the process of chemical reactions (\textit{Consolations}, dialogue 6). In a larger view, theories of matter inevitably impact human action, because they form the backdrop against which human action becomes knowable. Hannah Arendt adds that “change would be impossible if we could not mentally remove ourselves from where we are physically located and imagine that things might well be different from what they actually are” (5). I underscore that the necessary imagination of matter primed the pump to think about the nature of human action and to see that action in relation to the forces of the world.\textsuperscript{23}

Of course, the trajectory from corpuscularism to dynamism that I have outlined above is not in actuality so tidy. Newton, who is sometimes taken to be a dynamist, for example, subscribes to a corpuscular theory of matter and, in fact, grants hardness, impenetrability, and inertia the status of primary qualities (J. Edwards 101). But this does not prevent him from also supporting passive forces inhering in nature. The tradition of British dynamism, then, emphasized Newton’s claims about force, even though he treats force hypothetically in queries 18–24 of the \textit{Optics}, notwithstanding the fact that he considers the forces inhering in matter to be passive, and despite the fact that there are vestiges of corpuscularism within his notion of ether (J. Edwards 102–03).\textsuperscript{24} Newton ends the \textit{Principia} invoking a “most subtle spirit which pervades and lies hid in all gross bodies; by the force and action of which spirit the particles of bodies attract one another at near distances” (2: 547). Corpuscular definitions lost ground in the Enlightenment in no small part because of the empiricist objections of Hume and Berkeley. While
the term “dynamism,” moreover, usually embraces a rejection of corpuscularism, dynamism stresses the role of forces either in their own right or as constitutive of matter insofar as attraction and repulsion are what give matter the appearance of extension. An added complication: mechanism stresses the role of matter to which forces may or may not be superadded. So, as in the case of Kant, one can be a dynamist and a mechanist at the same time.

Qualifications aside, Romantic thinkers embraced a theory of matter that emphasized the activeness of force within matter so that human beings might engage with it and so that the dynamism of matter could flout determinism. Gone are Newton’s merely passive forces. Active forces within matter made it more unpredictable. No longer conveniently idealist and escapist, the Romantic imagination would now have to be understood as the entity that both intuits change and frames change itself as a continuous part of the universe. Since “every change presupposes the identity of the thing being changed” (Pollok, “Kant’s Critical Concepts” 571), human change would now have to be gauged against the constant forces of nature. I also must acknowledge that while Romantic writers did sometimes find the inevitability and ubiquity of worldly change therapeutic to their idealism, the need to measure human action against the actions of the physical world helped to contain that idealism. Percy Shelley, for instance, considers love to be one of the basic forces in the universe, akin to gravity and magnetism. The key now would be how to understand human agency in relation to the ongoing dynamic changes within nature, for how was one to know the difference? The cultural fascination with electricity and magnetism led to electrical and magnetic attractive theories of matter. Now that matter as force was no longer merely or simply mechanical, how to think about it? How did the activeness of matter impact human action? Matter itself would demand reimagination, which in turn set the stage for the rethinking of what counted as social change.

Possible within a Romantic view of nature is an ontological equality that allows contact and mutual relations between forces of nature and imagination. Steven Shaviro puts it thusly: “If the environment enters into the nature of each thing, then no single being—not even the human subject, and not even God—can claim priority over any other” (282). Hence, Romantic writers understand subject and object as versions of being, while relationality becomes an incipient unity. Mutuality further allows free will to be maintained so long as one chooses which forces surrounding oneself control the self.

Briefly, my large claim here is that in the Romantic period there was no necessary tension between the imagination and matter because, as Kant, Priestley, and Faraday argued, the corpuscular theory of matter was imagined, and irrespon-
sibly so.\textsuperscript{27} To wit, Schelling calls atomism “a lazy style of philosophizing” (189) because it relies upon impenetrability as its only ground (189), and impenetrability can be had only “by setting absolute bounds to the imagination” (169), a setting of bounds that is actually “deadening” to it (169). “It becomes so easy, once the imagination has been deadened, to conceive of something absolutely impenetrable,” Schelling warns.\textsuperscript{28} Dynamism, by contrast, led to the responsible (and for Schelling enlivening) imagination of matter in terms of a continuous change that is understood as an assumption to be proven.\textsuperscript{29} I will show how the dynamic theory of matter made it into an event to be synthesized by imagination, and thus matter was the embodiment of the forces of change. Furthermore, “force” worked as an intermediary between matter and consciousness, and it could do so because thought was considered to be motion: Coleridge, for instance, traced the etymology of mind to a German word indicating “vibratory yet progressive motion” (CN 1: 378).\textsuperscript{30} Motion, of course, was the external sign of force, and this way mind could act upon matter. Such reciprocity, indeed, was underscored in the German word for “imagination,” Einbildungskraft, because Kraft means “force.” No need then to choose mind over matter or vice versa because mind is matter and imagination has force, giving both the possibility of interaction and unity.

**REIMAGINING MATTER**

In the Romantic period, matter is increasingly understood in terms of dynamism—force and affinity—and what this means is that change and motion become inevitable. The problem now becomes how to measure human change against the forces of the world.\textsuperscript{31} That said, the dots connecting the dynamism of matter with human agency changes from scientist to scientist, writer to writer. My goal, however, is to show how this relation makes it unnecessary to assume that matter is necessarily intransigent to human will, and that some, like Kant, understood matter a form of action of attractive and repulsive forces that could be made consonant with human action.\textsuperscript{32} Because the concept of force itself in the eighteenth century was ambiguous, referring either to the momentum of a moving body or its energy, force threatened to make matter essentially active (Hankins 282). Hardness, extension, impenetrability, by contrast, all made matter seem intractable and resistant to change. The acceptance of forces as the ground for the properties of matter we can experience necessarily entails a rejection of hardness and the like as foundational qualities of matter (J. Edwards 110). Despite the fact that they consider atomism a delusion of the imagination when the atom was more than a concept, Boscovich, Davy, Faraday, Kant, and Priestley all insist upon the imagination as necessary to apprehend matter correctly.\textsuperscript{33} Not only then must the imagination...
be capable of self-correcting in ways that historicist critics have not acknowledged, but also the imagination now has material consequence in the form of shaping how one encounters matter and thereby counters the forces of nature, along with how one thinks of human action.

By showing how scientists turned to the imagination to think about Romantic matter, I aim to rethink the imagination’s relation to materiality. Two consequences ensue. One, the imagination can no longer be simply seen as fecklessly immaterial because it is enmeshed in the very thinking of matter itself. Two, since Romantic materiality is necessarily imagined, the one cannot become a cure for the other, and this should call into question the ways in which “materiality” often functions within Romantic literary criticism as a badge of honor. Within science, a disciplined imagination was thought to prevent delusion, and, in fact, many scientists considered the imagination as a way of bracketing claims as not yet proven. When he claimed that “every scientific statement must remain tentative forever” (153), Karl Popper invested science with the work of imagination. Schelling said it better: “The real concept of matter itself first proceeds from the synthesis of those forces by the imagination” (187–88). For Schelling, “real” means not merely logical, and his point is that most theories of materiality have put the cart before the horse. That is, they have put matter before the imagination that made its possibility possible.

Leibniz, as it were, got the ball actively rolling: he understood inertia as a principle of effort, which must be the outcome of an inherent force or activity (Jammer 161). He thus transformed the meaning of “force” “from a mechanical mode of operation” to “a principle of almost vitalistic activity” (158), an activity inherent in the moving body (161) that kept the universe from running down and coming to a halt (Hankins 282) and simultaneously made force the essence of matter. In his Essay de Dynamique (1692), he argued that since movement did not truly exist because it is a transient thing and space was only a relational concept, force was really “the cause of motion,” and force is the thing that “truly exists” (131). Leibniz explained that “active force contains a certain activity or entelechy and is midway between the faculty of acting and the action itself” (from his Monadology, cited in Jammer 160). In Theodicy (288), Leibniz claimed that spontaneity is the “body and basis” of freedom, and that monads—simple substances—are the spontaneous causes of their own states. The Leibniz scholar Donald Rutherford suggests, “Although agent spontaneity may be a requirement of freedom, the possibility of agent spontaneity presupposes the truth of monadic spontaneity.” For Leibniz, the spontaneous dynamism of matter, then, grounds freedom itself, for the two must exist in a preestablished harmony. Not only does the dynamism...
of matter allow it to be read in concert with human action, not against it, but also that dynamism helps define human action in such terms that matter and human effort are potentially in harmony.

Building on Leibniz but dismissing his need for actual living forces since mechanism could fully account for his concept of force, philosopher and physicist Roger Joseph Boscovich in 1758 defined matter as being “composed of perfectly indivisible, non-extended, discrete points” (67), and all these mathematical points, practically devoid of all properties beyond force, exert forces on each other. He defined force as a propensity to approach or recession, a propensity to be measured by the acceleration produced (Jammer 177). Boscovich had significant influence on both Davy and Faraday, among others (Knight, Atoms and Elements 14). Because impenetrability and extension are the “spatial expression of forces” (Jammer 178), forces are thus more fundamental than matter in the Cartesian sense, and, consequently, matter has no extension but is made up of focal points of attractive and repulsive forces (J. Edwards 103). Matter thereby became calculable and visualizable, and the visualizability of what was in fact invisible was key to intelligibility. Hence one reason why imagination was both important and dangerous to Romantic science. These geometrical points by virtue of their spatial relations became “a system of powers or tendencies to motion” (Levere, Affinity 13). Boscovich further shifted emphasis from issues of substance to issues of relationality. What mattered in his system was the relation of one atomic point to another, making possible an ecological understanding of matter. Each particle of the universe has a dynamic relation to every other particle (Jammer 174).

Boscovich’s fascination with the forces of matter further helps undermine any necessary tension between imagination and matter. In his preface to his A Theory of Natural Philosophy, Boscovich praised the superiority of geometry to algebra because while the latter “does not assist the imagination in the way,” the former does (8). Note that he frames the imagination not as something to be feared: it is something to be assisted. We can further unpack the significance of his invocation of the imagination if we attend to his description of how geometry assists the imagination:

The whole matter reduces to this. In a straight line of indefinite length, which is called the axis, a fixed point is taken; & segments of a straight line cut off from this point represent the distances. A curve is drawn following the general direction of this straight line, & winding about it, so as to cut it in several places. Then perpendiculars that are drawn from the ends of the segments to meet the curve represent the forces; these forces are greater or less, according as such
perpendiculars are greater or less; & they pass from attractive forces to repulsive, and vice versa, whenever their perpendiculars change their direction, as the curve passes from one side of the axis of indefinite length to the other side of it.

(Theory of Natural Philosophy 8)

The imagination allows Boscovich to conceptualize matter in terms of discrete points, themselves driven by forces represented through geometrical curves. The curves, and the perpendiculars drawn from the curves, enable the collapse of repulsion and attraction to “a single, continuous, action-at-a-distance curve of attractive and repulsive accelerations” (Schofield, Mechanism 236). At a certain distance from the point, Boscovich argues, attraction becomes repulsion. Geometry, therefore, assists the imagination by modeling the workings of matter.

In a larger view, the imagination allows Boscovich to envision one conclusion from geometry leading to another—emploting its workings in deductive steps—and in this way, he thought he had done Newton one better because he was able to reduce all of nature to a single axiom, the fact that matter was composed of discrete points. He submitted, “I have deduced the whole of it by a straightforward & perfectly rigorous chain of reasoning” (10). An additional boon from his theory of forces was his ability to turn to repulsive forces to explain sensation: “My repulsive force . . . is bound to excite in the nerves of those organs the motions which, according to the usual idea, are excited by impenetrability and contact” (56). Here, impenetrability is nothing more than the work of repulsion. Reasoning provides access to central truths about matter; and therefore imagination, insofar as it is disciplined by geometry, must remain a key means for the possible understanding of matter. Boscovich thus makes matter and imagination mutually reinforcing, since imagination is what allows matter to be encountered and understood. And yet this mutuality must remain a struggle because it is contingent upon the successful disciplining of the imagination by geometrical reasoning.

With Kant, the imagination was all the more necessary to apprehend matter. Against what he called a fabrication of the world “from the full and the empty in accordance with mere fantasy” (MFNS IV, 524) (aus dem Vollen und Leeren eine Welt blos nach der Phantasie zu zimmern [MAN 83]), Immanuel Kant redefines matter in terms of dynamic forces, and he does so because movement is what makes matter visible to us, and because he thinks that the empirical givens of impenetrability and extension are really the products of the forces of attraction and repulsion. Although Kant revered Newton, he could not abide by his atoms and voids because he thought both were empty concepts. Since for Kant the office of the imagination is the spontaneous synthesis of the presentations that un-
fold in time and space, there is no getting around it. His distinction between Phantasie and Einbildungskraft, however, rests on the degree of freedom given to the imagination.\textsuperscript{45}

My interest here is in how Kant is able to deploy fantasy (Phantasie/imagina-
tion) to delegitimate the rival corpuscular/atomic theory of matter and then si-
multaneously to use Einbildungskraft, the imagination, to argue for an empirical
concept of matter as the moveable. Of course, Kant himself in 1755 subscribed to
a corpuscular theory of matter and thus not only knew firsthand the power of
Phantasie but recognized how easily Phantasie might slide into Einbildungskraft:\textsuperscript{46}
unlike the former, the latter term insists upon the educability of imagination with
the word Bildung. In his Philosophy of Material Nature (1786), Kant jokes that
Swiss mathematician Johann Lambert’s theory of matter would place logic at its
center because for him the presence of something real carries with it resistance
by virtue of the principle of contradiction (PMN 2: 498). He therefore replaces
Lambert’s principle of contradiction with repulsive forces because those forces help
him to “understand” how the principle of contradiction arose in the first place
(2: 498). If Phantasie allows Kant to delegitimate versions of matter like atomism
or Boscovichean points by insisting that they are based on mere hypotheses, a dis-
ciplined imagination, whose discipline makes itself educable (Bildung) and which
knows the difference between fantasy and reality, also knows that movement
alone is what allows us both to perceive matter and make it empirical. Splitting
the imagination into disciplined and undisciplined forms enabled Kant to argue
that corpuscularity was mere fantasy, while dynamic forces were the result of
careful imaginative education. “But who claims to comprehend the possibility of
fundamental forces?” he asks (2: 525). These forces “can only be assumed, if they
inevitably belong to a concept concerning which there can be proved that it is a
fundamental concept not further derivable from any other” (2: 525). Kant’s choice
of “assumed” makes clear that his dynamic theory of matter is just a theory, albeit
functioning as if it were a foundational fact, but one that importantly lends matter
a phenomenality that makes it available to human experience.

The dynamic forces that constitute matter are thus necessarily imagined or
assumed, and Kant shows the discipline of his imagination by, on the one hand,
refusing to assume that these forces have more than conceptual status and by, on
the other hand, recognizing that our access to things must remain conceptual. He
continues, “He must not . . . presume to assume either of them as actual because
the authorization to set up a hypothesis irremissibly requires the possibility of
what is assumed to be entirely certain” (MFNS II, 525). Claims of knowing ac-
tuality are presumption; moreover, what is to be counted as certain must be first
shown to be possible. The imagination is not so much the problem for Kant: the problem is that it is often given the freedom to elide conceptual with actual things or, in this case, count on something as certain before it has even been proven encounterable by human perception.

Kant does recognize that corpuscularity carries with it all the advantages of mathematic physics. He insists, the advantage of a “merely mathematical physics . . . [is that it] allows the possibility of shapes as well as of the empty intermediate spaces [to] be proved with mathematical evidence” (MFNS IV, 525). But this advantage brings with it two damaging liabilities: “It must lay at its foundation [the] empty concept of absolute impenetrability, and secondly must give up all the proper forces of matter” (ibid.). Kant adds, “It is afterwards required to make explications and must then allow the imagination more freedom in the field of philosophy—and indeed allow this freedom as a rightful claim—than can be consistent with the caution of philosophy” (ibid.). The original German reads: “Nachdem es das Bedürfnis zu Erklären erfodert, der Einbildungskraft im felde der Philosophie mehr Freiheit, ja gar rechtmässigen anspruch verstatten muss, als sich wol mit der Behutsamkeit der ressteren zusammen reimen lasst” (MAN 85). Note that Kant does not use Phantasie as he did with atomism, but he uses Einbildungskraft because it insists upon education. Since reimen means “rhyme,” a more fitting translation might be freedom in tune with the caution of philosophy, making any freedom worth having at the same time necessarily disciplined by philosophical caution and a sensuous experience that is enhanced, not expunged, by philosophy, the means to Bildung.

Kant insists, by contrast, that corpuscular theory of matter allows more “freedom of imagination than philosophy demands” despite the fact that he must admit that, with his own theory based on forces, “all means are wanting for the construction of this concept and for presenting as possible in intuition what we thought universally” (4: 525). The point to underscore here is that the problem is not a necessary antagonism between imagination and philosophy: excess of freedom is the problem. It would seem that the lack of a means for constructing a concept is better than an empty concept, but this choice makes the imagination perilously close to Phantasie.

On what grounds, then, does Kant associate excessive imaginative freedom with the former theory of matter, and how does he insulate his own theory from that very charge, especially given that he cannot use force to fulfill his very own criteria for pure, a priori knowledge? Kant admits that the laws of “fundamental forces . . . we are not able to determine a priori, [and] still less are we able to reliably indicate a manifold of such forces sufficient for explicating the specific var-
ety of matter” (MFNS IV, 425). After all, movement is undeniably empirical and thus not the same as universality.

To answer that question, we need to go back to the Critique of Pure Reason and understand the role Kant assigns to the imagination. Kant charges the Einbildungskraft with “synthesis,” “the mere effect produced by the imagination” (CPR 130). He defines “synthesis” as “the act of putting various presentations with one another” (130), and this synthesis is the ground for cognition, though it is not yet cognition. This “pure transcendental synthesis of imagination . . . underlies the possibility of all experience (inasmuch as this possibility presupposes necessarily that appearances can be reproduced)” (155). As such, the imagination is the ground of possible knowledge, while, at the same time, its development is tantamount to intellectual development itself (Kneller 32). Without imagination, “we would have no cognition whatsoever” (CPR 130). He later grants the imagination the power to make cohere the “manifold of intuition,” sensibility, and the “necessary unity of pure apperception,” or the understanding (170).

Kant’s theories of matter shed light on the development of the imagination, that blind faculty necessary for cognition to take place, because one must learn through cautious philosophy to distinguish when the imagination has too much freedom. Although the corpuscular or atomic theory of matter allows for the mathematicization of physics, it must ground itself on the idea of absolute impenetrability, which for Kant must be an empty concept insofar as no experience whatsoever can be capable of proving it. He writes, “Absolute impenetrability is indeed nothing more or less than a qualitas occulta. For one asks, what is the reason why matters cannot penetrate one another in their motion? He receives this answer, because they are impenetrable” (MFNS II, 503). Despite the fact that fundamental forces can never be rendered certain (Watkins), they amount to more than an empty concept insofar as they have a phenomenality that makes the experience of the effect of them, movement, possible. Kant comments, “The appeal to repulsive force is free of this approach,” and here the approach he dismisses relies upon the use of occult things (2: 503). He elaborates, “For although this force likewise cannot be further explicated according to its possibility and must hence be admitted as a fundamental one, it nevertheless yields the concept of an active cause and of the laws of this cause in accordance with the effect, namely, the resistance in the filled space, can be estimated according to the degrees of this effect” (2: 503). By stipulating force to be fundamental and by explaining how force makes matter encounterable, Kant does away with the need for further explication. But Kant further highlights the gains of his approach: the ability to estimate the resistance in the filled space. The reason to choose dynamism over corpuscularity turns out
to be both the avoidance of occult entities and the ability to make predictions based on the theory.

The imagination, then, must learn to distinguish between pure concepts, “empirical concepts that are based on transcendental conditions for their possibility” (Pollok, “Kant’s Critical Concepts” 560), and empty concepts, which we either have no phenomenal access to or which are not necessary concepts for thought itself, like time and space and causality. Movement is necessarily empirical, but it can only become the basis for a phoronomy, a part of natural philosophy that examines motion as a pure quantum, when it serves as the basis for the derivation of all further predicates (ibid.). Within science, Kant stipulates further that empirical concepts must be subject to experimental confirmation. The “dynamical mode of explication,” Kant urges, “(which is far more suited and more favorable to experimental philosophy) inasmuch as it leads directly to the discovery of the moving forces proper to matters and laws of such forces, but restricts the freedom of assuming empty intermediate spaces and fundamental particles of determinate shapes, (neither of which can be discovered and determined by any experiment)” (MFNS IV, 534). The value of dynamism for Kant is that it puts necessary curbs on imaginative freedom—getting rid of empty spaces and determinate shapes—and makes possible experiments that will corroborate hypotheses. Likewise, Schelling required of the atomists “to set limits to the freedom of the imagination” (189) because he found “absurd” the notion that matter could be made up of “infinitely many parts” (189). Crucially, for Kant, dynamism is a mode of “explication.” It was not until 1905 that Einstein with his paper on Brownian motion connected diffusion rates implied by this motion to a scale for atoms. Einstein thus showed that evidence for atoms could be found. Previously, atoms were models without scale, useful for chemical shorthand but of dubious reality and without consequence, since one could always shift scales to fit any theory. One might say then, until Einstein, committing oneself to atoms was a materialism without consequences.

Invoking the aid of Boscovich’s concept of atoms as centers of attraction and repulsion (1: vi, xxxiv, 24–27), Joseph Priestley, by contrast, collapses matter and spirit in his *Disquisitions Concerning Matter and Spirit*, partly on the grounds that “we know nothing at all of the thing or substance besides the powers that we ascribe to it” (1: 32). Once again matter is necessarily imagined because the essence of its thingness is unknown: all we have access to are its powers. As a result, Priestley argues that he has as much right to say that matter is composed of attractive and repulsive forces as another has to say that it is made up of impenetrability. He believes his view superior, however, in that it recognizes that impenetrability is based on those forces. Solidity is based on resistance, and, in making this claim,
Priestley, like Kant, seeks to make our knowledge of matter conform to the character of empirical experience (J. Edwards 107). But, unlike Kant, he does not look to the regulative principles that are necessary for experience. For Priestley, forces were what we can empirically know about matter, and he contrasts this to an absolutely unknowable idea of invisible corpuscularity. When push comes to shove, Priestley avows that he has made no claims concerning the “internal structure of matter” (Disquisitions 1: 35), and that all he has done is quote Boscovich’s ideas of points of matter. Once again the interiority of matter is necessarily imagined, making Romantic materiality a form of irony insofar as the gap between appearance and reality can only be temporarily be sutured by thought. As Yolton sums up, “A materialism along these lines need not be opposed to a humanistic conception of man” (200).

Priestley further argued for the existence of a common substance that would allow matter and spirit to interact: without such a substance, it would be impossible to conceive of an interaction between them. He contends, “Let a man torture his imagination as much as he pleases, I will pronounce it impossible for him to conceive even the possibility of mutual action without some common property, by means of which the things which act and react upon each other, may have connexion” (Disquisitions 1: 81). The tortured imagination here functions as the basis for a rational argument about common properties: the inability to conceptualize a relation between body and spirit without a common empirical property becomes the basis for the need for that common property. That common property would be force, that which comprises the powers of attraction and repulsion (1: ii). Well aware that this collapse makes it impossible to relegate matter to the source of evil (1: iii), Priestley then unites matter and spirit by making extension into the power of repulsion. Once he has gotten rid of impenetrability as the essence of matter, “the whole argument for an immaterial thinking principle in man . . . falls to the ground” (1: 23). If the downside of his version of matter, however, is that human volition is now governed by a “series of fixed laws” (1: v), Priestley’s collapse of body and soul allows the human to work in concert with the divine. In The Marriage of Heaven and Hell, William Blake would leverage this collapse into a denial of priestly hierarchy.

Priestley further invokes Newton’s restatement of Occam’s methodological imperative not to admit more causes than necessary to do away with conventional notions of spirit because he sees Newtonian method as a cure to the excesses of imagination. Not to obey Newton’s methods amounts to a “wandering into the regions of fancy” (Disquisitions 1: 8), with the result that we are “merely entertaining ourselves with our crude imaginations and conceits” (1: 8). Priestley thus
names Newton the cure to a crude imagination, thereby sobering the imagination with Newtonian judgment. Of course, Newton himself could have used such sobering, for, in his adoption of ether, Priestley points out that he has violated his very own principles (1: 30). Priestley’s reasoning merits full consideration: “The reason why solid extent has been thought to be a complete definition of matter is because it was imagined that we thought we could separate from our idea of it everything else belonging to it, and leave these two properties independent of the rest, and subsisting by themselves. But it was not considered, that, in consequence of taking away attraction, which is a power, solidity itself vanishes” (1: 11). The vulgar notion that the essence of things is composed of solid extension is based upon an imagined separability of our idea of the power of solidity from its properties. Once again, since those very properties are based on the power of attraction, the imagination is in error when it separates ideas and things, or what Heidegger referred to as propositions and things. My point here is not only that the imagination is central to thinking about matter, but also that its errors have material impact since it affects our understanding of what matter is and does. Priestley in fact repeatedly insists that we have “imagined” solidity to be the ground of materiality (1: 17, 44), and thus the vulgar notion of things is really nothing, an unsubstantiated hypothesis. In fact, Priestley wryly retorts, without some idea of power, “nothing would be left for the imagination to fix upon” (1: 13). In much the same way as he collapses matter and spirit, Priestley’s imagination needs things to fix upon, for, without them, there is no content to consciousness. Like Kant, Priestley insists there simply is no warrant for a thing underlying the powers of attraction and repulsion because such a thing “does not appear from any phenomenon we are yet acquainted with” (1: 21). “The kind of matter on which the two-substance view is based does not exist” (Yolton 114). The fact that the thing is really a power or force allows mind and matter to interact. In Priestley’s view, materiality becomes that which conforms to the character of our experience of it, and thus materiality is a form of intelligibility. Matter and spirit are thereby indissoluble. To wit, he argues, “In this disquisition, I by no means suppose that these powers, which I make to be essential to the being of matter, and without which it cannot exist as a material substance at all, are self-existent in it. All that my argument amounts to, is, that from whatever source these powers are derived, or by whatever being they are communicated, matter cannot exist without them” (Disquisitions 1: 13). Several features demand comment. Priestley admits that he has made these powers essential and thus essence is his construction; he further insists that he is not supposing the “self-existence” of these powers. Priestley is in effect turning to the imagination to make essentialism a necessary strategy rather than an ontological claim.
Priestley intensifies such bonds when he addresses readers, whom he imagines to be “well meaning Christians . . . of a philosophical turn of mind” (Disquisitions 1: x), by which he means rational Christians. He hopes that they may be prevailed upon, having found “the true system of revelation to be quite another thing than they had imagined it to be, and infinitely more consonant to the real appearances of nature, may think it worth their while to consider it in various other lights, and attend to the evidence that myself and others have produced in favour of it” (1: x–xi). Although revelation is initially imagined to be quite different from the “appearances of nature,” Priestley insists that revelation conforms with those appearances and, in so doing, collapses matter and imagination under the rubric of “appearances of nature” (1: xi). Matter can be known only by its appearance and thus is imagined. At the same time, Priestley suggests that the imagination is open to correction by evidence, even when the form of that evidence is different from what one initially expects. First, matter therefore must be imagined in two ways: since its essence cannot be known, all one can talk about is its appearance. Second, since its appearance is different from its actuality, matter must remain under the sign of difference and thus cannot function as a surrogate for logocentrism. This further implies that the deferral we have credited to the powers of language originally belonged to the powers of matter.

Within chemistry, much speculation went into understanding the reasons why substances had “preference” for certain kinds of reactions. Affinity began to replace a principalist approach, whereby “the properties of bodies were determined by the kind and quantity of the principles contained in them” (M. Kim 116). In a model where principles were the causal agents engendering the properties (Klein and Lefebvre 44), composition determines affinity; under affinity, affinity determines composition (M. Kim 145). Here, essence moves away from substance and toward the attraction of the substance for another substance, not only making the essence of things attractive forces that have the potential to combine with other things but also rendering substances as actions. The famous German chemist Georg Ernst Stahl believed in “an Anima, a conscious, rational, immaterial principle in living substance responsible for the unique properties of life” (Schofield, Mechanism 200–201). The anima directs the immaterial motions of matter, exhibiting intention and denying determinism (200).

I have thus far argued that Romantic materiality was necessarily imagined, making the citation of the material a conscious strategy instead of an ontological claim. Linking the material with strategy not only made matter about possibility instead of determinism but also enabled matter to be put to use to help get rid of tyranny. Humphry Davy taught himself chemistry by reading Lavoisier, and, per-
haps because the French chemist, to make chemistry purely analytical, neglected the internal constitution of matter (Goodstein 3), Davy took a different path. Early on, Davy thought that matter was essentially dynamic: “Far from being conscious of the existence of matter, we are only conscious of the active powers of some being” (cited in Levere, Affinity 26).55 His chemical experiments led to his discovery of sodium and potassium, among other elements. Davy’s emphasis on active powers made the chemistry of matter about interactions (Goodstein 5); his attempts to prove that electrical forces are really chemical forces enabled him to provide a universal explanation for matter (Chai 126). My point here is that Davy aligns matter with activity and change, and he often turns to the imagination to think about it.56 The imagination moreover helped him to claim the role of a natural philosopher, one whose theoretical knowledge, on the one hand, lent him authority over chemical artisans and, on the other hand, got his critics to accuse him of being overly passionate and unreliably speculative (Golinski, Experimental Self 185).

On January 21, 1802, Davy gave an introductory lecture on chemistry at the Royal Institution, which Coleridge attended, claiming that “chemistry takes the beings and substances of the external world [and] explains their active powers” (C. Lawrence 220).57 Around the same time, he wrote in a notebook:

All our visible imagery occurs in trains, hence when we meet with unconnected images we fill up the intermediate links by imagination

What is imagination, almost always the recurrence of remembered visible imagery under the influence of hope and fear

When we awake our trains of imaginations are perpetually broken by Impressions, In dreams all ideas are nearly of the same vividness.

(“Personal Notebooks” 13/D, 1800)

In the same way that Kant turns to the imagination to synthesize the manifold of presentations, Davy has the imagination fill in the blanks of any unconnected images in our trains of imagery. Quite literally so here, as the reader must fill in the gaps between statements. However, unlike Kant, Davy stresses how the imagination is influenced by the emotions of hope and fear, thus inviting a double consciousness with regard to it. When we are awake, the trains of imagination are broken and, therefore, presumably are more easily subject to judgment. To the extent that the imagination fills in perceptual blanks when it is guided by hope and fear, it can be dangerous to science, and the only way to impose judgment over it
is to treat such imagery with suspicion. Indeed, Davy’s language here recalls what he said about nitrous oxide: “I lost all connexion with external things; trains of vivid visible images rapidly passed through my mind” (Davy, Works 3: 289). Nonetheless, he calls “reason, the first revelation” (“Personal Notebooks” 13/E, page 5), and in so doing casts aspersion on the reliability of the second revelation, by which he means the “absurd” biblical account of it. The revelations of reason thus were needed to counter the mystical revelation of the Bible, and thus it is hardly surprising that he would develop suspicion regarding the imagination, especially after he likened it to the effects of laughing gas. Perhaps the gap between the two kinds of revelation would help shape the imagination’s scientific role.

To that end, Davy opened his 1812 Elements of Chemical Philosophy by pronouncing, “Most of the substances belonging to our globe are constantly undergoing alterations in sensible qualities, and one variety of matter becomes as it were transmuted into another” (4: 1). The imagination affords initial speculations about chemical changes that with the proper experiment might eventually provide the basis for a scientific advance. But Davy cautions that “theories are merely systems of logic and not systems of the universe; moreover, alterations in words are not connected with alterations in things” (Lecture Notes HD/3/A/1, pages 33–34). Mindful of the gap between logic and the universe, Davy demands that neither thinking nor logic be equated with knowing. In an 1806 paper, “On the Relations of Electrical and Chemical Changes,” he writes, “I shall detail an experiment which I made under a different form some years ago, and which may assist the imagination in the conception of this singular and mysterious mode of action” (Works 6: 338). Experiments here lead the imagination to conceptualize modes of action not visible on the surface, thus making chemical action intelligible. The key, however, was not to mistake intelligibility for ontology. Three years later, he wrote, “Doubt in physical research is highly salutary; & is always the parent of enquiry, and often of truth. Though our reasonings may have the perfect character of verisimilitude as applied to known objects, yet we have no right to say that our view is an ultimate one. Our systems of logic cannot unfold all the resources of nature” (Lecture Notes HD/3/A/4, lecture 4, pages 106–07). Surprisingly, his use of “verisimilitude” asserts doubt, making identity into appearance. He later explicitly associated the imagination with powers of intelligibility, but not truth, when he commented, “This mechanical doctrine was considered as so just that several of the earlier observers with the microscope attempted to discover these [illegible] in acid fluids; and here were not wanting some who carried their imagination so far as to believe they had actually seen them” (Philosophy of Experi-
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mental Chemistry 10). In stressing the limits of how far one could and should carry the imagination, Davy was not trying to eliminate it but rather to warn against mistaking intelligibility for claims about things.

His suspicion of imagination was intensified by the fact that he could not do without it. In a letter to Thomas Poole, Davy claimed to be “a lover of Nature, with an ungratified imagination” (“Letters” May 1803). Presumably, the ungratified state of his imagination is what continually orients him to the scientific study of nature, a point underscored in his “Introductory Lecture for the Course of 1805” when he announced that “the works which awaken the imagination and exalt the feelings have preserved all their effect upon the mind” (Works 8: 162). Again, imagination is what entices, and has effects on, the mind. Speaking in 1810 of nature’s “infinite diversity of forms,” he notes their powers to “haunt the imagination as sources of the magnificent and the beautiful” (Lecture Notes HD/3/B/9, lecture 10, page 166). Imagination here endows the diversity of nature with a special quality whose haunting drives scientific inquiry.

Historians of science have been embarrassed by Davy’s imaginative speculations, his presumptuousness, but his thinking about the imagination is more careful than is acknowledged. He articulates an initial position that seems hostile to the imagination, commenting, “For experiments alone constitute the strength and vitality of our philosophical arrangements; these are things themselves whereas even the most perfect hypotheses are but as shadows of things” (Works 8: 317). Hence, Davy chides Dr. Black because his “ultimate particles or atoms are mere creatures of the imagination” (9: 363), and this meant that imagination needed corroboration of some kind. Davy even considered that a research program might even cure an unhealthy imagination: he wrote that “the pursuit of experimental research . . . may destroy the diseases of the imagination, owing to too deep a sensibility” (2: 326).

Davy knew no German; he had learned about Kant from his reading of F. A. Nitsch’s 1796 A General Introductory View of Professor Kant’s Principles Concerning Man, the World, and the Deity (Levere, Affinity 29) and thus may owe this understanding of the imagination to Nitsch’s version of Kant. Nitsch rehearsed Kant’s claim about the reproductive imagination, “which reproduces what has been connected and collected, in order that the immediately preceding affections may be annexed to those immediately succeeding; and for this reason this act may be called a synthetical act of the reproductive imagination” (76). By “reproductive,” Kant indicated the ways in which imagination synthesized collected data and limited the work of imagination to the passive offices of collection and synthesis. Nitsch does not discuss Kant’s more creative imagination, the productive one, and when Davy makes “the food of the imagination” the senses, he too is
limiting the imagination to reproductive work rather than creativity. Instead of
embODYing synthesis spontaneously in the way Kant suggests, Davy’s idea of imagi-
ation makes it the catalyst to such synthesis through analogy. Davy wrote,
“The chemical enquirer cannot enter like the poetical enthusiast at once into the
middle of his object and make the results of observation subservient to an exalted
imagination. He must begin by using coarse and material instruments” (Lecture
Notes, HD/3/A/4, lecture 4, page 103). Having closed the door to the enthusiastic
imagination, Davy then argues, “He must witness their effects, trust wholly to
sensible results and [list?] all prime analogies” (ibid.). The imagination nonethe-
less can help see analogies that may be fruitful.

Immediately, however, Davy qualifies his resistance to the imagination, ac-
knowledging it to be indispensable to discovery. He writes, “In making this dec-
laration, it must not be supposed, however, that I am arguing generally against
conjectural inferences, or attempting to prove that the imagination ought to be
passive in physical research. This would be giving up a noble instrument of dis-
covery; for analogy is in science what the blossom is in vegetation, beautiful and
replete with promise, and may ripen into useful fruit” (Works 8: 317). Davy recog-
nizes the value of the imagination in generating conjectures and analogies that
will provide fodder for experiment—crucially, the fruits of imagination must
“ripen”—but only insofar as he instrumentalizes it into a means of discovering
something that will later be proven to be real. In his 1806 “Bakerian Lecture”
titled “Some Chemical Agencies of Electricity,” he spoke of how the “imagining
[of] a scale of feeble powers” would help “account for the association of the insol-
uble metallic and earthy compounds” (5: 55). Accounting generates possible ex-
periments. Davy again connected the imagination to the operationalization of
experiment in his letter to Reverend E. D. Clarke of 1816. While trying to repli-
cate the mineralogist’s results, Davy wrote, “I cannot imagine an advantage from
using Nitrate of Barytes” (“Letters”). He then inquired whether the reverend was
sure his barytes was pure. The experimenter must imagine the substances and the
means that will provide the most advantages. In his experiment on nitrous oxide,
moreover, he remarked that it “appeared to act as a diuretic, and I imagined that
it expedited digestion” (Davy, Works 3: 141). Properly used, the imagination spec-
ulates and brackets its claims in terms of speculations that must be confirmed by
experiment. Of course, it was his ability to imagine the voltaic pile as the instru-
ment for pulling apart compounds that helped him to make so many discoveries.
He also had to imagine how to refine it, and he used more purified materials as
well as more expensive platinum wires to increase its power (Golinski, Experimen-
tal Self 109).
In making the imagination the source of analogy, Davy indirectly credited it for allowing him to unify previously distinct kinds of matter in a “unified, cross linked pattern” (Levere, Affinity 40). And, indeed, Davy fervently hoped to unify the basic forces of matter because that bespoke God’s infinite wisdom. His 1809 “Electro-Chemical Lectures” announced, for example, that although electricity and chemistry “appear to be separate & distinct, [they] are scions from the same stock, [and] when profoundly examined, are discovered to have a common origin and to be governed by analogous laws” (Lecture Notes HD/3/A/1, page 32). While analogy, then, provided some inkling of unity, dynamism reinforced that unity. By his third lecture in that series, he asked, “But are these electrical energies or attractions of bodies and the chemical affinities coincident in force?” (“Electro-chemistry” HD/3/A/3/4, page 79). If proven true, then physics and chemistry could be united by the study of force.

In an 1822 paper, “On the State of Water and Aeriform Matter in Cavities found in Certain Crystals,” published in the Philosophical Transactions, Davy again connected the imagination to analogy. “The imagination is excited by the magnitude of the operations [of nature during the earth’s history], by the obscurity of the phenomena, and the remoteness of time at which they occurred; and all the intellectual powers are required to be brought into activity to find facts or analogies, or to institute experiments, by which they may be referred to known causes” (Works 6: 207). Prompted by the excitation of the imagination, then, the intellectual powers work either to find facts or analogies that will provide the basis for future experiments. Davy wrote in a notebook entry dated 1816–21, “May it not be imagined that the monads or spiritual germs which animate or create organic frames, have no relation to space, and pass from system to system wholly unlike matter, which is limited to its own gravitating sphere. Is not light the first envelope of the monads, and may not my earliest hypothesis be true?” (“Notebooks” 119). Even at the end of his career, when he wrote Consolations in Travel, Davy insisted, “With respect to the higher qualities of intellect necessary for understanding and developing the general laws of the science [of chemistry], the same talents are required for making advancement in every other department of human knowledge . . . The imagination must be active and brilliant in seeking analogies; yet entirely under the influence of judgment in applying them” (9: 366). So long as imagination remains under the discipline of judgment, it can remain active and brilliant. Moreover, the analogical powers of imagination allow natural philosophers to group phenomena together so that they build upon on another and demonstrate the unity within multeity of the world.

As the above examples show, awareness of the imagination’s limits could lead
to more effective forms of discipline. In an April 1799 letter to Davies Giddy, the engineer who recommended Davy to Thomas Beddoes for his Pneumatic Institute, Davy commented, “The supposition of active powers common to all matter, from the different modifications of which all the phenomena of its changes result, appears to me more reasonable than the assumption of certain imaginary fluids alone endowed with active powers, and bearing the same relation to common matter, as the vulgar philosophy supposes spirit to bear to matter” (“Letters”). Here “imaginary” paradoxically helps him distinguish between warranted and unwarranted supposition.

In his 1810 “Researches on Oxymuriatic Acid,” published in the *Philosophical Transactions*, Davy develops how imagination can remain part of the experimental process. These experiments were part of his campaign to disprove Lavoisier’s assumption that acidity was dependent upon oxygen. Lavoisier had derived “oxygen” from the Greek, meaning “acid producer.” Muriatic acid was extracted from sea salt (Goodstein 64), and Davy knew that adding oxygen to muriatic acid diminished its acid properties. Davy wrote, “When a solution of oxymuriatic acid in water is electrized, oxymuriatic acid and oxygen appear at the positive surface, and hydrogen at the negative surface, facts which are certainly unfavourable to the idea of the existence of hyper-oxygenized muriatic acid, whether it be imagined a compound of oxymuriatic acid with oxygen, or the basis of oxymuriatic acid” (*Works* 5: 295). Davy used Volta’s battery to decompose oxymuriatic acid into its components, and this is how he discovered chlorine and replaced the debunked phlogiston with hydrogen (Goodstein 78–79). By mixing oxymuriatic acid with water and by decomposing this mixture, Davy argues that hyper-oxygenized muriatic acid does not likely exist. But, to do so, he must imagine what the decomposed form of hyper-oxygenized muriatic acid looks like, and he imagines two forms of it, a compound and a basis from which oxymuriatic acid can be derived so he can refute their existence.

Davy carefully models how the imagination should be used in science and in the treatment of matter. His early research papers refer to the imagination to indicate an idea not yet demonstrated. In his experiments on nitrous oxide, for instance, he notes that Mr. Kirwan, “from the non-coincidence in the accounts [of the composition of nitrate of ammonia], has imagined that it is partly decomposable” (*Works* 3: 52). On the one hand, he praised Benjamin Franklin, “who conceived the bold idea of bringing lightening from the clouds, who first imagined that by pointed conductors charged electrical clouds might be made more harmless” (*Lecture Notes* HD/3/B/3/4, page 78). He thus credited the imagination as the source of the conception of one of the Enlightenment’s most famous experi-
ments. On the other hand, he chastises Ritter because “in some of his conclusions he seems to have followed the impulses of strong imagination rather than the results of observation” (85). He pits observation against impulse. Nonetheless he notes that “science is indebted to him for the invention of several happy combinations” (ibid.).

In the Romantic period, scientists debated whether heat was a substance (caloric) or merely a form of energy. Davy opens his lecture on heat by pronouncing, “I once had this idea. It satisfied the imagination; but, not the reason” (Lecture Notes HD/3/B/3/4, page 53). He elaborates, “If we suppose the [heat as] fluid and this fluid carries heat with it whence can its heat be derived; if we conceive it to be heat or light why should it be resolved into heat or light at the amount that it is strongly attracted by matter” (ibid.). Davy makes it clear that satisfying the imagination is easy and that reason is a much harder taskmaster. “The only use of an hypothesis is that it should lead to experiments” (“Electrochemistry” 100), he insists. Nonetheless, the imagination generates hypotheses that make possible the experiment. He warns that “the chemical enquirer cannot enter like the poetical enthusiast at once into the middle of his object and make the results of observation subservient to an exalted imagination. He must begin by using coarse and material instruments” (Lecture Notes HD/3/A/4, page 103). In sum, then, Davy enlists the imagination in aid of experiment but makes the outcomes of experiment the final arbiter of its value. Davy labels the exalting of the imagination over observation in terms of an excess of enthusiasm, a charge others lambasted him with in his early career.

Jane Marcet, the wife of Keats’s chemistry teacher and of whom Faraday had a high opinion, wrote an important and popular handbook of chemistry for women, Conversations on Chemistry, and was inspired to do so after having attended one of Davy’s courses (Golinski, Science as Public Culture 194). Framing instruction as a dialogue between Mrs. B. and her pupils, Marcet explained that the goal of chemistry was “to obtain the intimate nature of bodies, and of their mutual action on each other” (28). She instructed her pupils that the force of attraction could be calculated by figuring out the force that it took to separate compounds. And she emphasized that matter was held together by forces of cohesion and attraction. She explained that heat and electricity worked together to “exalt the electrical energies of bodies, and consequently their force of attraction facilitates their combination” (122). For Mrs. B., the imagination is a pedagogical tool that assists in intelligibility. For example, after listing the various material components of plants, she cautions her pupils, “You must not imagine that every one of those materials is formed in each individual plant” (295).
No treatment of dynamism in the Romantic period would be complete without looking into the career of Michael Faraday, inventor of the motor and discoverer of the magnetic field. Faraday is central to understanding why some scientists thought that the essence of matter was force. Trained as a bookbinder, Faraday got his start in science after having attended Davy’s lectures at the Royal Institution and having bound and indexed those lecture notes and given them to Davy. Davy was so pleased, he hired him initially as his assistant while on continental tour and later as his lab assistant. Crucially, for the purposes of grasping the relation of the history of matter to the imagination, Faraday thought of himself as both a “very lively, imaginative person, [who] could believe in the Arabian nights as easily as in the Encyclopedia [Britannica]” (cited in James, Michael Faraday 22), and insisted, “I must keep my researches really Experimental and not let them deserve anywhere the character of hypothetical imaginations” (Diaries 2: 184; cited in Levere, Affinity 86). “Experimental,” then, could not acquire any epistemic virtue, if the temptation to imagine were not always present. Matters were especially tricky, given that Faraday did not think the contemporaneous notions of electrical current were sufficiently precise.

Because of his self-professed imaginativeness, Faraday turns to experiment to counter the hypothetical imagination. However, experiment could not function as a cure-all. Faraday recognizes the imagination’s complexity when he refers to it while trying to parse the meaning of an experiment. Writing to Charles Daubeny, reader in chemistry at Oxford University, about his attempts to decompose water and thus deny its elementality, he stated, “I can imagine the oxygen leaving the hydrogen only because it from some cause or other is no longer in the relation of a supporter of combustion and if it be imagined to lose its power of combination with hydrogen, I see no reason why it should retain its power of combination with sulphur” (James, Correspondence 1: 405). Here, imagination is needed to understand what one is looking at. Part of the story I want to tell here is how Faraday shifted from thinking about magnetic lines of force—which became the field—as concepts and when he understood them to be physical things. As lines of force became material, what role, if any, did the imagination play? As we shall see, for Faraday, materiality begins as imagination, but this meant that the imagination had first to be properly disciplined.

Like so many scientists before him and in much the same way that Romantic critics link it with escapism, Faraday initially dismissed the imagination. In a recently discovered early essay dated August 1818, “On Imagination and Judgment,” Faraday wrote, “I may by Fancy led wander in the realms of Fairy land and see shepherds with their flocks, woods castles mountains of snow and as great a variety
as there are changes in the scene . . . This I consider the province of Imagination. It requires no exertion of the mind but naturally produces a considerable degree of sensitive pleasure” (Jenkins 52). Faraday thus equates the imagination with a kind of spontaneous and irresponsible reveling in the pleasures of sensation, and he contrasts the imagination with the rigorous labors of induction, an “operation of mind [that] produces no pleasure of sense but on the contrary a degree of pain owing to the necessary concentration of the mental powers to one object for a lengthen’d [sic] time” (53). He insists, it is because ratiocination is so difficult that there is an “almost universal inclination . . . to follow the airy whims of Imagination” (ibid.). Thus far, it would seem that never the twain of science and the imagination shall meet, and historicist critics of the imagination are right in their insistence that the imagination is about the dereliction of duty. However, Faraday cannot simply let go of the imagination because it works spontaneously and because it can be the source of knowledge production if disciplined. He comments, “There is a much greater difficulty in following up an idea which reason teaches us is for our benefit, than that which is spontaneously dictated by the imagination” (52).

Perhaps to deal with what Hume called the impotence of reason to motivate, Faraday immediately offers a definition of imagination that allows it to work symbiotically with judgment. He argues, “Still I consider that Imagination owes as much to judgement as judgement does to imagination. When a decision is made Imagination immediately enlists it under its banner to enrich and increase the extent of its operations. Altho’ the feeling arising from judgement is not a sensitive pleasure it is of a nobler kind” (Jenkins 54). In this formulation, the imagination is no necessary enemy to science because it works in concert with judgment. Indeed, Faraday sets them up to work chiastically: imagination enriches the extent of judgment’s operations while judgment enhances the imagination. While he is more reticent on the latter, he does credit imagination with extending the range and richness of a decision’s operations: its motivating powers. He concludes by praising the wisdom of the deity for requiring the same kind of exercise for the mind as for the body: “to drive away ignorance and superstition and to keep in proper bounds the delusive vapours of Imagination” (ibid.).

We can perhaps now piece together how Faraday thinks judgment can enhance the imagination by looking at his Friday Evening Lectures, published in the Athenæum. In the lecture of January 24, 1834, Faraday recounted a new law of electric conduction: “Suppose metals have a specific power of attraction for gases, totally different from chemical affinity; and second, by their peculiar condition of elastic bodies when mixed” (“Abstracts,” F/13/F(1), page 29). Such said Mr. Faraday “is my theory: everyone is, of course, partial to the child of his own imagina-
tion: and I have not after much pains, been able to see where this is deficient” (ibid.). His implication here is that because one is inevitably partial to one’s imagination when it produces its own theory, even more judgment than usual is needed when the theory is one’s own. Faraday’s preferred form of demonstrated judgment was epistemological modesty, and such modesty often took the form of labeling speculation as speculation and fact as fact, and especially so for one’s own speculations.76

As the above example indicates, Faraday invoked the imagination as a form of epistemological modesty. Just how important epistemological modesty was to Faraday can be seen in an 1819 lecture on matter where he declares his opinion that the electrical agency of matter “inclines to the immaterial nature of these agencies” (“Lectures on Chemistry” 507).77 Crucially, Faraday frames the immateriality of these agencies as an “inclination.” Nonetheless because he considered matter to be basically a network of forces, forces could paper over the not yet known properties of electricity.78

In the essay, Faraday struggles to make sense of what it means that as matter moves from solid to fluid to gas, “physical properties diminish in number and variety” (“Lectures on Chemistry” 505). Faraday’s implicit conclusion is that what we take as real properties are not in fact real. He goes on to write:

Nothing is more difficult and requires more care than philosophical deduction, nor is there any thing more adverse to its accuracy than fixity of opinion. The man who is certain that he is right is almost sure to be wrong, and he has the additional misfortune of inevitably remaining so. All our theories are fixed upon certain data, and all of them want alteration and support. Ever since the world began opinion has changed with the progress of things and it something more than absurd to suppose that we have a sure certain claim to perfection or that we are in possession of the acme of intellectuality which has, or can result from human thought. (“Lectures on Chemistry” 508–09)

Faraday here codifies the dangers of certainty and fixed opinions, and offers scientific epistemological modesty as a cure to them; moreover, he turns to imagination to signal that modesty. His claim that facts had saved him is here complicated by his recognition that the data itself was constantly changing, and therefore facts were changing. If facts change as the data changes, then doubt must prevail over ontology, but that doubt potentially will be overcome through future scientific work. In the 1820s Faraday, through a series of experiments, came to reject the idea that electromagnetism was composed of forces of attraction and repulsion, and instead he argued that it was made up of dynamic circular motion (Steinle,
Exploratory Experiments 235–37). Well aware of how little about electricity was actually known, he in 1834 warned, “We may imagine, but such imaginations must for the time be classed with the great mass of doubtful knowledge which we ought rather to strive to diminish than increase; for the very extensive contradictions of this knowledge by itself shows that but a small portion of it can ultimately prove true” (Experimental Researches 1: 288). Faraday thus employed “imagination” in order to bracket claims in terms of doubt.

Twenty years later, Faraday would underscore the imagination’s proper role in self education as the cultivator of doubt. In his “Observations on Mental Education,” he insisted, “I hold it as a great point in self-education that the student should be continually engaged in forming exact ideas” (Jenkins 207). He added, “I should be sorry, however, if what I have said were understood as meaning that education for the improvement and strengthening of the judgment is to be altogether repressive of the imagination, or confine the exercise of the mind to processes of a mathematical or mechanical character” (ibid.). “I believe that, in the pursuit of physical science, the imagination should be taught to present the subject investigated in all possible and even impossible views; to search for analogies of likeness and (if I may say so) of opposition—inverse or contrasted analogies; to present the fundamental idea in every form, proportion, and condition; to clothe it with suppositions and probabilities,—that in all cases may pass in review, and be touched, if needful by the Ithuriel spear of experiment” (ibid.). Faraday makes clear that exactness of ideas should not repress the imagination. Moreover, if the imagination is above all a faculty to be taught, it is not to be restricted to the realms of the possible and should even contemplate inverse analogies. Faraday highlights the uses of the impossible by invoking spear of the angel Ithuriel, because no falsehood can allegedly withstand the touch of this spear. He thus gives experiment mythical properties. In keeping with his epistemological modesty, however, Faraday insists that since ideas can take multiple forms and are to be “clothed” in suppositions: aesthetic embodiment is not to be mistaken for ontology.

Given his careful reflections upon the uses of imagination, it is no surprise that Faraday’s Diaries and published papers repeatedly show his reliance upon the disciplined imagination during experiment.79 While thinking up ways to strengthen the power of a zinc battery, Faraday decides to try amalgamated zinc. He writes, “It might at first be imagined that amalgamated zinc would be much inferior in force to common zinc, because of the lowering of its energy, which the mercury might be supposed to occasion over the whole of its surface; but this is not the case” (Experimental Researches 1: 306). Faraday’s “at first” brackets the imagination’s claims as provisional, granting them a necessary sell-by date. In another
instance, he considered imagined things as offering possibilities to be negated. He insists, “With all these precautions the results were the same: and it is thus very satisfactory to obtain the curved inductive action through solid bodies, as any possible effect from the translation of charged particles in fluids or gases, which some persons might imagine to be the case, is here entirely negativized” (1: 385). He also thought that if he could prove that “gravitation requires time,” that would, in turn, prove that a “physical agency existed in the course of the line of force” (Faraday’s Diary 2: 409). And yet the paradox remains that although imaginative speculation introduces the possibility of delusion, its speculations are not necessarily delusional, and, thus, without it, experimental advances are not possible.

In this way, imagination enables the discovery of physical truth. Commenting on Berzelius’s theory that heat and light evolved in cases of combustion, Faraday cautioned, “We may imagine, but such imaginations must for the time be classed with the great mass of doubtful knowledge which we ought rather to strive to diminish than to increase” (“Annotated Offprints,” F/3/C, paragraph 959). As late as 1859, while testing the relation of heat, electricity, and gravity, he wrote in his Diary: “Let us encourage ourselves by a little more imagination prior to experiment. Atmospheric phenomena favour the idea of the convertibility of gravitating force into Electricity” (7: 336). He adds, “Let the imagination go, guarding it by judgment and principle, but holding it in and directing it by experiment” (7: 337).

Having shown how Faraday carefully sought to partner imagination with experiment, I now return to the issue of dynamism. In his 1816 chemistry lectures, Faraday is unsurprisingly wary about claiming that forces are the essence of matter, but he is moving in that direction. On January 19, 1816, for instance, he told his peers, “Chemistry is the knowledge of the powers and properties of matter” (1). After describing the properties “generally considered as essential to matter; as extension, solidity, tangibility, divisibility, inertia & c,” he proceeds to acknowledge that “these essential characters, have however, been doubted by some, and even solidity in the common acceptation of the word, denied to matter” (3). Faraday sees essence as a problem and does not know what is its ground since ideas are inseparable from properties. Despite the articulated doubts of others, Faraday announces, “It would be improper however to pass them [the supposed essential properties] entirely unnoticed” (3). Although he admits, “We are able, in some degree, to form ideas of the properties of matter abstracted from itself; and we can discuss the phenomena of attraction or repulsion” (2), he recognizes the limitations of a force approach within chemistry, which cannot get to the individual properties of matter. He ends this discussion by talking about gravity as a property of matter, and by gravity he means attraction (7). While doing experiments in
which he tried to measure the effect of the strength of an acid on electrical voltage, he noted that the oxygen disappeared: “I have not yet had the time to examine minutely the circumstances attending the disappearance of the oxygen in this case, but imagine it is due to the formation of the oxywater” (Experimental Researches 1: 214). “Imagine” is the spur to a further experiment that will provide evidence supporting causality, the placeholder until he has the time to carry out those experiments. Sure enough, his next researches probe “the primary or secondary character of the bodies evolved at the Electrodes” (1: 218), either the hydrogen or oxygen.

As he deepens his experimental researches, Faraday licenses himself to evoke the imagination more positively because he has repeatedly shown his powers of self-discipline. He does so when he needs to imagine how far to extend the implications of his results. He argues, “The results connected with different conditions of positive and negative discharge will have a far greater influence on the philosophy of electrical science than we at present imagine, especially if, as I believe, they depend upon the peculiarity and degree of polarized condition which the molecules of the dielectrics concerned acquire” (Experimental Researches 1: 485). Although he imagines a future when this idea will sharpen research, he is at the same time careful to label his ideas as beliefs yet to be proven.

Faraday abandons the idea of atoms in May–June 1833 and then becomes a dynamist, adopting the centrality of forces of matter. Faraday’s discovery of electromagnetic induction in 1831 had raised the issue of how electromagnetic forces were propagated (Harman 73). An analysis of the shift between series 4 and series 5 of his Experimental Researches on Electricity helps explain why. In series 4, Faraday explored the increased conductivity of electricity when something was liquefied. In series 5, he takes on electrochemical decomposition. Whereas, in the former series, Faraday’s emphasis is on how solidity “chain[s] particles to their places, under the influence of aggregation” (1: 118), in the latter, he stresses forces, attraction, repulsion, and power (1: 143). He notes that “M. de la Rive considers the portions of matter which are decomposed to be those contiguous to both poles” (1: 139). One major objection Faraday has to atoms is how to understand the space between atoms that this theory requires. Contiguity, thus, is suggestive of continuous forces and is a denial of atoms, spaces, and the occult workings of action at a distance even as it substitutes contiguity for direct touching as the form of causality. Of course, contiguity is almost a kind of action at a distance that forces make palatable. The key shift occurs in paragraph 524: while attempting to entertain the cause of electro-chemical decomposition, “I conceive the effects to arise from forces which are internal, relative to the matter under decomposition—and
not external, as they might be considered, if directly dependent upon the poles” (1: 151). He then “supposes that the effects are due to a modification, by the electric current, of the chemical affinity of the particles through or by which that current is passing” (ibid.). He prefers his explanation because “the effect appears to be a natural consequence of the action: the evolved substances are expelled from the decomposing mass, not drawn out by an attraction which ceases to act on one particle without any assignable reason” (1: 155). He concludes that his theory based on forces “seems to me at present to leave nothing unexplained” (1: 156); after all, expulsion did away with the need to explain why attraction ceases. Faraday also thinks that electrical scientists have misunderstood the source of attractions. On the one hand, dynamism and forces thus offer complete intelligibility, leaving no mysterious entities like action at a distance to be explained. On the other hand, dynamism is a both supposition, not a claim of ontology, and a claim of proximity as action without distance.

We now come to the moment when Faraday considers “lines of force” to move from a concept to a physical entity. These “lines of force” become the basis for the magnetic field. Unlike Ampère, who thought that electromagnetic forces acted at a distance, Faraday turned to lines of force because their interactions with each other and with matter “gave rise to all electrical, magnetic, and electromagnetic phenomena” (Steinle, Exploratory Experiments 7). I have suggested that Faraday’s epistemological modesty prevents him from too readily making ontological claims. In his view, the ontological claim is a risk of immodesty, one that potentially undermines Faraday’s claim that he knows the difference between imagination and fact. In this light, imagination becomes central to the work of science because science is a continual process of improvement. As new data appears, and as facts shift, framing one’s ontological claims as imagined allows the caution of the scientist to reframe continually new data and facts in relation to the evidence. Early on, Faraday invokes the imagination when thinking about how to think about electrical and magnetic force. For instance, while explaining Arago’s magnetic phenomena, Faraday writes, “If a wheel be imagined, constructed of a great number of these radii, and this revolved near the pole, in the manner of copper disc each radius will have a current produced in it as it passes by the pole” (Experimental Researches 1: 34). Here the imagination creates an image that is useful for thinking, but Faraday does not mistake this image for actuality. In 1837, he explicitly states that “lines of inductive force and curves lines of force . . . are imaginary” (Experimental Researches 1: 39).

A comparison of his two published papers, “On the Lines of Magnetic Force,” published in the Royal Society’s January 1852 Philosophical Transactions, and
“On the Physical Character of the Lines of Magnetic Force,” dated June 1852, which he thought more appropriate for the more speculative *Philosophical Magazine*, is instructive. In the former paper, he underscores that “the term line of magnetic force is intended to express simply the direction of the force in any given place, and not any physical idea or notion of the manner in which the force may be there exerted” (*Experimental Researches* 3: 402). He concludes that paper, “The lines of force well represent the nature, condition, direction, and amount of the magnetic force” (3: 406). Here, his insistence on the lines as a form of representation makes them vectorial, and they do not amount to a claim of ontology, despite his use of the terms “nature” and “amount.” Just five months later in the second paper, Faraday explicitly brackets his claims about physicality as speculation and then proceeds to defend the value of speculation: “Though I value them highly when cautiously advanced, I consider it as an essential character of a sound mind to hold them in doubt; scarcely giving them merely as probabilities and possibilities, and making a very broad distinction between them and the fact and laws of nature” (*Experimental Researches* 3: 408).

One can thereby understand why the imagination would play such a key role in the ontologization of the magnetic field: it suspends them in doubt so they can earn their reality. Of particular interest is the fact that, rather than espousing the proverbial view from nowhere we have come to expect expected from science, Faraday insists on the soundness of his mind, which he demonstrates by emphasizing his doubts. Doubts are central to science, and, to the extent that the imagination can be used to enhance skepticism by bracketing as of yet unproven claims as opinion or speculation, it is not something for a scientist to fear. Indeed, insofar as Faraday refers to science as “a continual correction of ignorance” (Jenkins 210) and treats the imagination as the source of “doubtful knowledge” (see above), he renders science and imagination mutually reinforcing.

Faraday goes on to say that such speculations are “useful in rendering the vague idea more clear for the time, giving it something like a definite shape, that it may be submitted to experiment and calculation; but they lead on, by deduction and correction, to the discovery of new phenomena, and so cause an increase and advance of real physical truth, which, unlike the hypothesis that led to it, becomes fundamental knowledge not subject to change” (*Experimental Researches* 2: 408). What perhaps began as “delusive mists” that have escaped their proper bounds are now hypotheses, which themselves have no value until confirmed by experimental evidence, which transforms them into “real physical truth.” Readers of Shelley recognize that “shape” grants these lines a provisional materiality, one based not on any ontological claim but rather on claims of intelligibility.
Faraday elaborates, “The lines of magnetic force have not as yet been affected in their qualities, i.e., nothing analogous to the polarization of a ray of light or heat has been impressed on them. A relation between them and the rays of light when polarized has been discovered; but it is not of such a nature as to give proof as yet, either that the lines of magnetic force have a separate existence, or they have not; though I think the facts are in favour of the former supposition” (3: 412). Physicality is tied to supposition, and, until Faraday has evidence that the lines of force have qualities that are affected and that they take place in time, lines of force must remain vectors of imagination.

Faraday elaborates, “It appears to me, that the outer forces at the poles can only have relation to each other by curved lines of force through the surrounding space; and I cannot conceive curved lines of force without the conditions of a physical existence in that intermediate space. If they exist, it is not by a succession of particles, as in the case of static electric induction, but by the condition of space free from such material particles” (Experimental Researches 3: 414). Even when he comes closest to making a physical claim, Faraday brackets the claim of physicality by appearance and by conception. The lines of magnetic forces are to be explained by “the condition of space,” but what that means is not entirely clear. Previously, he had warned that, “in numerous case of force acting at a distance, the philosopher has gradually learned that it is by no means sufficient to rest satisfied with the mere fact, and has therefore directed his attention to the manner in which the force is transmitted across the intervening space” (3: 408). Faraday’s sense of the physical lines of force, then, means to supplement the idea of action at a distance and does so by shifting the attention from the actuality of the lines to understanding how the lines work across space. He thus argues that if he could prove whether lines of force require time, “it would show undeniably that a physical agency existed in the course of the line of force” (3: 409).

Temporality thus becomes a future arbiter of physicality, for he admits that “no relation of time to the lines of magnetic force has as yet been discovered” (Experimental Researches 3: 412). As expected, he then embarks on experiments that will help him show that lines of magnetic force do require time. He notes, for example, that “the simple disposition of the lines, as they are shown by iron particles, cannot as yet be brought into proof of such curvature, because they may be dependent upon the presence of these particles and their mutual attraction on each other and the magnets” (3: 412). Faraday, moreover, turns to imagination to render these lines physical, arguing, “If it be imagined for a moment, that the two polarities of the bar-magnet are in relation to each other, but whilst there is no external object to be acted upon they are related to each other through the magnet itself
...still it would follow, that upon the forces being determined externally, a change in the sum of the force both within and without the magnet should be caused” (2: 415). Only by imagining a relationality between the polarities does Faraday come up with a way of calculating a change in forces that would underscore their relation to time, and this relation proves their physicality.92

Faraday concludes this paper, speculating, “Whether it of necessity requires matter for its sustenation will depend upon what is understood by the term matter. If that is to be confined to ponderable or gravitating substances, then matter is not essential to the physical lines of magnetic force any more than to a ray of light or heat; but if in the assumption of an aether we admit it to be a species of matter, then the lines of force may depend upon some function of it” (Experimental Researches 3: 443). Imagination goes with matter when physicality demands the most careful speculation; magnetic lines are more readily understood as physical if we allow an assumption of imponderable matter like ether, a curious if capacious form of materiality that resists measurability.

As we have seen, for physicists and chemists, matter provided one of the most difficult subjects to distinguish between imagination and fact. As late as 1844, Faraday bemoaned “how little general theory of matter is known as fact & how much is assumption” (“Speculations”). Kant had dismissed the corpuscular theory of matter as Phantasie, and Faraday would concur. In “A Speculation touching Electric Conduction and the Nature of Matter,” first published in the February 1844 issue of the Philosophical Magazine and later printed as the last paper in his Experimental Researches in 1844, suggesting a last-minute addition, Faraday argued that “the word atom, which can never be used without involving much that is purely hypothetical, is often intended to be used to express a simple fact; but good as the intention is, I have not yet found a mind that did habitually separate it from its accompanying temptations” (Experimental Researches 2: 285).93 Here, Faraday rejects John Dalton’s terms “definite proportions” because they “were not expressive enough, and did not say all that was in the mind of him who used the word atom in their stead; they did not express the hypothesis as well as the fact” (ibid.).94 He later calls this an “extension of the atomic theory which chemists have imagined” (2: 287).

Part of the problem with corpuscularity is, what to make of the space between atoms, and does that space count as matter? Moreover, if action between contiguous particles were denied, then it would be necessary to credit space between the atoms to account for interactions between the particles (Harman 76). He queries, “For where is the least ground (except in a gratuitous assumption) for imagining a difference in kind between the nature of that space midway between
the centres of two contiguous atoms and any other spot between these centres? A
difference in degree, or even in the nature of the power consistent with the law of
continuity, I can admit, but the difference between a supposed little hard particle
and the powers around it I cannot imagine” (Experimental Researches 2: 290). His
theory of matter allowed it to be contiguous. He continues, “What thought re-
 mains on which to hang the imagination of an independent of the acknowledged
forces?” (2: 291). Thought provides a basis for imagination to speculate on physi-
cality. Forces become the essence of matter because they do not presume a noth-
ing as its basis, but even forces must be bracketed by speculation, making what-
ever essence they have subject to doubt and revision.

Because Faraday claimed to have been rescued from his imagination by facts,
it is crucial to recognize that his later insistence upon force as the very essence of
matter is, like Priestley’s, a result of his conviction that force is the only thing we
can empirically experience about matter, even though all we can see are force’s
effects. He argues in 1844, “We can know nothing about matter but its forces—
nothing in the creation but the effect of these forces—further our sensations and
perceptions are not fitted to carry us—all the rest which we may conceive we know
is only imagination” (“Syllabus” F/4/J/4, page 22). Effect of forces is the only thing
we can know, especially since effects are not necessarily equivalent to causes.

And yet if his empiricism was a key influence, so was his theology. Historian of
science David Gooding has shown that Faraday needs an active, almost vital sense
of force so that he can leave God in the universe. Gooding explains that Faraday
resisted understanding force as a mechanical equivalent to work because he con-
flated potentiality with exertion and the effects of those powers (“Mechanics ver-
sus Measurement” 11), and to think of force in terms of mere mechanism was
fundamentally incompatible with his theology. Like his mentor, Humphry Davy,
Faraday’s search for a unity of the forces in the world stemmed from his convic-
tion that a beneficent God worked through simplicity. In his early papers, he af-
firmed the identity of electricity and chemical affinity (Harman 34). In his Juve-
nile Lectures at the Royal Institution of 1859, Faraday took pains to demonstrate
the convertibility of chemical force into electricity and electricity into magne-
tism, and his ultimate aim was to show the “universal correlation of the physical
forces of matter” (Forces 87), one that spoke to the simplicity and elegance of the
designed universe.

Thinking about matter in terms of force had one additional advantage for
Faraday. Force not only allowed Faraday a way to conceptualize how the mind
works but also a way of negotiating the relationship of the human mind to physics,
giving them a common language. In his lecture “Observations on the Inertia of
the Mind,” given at the City Philosophical Society on July 1, 1818, Faraday sought to get to the bottom of “apathy of the mind” (“Observations” 340).97 After defining inertia as an “essential property of matter” (348), Faraday wonders whether it is a “never failing attendant on the mind” (348). He continues, “I hope it is for as it seems to be in full force whenever the mind is passive I trust it is also in power when she is actively engaged” (348). He then meditates on the “disturbing forces” that interfere with inertia:

The centripetal force, the force resulting from chemical action and that which originates in muscular exertion are at all times active in changing and varying the states induced by inertia, sometimes aiding, sometimes counteracting its effect. These are represented among intellectual beings by the sensations, perceptions, passions, and other mental influences which interfere (frequently so much to our inconvenience) in the dictates of our reason . . . So vanity, ambition, pride, interest, and a thousand other influences tend to make men redouble their efforts; and the effect is such, that what appeared at first an impassable barrier easily gives way before the increasing power opposed to it.98 (“Observations” 350–51)

“Force” is such a useful term for Faraday because it enables him to bring together forces like centripetal and centrifugal force—which cannot be merely mechanical—with sensation, perception, passion, muscular force, and other mental influences.99 Forces further allow human will and passion to interact with the physics of nature and, at times, to overcome them. And yet by labeling both industry and apathy forms of mental inertia, Faraday can think about them both as habits: “Both Idleness and Industry are habits and habits result from inertia” (352). In the same way that inertia is a force that seeks to maintain its state, habits are inertial, and so the key is to start off with the right habits because they are difficult to change. In the same way that physical forces require intervention or disruption, mental forces demand control capable of overcoming inertia. Faraday’s position regarding change, then, was fundamentally conservative.

Faraday would return to the relationship between internal and external force in his diary.100 While experimenting on various modes of electrical transmission on December 2, 1833, he noted, “Priestley was probably the first who put forth the view that Electricity is an important agent between mind and body in the animal system” (2: 177). Two weeks later, he considered how little electricity was necessary to effect frogs and mused, “How little required for mental Government” (2: 183). Although he was not convinced that “nervous fluid is only electricity,” he supposed that “magnetism is a higher relation of force than electricity, so it may
well be imagined, that the nervous power may be of a still more exalted character, and yet within the reach of experiment” (“Annotated Offprints” F/3/E, entry 1792). Indeed, on the back of his manuscript notes for his 1835–36 Juvenile Lectures on Electricity, Faraday wrote, “First chem force is electricity is magnetism is heat is nervous energy or like it” (“Royal Institution Lectures” back of A34).

Romantic theories of matter thus undermine the notion of nature as an unchanging constant. The idea of nature as fixed is useful to a socially constructionist theory that works by moving entities from the category of nature to that of culture so that it can be changed. That nature was understood dynamically meant that it stood on the side of change instead of against it. Moreover, because thinking about the active forces in matter had consequences for how human beings are to act, the forces of matter resonated with imagination. On the one hand, the forces of nature can become human agency. This allows for a seamless integration of humanity and the environment, but at the expense of nature’s force being annexed to mankind’s. On the other hand, the difference between human force and matter’s force is the ground for agency, an especially vexed ground, given that force was often granted an activeness of its own.

**PERCY SHELLEY: IMAGINING THE DYNAMIC FORCES OF MATTER**

I have argued that Romantic theories of matter ultimately made the synthesis of imagination and matter possible. Long understood to embody a tension between science and the imagination, Percy Shelley’s 1820 “Letter to Maria Gisborne” offers a test case that allows me to first show how matter and the imagination are unified and then, second, to think about why this alleged tension has been so useful to Romantic criticism.101 Don Reiman and Neil Fraistat, two of Shelley’s most gifted editors, curiously remark that “running through [the poem] is a strong unifying theme contrasting mechanical and scientific knowledge with the magical powers of the imagination” (Shelley’s Poetry and Prose 329). I contend that Shelley makes no such stark contrast. When matter is no longer assumed to embody presence and instead, through an interaction of forces, makes solidity matter’s appearance, figurative language can no longer be credited with automatic skepticism about unity and presence because Romantic thought about matter is equally and already skeptical about forms of presence. If Shelley’s detractors like F. R. Leavis complained of the poet’s “weak grasp of the actual” (206), I want to underscore that critics have had an impoverished understanding of what Shelley thought of as actual. For instance, Shelley’s critics have generally accepted that in 1812 when writing “On a Future State,” the poet renounced materialism. He wrote,
"For when we use the words principle, power, cause, &c., we mean to express no real beings, but only to class under those terms a certain series of co-existing phenomena; but let it be supposed that this principle is a certain substance which escapes the observation of the chemist and the anatomist. It certainly may be; though it is sufficiently unphilosophical to allege the possibility of an opinion as proof of its truth" (Ingpen and Peck 6: 208–09). Far from a renunciation of materialism, Shelley insists that the principle may be a substance. His concern is epistemology, not ontology; classification, but only as a way of thinking. What he objects to is the offering of an opinion as evidence. Moreover, in grouping terms like “principle,” “power,” and “cause” under phenomenality, Shelley maintains his interest in epistemology by arguing for a way of thinking about materiality that resists equating appearance with reality. As I will demonstrate here, Shelley considers matter in terms of forces, because forces are what give matter whatever phenomenality matter has for us, and, in thinking about matter in terms of forces, Shelley also transforms perdurability into phenomena that mask the inevitability of change (thus his use of “brief omnipotence” to refer to Jupiter’s reign in Prometheus Unbound). Forces furthermore enable him to think of the world in terms of multiple centers of interacting forces that downplays the role of the self. The alleged tension between the creative imagination and science has served to make creativity the province of the arts, not the sciences, with the result that theories of matter have not been seen as essentially creative and, thus, a response to concepts of matter that resist change by bringing matter in line with change.

Like Anna Laetitia Barbauld’s “An Inventory of the Furniture in Dr. Priestley’s Study,” Shelley’s “Letter to Maria Gisborne” centers on Henry Reveley’s study, filled with scientific and engineering instruments. Shelley insists on the geographic gap between Henry and him, Henry being in London, and Shelley in Italy. However, Shelley’s thinking about matter in fact ultimately allows us to reconcile science and poetry, not to mention matter and the imagination. In fact, in response to Henry Reveley’s Friday, November 12, 1819, description of the casting of the steam cylinder and air pump that Shelley had helped to pay for, Shelley wrote, “Your volcanic description of the birth of the Cylinder is very characteristic of both you & of it. One might imagine God when he made the earth, & saw the granite mountains & flinty promountories [sic] flow into their craggy forms, & the splendor of their fusion filling millions of miles of the void space, like the tail of a comet” (Jones 2: 158). In the above letter, Shelley’s imagination made no such division between science and art, and in fact Reveley’s casting of the cylinder immediately prompts the poet’s imagination to generate metaphors for the creation of the world, thereby connecting even godly engineering, human engineering, and poetic mak-
ing. Henry had come up with an idea to create a steamboat to ferry passengers between Leghorn, Genoa, and Marseilles (Jones, *Maria Gisborne* 7).

Let’s begin our brief examination of “The Letter to Maria Gisborne” with Shelley’s fascination with quicksilver, or mercury.105 As liquid metal, it symbolizes “Proteus transformed to metal” (line 45). Humphry Davy had in his 1812 *Elements of Chemistry* noted mercury’s ability to “combine with most of the common metals” and warned of its volatility (*Works* 4: 330). Already harnessed for use in scientific instruments, quicksilver precedes Shelley’s catalogue of “scientific instruments” (lines 82–83), and thus mercury literally has a unifying function, drawing together scientific instruments and the poet’s measured “catalogiz[ing] . . . verse” (line 55). Shelley recognizes that matter embodies similar Protean possibilities as figurative language, so much so that “Tubal Cain” (line 51), regularly cited in the period as the first chemist, and all his brood, are “puzzled” by the various shapes of wood and brass in Reveley’s study. Boerhaave’s *Elements of Chemistry*, for instance, named Tubal Cain as a cultivator of the “art of metallurgy,” a branch of chemistry (1: 5). Boerhaave not only treated chemistry as a practical art, not science, thereby closing the gap between Reveley and Shelley, but he also noted that the etymology of “chemistry” alludes to mystery, the occult, and magic (1: 5). Shelley’s reference to books of old chemistry (line 99) further reminds us that chemistry begins with the study of alchemy, the transmutation of baser metals into gold, which in turn reminds us that the history of chemistry and of magic are intertwined, not separate.106 Once again the magic powers of imagination belong to science and to art, even as chemistry belonged to both. Like Henry, who is working on the steamboat, Shelley floats a paper boat in the ocean of mercury. If matter has all the plasticity of figurative language, then Shelley has no need of figures to undermine the presence within matter, and Shelley’s ability to deconstruct matter and language here through scientific knowledge prevents creativity from being the lone province of the arts. Shelley writes:

> And in this bowl of quicksilver—for I
> Yield to the impulse of an infancy
> Outlasting manhood—I have made to float
> A rude idealism of a paper boat—
> A hollow screw with cogs—Henry will know
> The thing I mean and laugh at me

(lines 74–77)

Not only does Henry’s making prompt Shelley’s making/engineering of a paper boat, but also these acts of construction prompt the making of the poem. The “hollow screw with cogs” refers to Archimedes, mentioned in line 16, who in-
vented a screw that scoops up a volume of water. Thus, Shelley weaves a genealogy of making from Archimedes to Henry to himself, one that disperses action along the continuum of history. Like Archimedes, who invented the screw to pump out ships and keep them afloat, Shelley floats his idealism on mercury, known for its healing powers. In comparing himself to this bowl of quicksilver, and in connecting the protean nature of this metal to the childish, even infantile, impulse that he allows to drive him (the verb “yield” insists on deliberation, as does its trochaic substitution), Shelley juxtaposes quicksilver’s affinity to other elements to his intentional state, further preventing any separation of imagination and science. One might even say that the quicksilver prompts the poet to create the “I” who yields as a virtual epiphenomenon out of an impulse that is close to the physics of action. At the same time as the genealogy across time insists, this “I” is just a node of action, and thus selfhood is limited.

Shelley further joins together the forces of moonlight (lines 255–56) and his thoughts. “I recall / My thoughts,” Shelley intones, “and bid you look upon the night. / As water does a sponge, so the moonlight / Fills the void, hollow, universal air—” (lines 253–56). Moonlight fills the void, as water fills the sponge and thoughts fill the air. Yet in framing the act of looking in terms of simile, Shelley’s emphasis is on apprehension, not ontology. Moreover, the poet’s thoughts fill the “universal air,” and the very universality of that air forges an interactivity between poet and engineer. “Universal air,” moreover, recalls Newton’s ether, both the vehicle through which God’s forces acted from a distance and one key limitation of the atomic theory of matter. But Shelley’s theory of dynamic matter has neither need of an ether nor of a God behind it because there is only continuous interaction of matter. Shelley thereby both gives thought material form and allows it to interact with the things of this world since it shares a dynamic material force. To highlight Henry’s and the poet’s essential unity despite the geographic distance, Shelley concludes the previous verse paragraph with a list of the people “you and I know in London” (line 253).

This image of thought as a force like moonlight prepares the way for Shelley’s self-description as “some weird Archimage sit I, / Plotting dark spells, and devilish enginery, / the self-impelling steam-wheels of the mind” (lines 106–08). Spenser, we recall, linked Archimago to science: “For by his mightie science he could take / As many forms and shapes in seeming wise, / As ever Proteus to himselfe could make” (book I, canto II, lines 11–13). Archimage understands matter in terms of forms and appearances—hence he embodies “image”—and thus unites mercury, Proteus, and science, and perhaps even the self-impelling quality of the poet’s mind insofar as “Proteus to himself could make.” Self-impelling indeed: Joanna
Picciotto argues that Spenser’s Archimage functions as a trope of iconoclasm, itself generating narratives to fix the problem of signs hoping to be signifieds (19). In this way, the poet produces representations always subject to self-correction, much in the way that a scientific method tries to redeem itself from error. Far from being the opposite of poetry, physics gives Shelley ways of thinking about what thought actually was; and the fact that Reveley’s engine works through steam collapses the gap between the poet’s mind and machine, since, as John Tresch argues, steam engines look self-propelled, as if alive (12). When the poet refers to Coleridge’s mind in terms of an “Intense irradiation of a mind/Which, with its own internal lightning blind” (lines 204–05), he once again uses metaphors associated with scientific force to think about thoughts and their physical means of influence.

Irradiation is the power of giving off rays, and this recalls the forces of moonlight entering the atmosphere. Unlike Coleridge’s thoughts, which are reduced to a kind of mind-blinding internal lightning, Shelley makes his thoughts like ether and light, illuminating the world. To underscore the union of Shelley and Reveley, he describes the “communion” (line 145) of the two of them, and Shelley recalls how Henry “listened to some uninterrupted flow/Of visionary rhyme, in joy and pain/Struck from the inmost fountains of my brain” (lines 168–70). Shelley’s enjambment allows Henry’s listening an immediate connection to the poet’s brain through rhyme, and along with them the “you” and “my” become a “we” (lines 167, 169, and 170). The bottom line is that there is no gap between science and imagination, and the poet’s turn to force additionally allows him to unify thought and matter insofar as his brain is a self-impelling engine whose light irradiates the earth. Shelley knew that alchemy and magic were furthermore an undisputable part of chemistry’s past—even the great Newton was an alchemist—and Shelley limits neither creativity nor magic to the artistic imagination.

In *Prometheus Unbound*, Shelley continues to describe matter in terms of the forces within it, not in terms of its hardness or pedurability or extension. Matter thus participates in change instead of being an obstacle to it. Earth is, after all, one of the major characters. For the poet, matter is a force that acts in the world: the poet’s repeated use of “whirlwind” (lines 44 and 66) to describe matter underscores his dynamic understanding of it. Shelley emphasizes this dynamic understanding through his insistent use of “radiant” to modify forms of matter—which Humphry Davy defined in 1812 as a fourth state of matter, and which he thought was imponderable or immeasurable—thus giving them an equivocal materiality. All bodies, many chemists and physicists thought, “radiate” light and heat, and sometimes light without heat. Newton thought that the ability to radiate heat or light depended upon the exact arrangement of particles in matter. Asia de-
scribes the “radiant looks of unbewailing flowers” (II.4.16), the spirit of the hour describes the “radiant forms” of the earth (III.iv.155), and Ione mentions the “radiant air” (IV.239). But does the source of radiating power come from the sun, from an undulating elastic substance (Davy, *Works* 4: 157), or from the matter itself? The very category of radiant matter frustrates an easy answer because it acts; moreover, radiant matter implies a matter whose very essence is the dynamic force within it.

Humphry Davy thought that, in radiant matter, “the particles act almost independently of the common laws of attraction” (*Works* 4: 157–64; Grabo 110), indicating his sense of heat and light as vibrations in the particles that made up the body. The category therefore fudges the source of the radiance and grants matter a kind of strategic activity; Shelley suggests the active forces in matter are both the source of the rays and the reason why we can know matter only as form or appearance. No wonder why radiant matter had been the subject of much imagination: Davy noted that scientists had “imagined” an “imponderable substance capable of producing light” existing in “inflammable bodies” (*Works* 4: 163). He did think that “the calorific particles of terrestrial bodies . . . may be imagined as larger than those of the sun” (4: 164).

Within the drama, Prometheus identifies the source of matter’s radiance as hovering between mind and reality. When imagining the cave in which he and Asia will be reunited, Prometheus insists:

> And lovely apparitions dim at first,
> Then radiant—as the mind, arising bright
> From the embrace of beauty (whence the forms
> Of which they are the phantoms) casts on them
> The gathered rays which are the reality—

(III.iii.49–53)

These lines ostensibly frame the mind as the source of radiance, as well they should insofar as Prometheus is imagining this radiance. And yet, the grammatical ambiguity of the first two lines confuses the actual source, as does Shelley’s invocation of “the reality.” Apparitions are initially the grammatical subject of the lines, but these are displaced by the mind, which does the casting. And yet if the “gathered rays” are the reality, what is apparition, and what is form, and phantom? Shelley’s framing of the mind within dashes further supports a separation of apparition and mind, as does the additional ambiguity of “gathered.” Do the rays gather by themselves, or are they gathered by mind into radiance? Davy notes that optics was one of the main ways to study radiant or electrified matter because it was
speculated that the undulations of the ethereal substance beneath radiant matter “constitute the sensations of vision” (Works 4: 157). It turns out, then, that “appa-
rition” and “rays” point to the same reality of electrified or radiant matter. Stuart Curran argues that Prometheus’s forgiveness of Jupiter enables the entire cosmos to turn because the recalling of the curse ends the cycles of violence (96). The turn of the cosmos can likewise enhance the radiance of the mind, and this interaction is through the medium of the rays. When Shelley describes the rays as “lovely,” he associates them with love, and the adverb aligns them with active force.

In any case, Shelley’s insistence on the phenomenality of matter itself speaks to the forces that inform it, even as mind and matter now have a possible means of interaction. Shelley’s love of such terms as “inter-transpicuous” and “inter-penetrates” to describe matter, moreover, insists on the spaces within matter that provide homes to the various electromagnetic forces of the universe. Both the sun and moon are porous: sunlight has pores, and the moon insists “love and odour and deep melody” work “Through me, through me” (IV.i.331). Impenetrability thus is at best a form of matter’s appearance, a consequence of the forces. Here, of course, Shelley’s insistent “throughs” put to bed the alleged impenetrability of matter even as “home” resists ontologizing the forces as presence since it is a mere container. This force takes on many forms: Shelley’s preface casts Prometheus as “the patient opposition to omnipotent force” (Reiman and Fraistat 207): we learn as the play unfolds that Jupiter’s force only “seems Omnipotent” (IV.572). Shelley’s universe teems with other forces: electricity, magnetism, light, ether, and—even and especially, understood most literally as—the planetary attraction of Venus for other planets. Prometheus has to learn that those forces are capable of countering Jupiter’s force, just as Jupiter must learn not to believe in his own omnipotence, since his force is both brief and hardly the only game in town. In his early essay “On Love,” Shelley claims that love “is that powerful attraction towards all that we conceive or fear or hope beyond ourselves when we find within our own thoughts the chasm of an insufficient void and seek to awaken in all things that are a community with what we experience within ourselves” (Reiman and Fraistat 503). Curiously, “love” straddles the internal and external: now an external force, now a state of mind or emotion. It is an attraction whose force we first encounter when we experience the void within our own thoughts, and thus it seems external to us. Nonetheless, since this void prompts us to awaken a wider community, the force of love is simultaneously part of us. When love is considered a force, it can challenge tyranny, and Shelley’s figures love as having eyes that are “veiled not” (IV.i.92). Shelley also links love to a force when he describes it as “Forcing Life’s
wildest shores to own its sovereign sway” (IV.411). His initial trochaic substitution enacts that very force. By making love own its own sovereignty, Shelley reminds us that love without power and ownership is feckless.

Equating the forces of attraction with love allows Shelley, in keeping with scientific sensibility, not to assume that the material and moral are separate entities. Like his friend Humphry Davy, speaking as Philalethes in his posthumously published Consolations in Travel, Shelley would anticipate Davy’s speculation that “love is the creative principle in the material world” (Works 9: 346). Philalethes sees “in all the powers of matter the instruments of the deity” (ibid.). Unlike Philalethes, who connects love to the divine and limits it to a “divine attribute” (ibid.) so he does not have to believe in a materialism that endows matter with “irritability, ripening into sensibility” (9: 345–46), for Shelley the material is spiritual. Panthea explains to her sister, Asia, that “Love, like the atmosphere of the sun’s fire filling the living world, Burst from thee, and illumined Earth and Heaven” (II.v.26–28). Love is like fire, sun, heat, and light, where “like” functions not so much as a form of linguistic deferral but rather as an attractive spatial force linking all things. The simile marks relationality and, more specifically, relationality as the closest possible claim to ontology. Quite literally so: love is the source of radiance, electrifying matter. Like Newtonian ether, and like the Higgs boson, the field that explains why matter has mass, Shelley’s love surrounds, interpenetrates, and fills the world (I.i.660). It fills receptive subjects, at once animating subjectivity with objective force. Crucially, however, the mere presence of forces does not dictate triumph: one obstacle is that it must be perceived, felt, and understood to have effect on humans; it must also earn its subjectivity by being taken in, and owned, as part of the self, only then to be redispersed through the world.

Read with an emphasis on Shelley’s understanding of matter as the product of active forces, Panthea’s famous vision of “ten thousand orbs involving and involved” no longer serves merely as a feckless visionary symbol but instead embodies the world, of which Prometheus is only an inextricable part. Shelley’s insistence upon “involved” and “involving” unifies subject and environment, making escapism impossible: one has no choice but to remain involved. Although Panthea describes it as “solid as chryystal” (IV.239), Shelley comments that “through all its mass/Flow, as through empty space, music and light” (IV.239–40). “Chryystal” perhaps also alludes to the theory that even minerals were informed by a principle of organization. The poet’s emphasis on flow underscores his dynamic understanding of matter, whereby solidity is the outcome of those forces. The spheres are further
Yet each intertranspicuous, and they whirl
Over each other with a thousand motions
Upon a thousand sightless axles spinning
And with the force of self-destroying swiftness,
Intensely, slowly, solemnly roll on—

(IV.246–50)

All of this simultaneous spinning intensifies forces that continually destroy each other, but this destruction both frustrates tyranny and enacts what earth calls “the animation of delight” (IV.321). Against a corpuscular version of matter that demands one center of force, this universe has multiple centers that demand an ecological understanding of force (it radiates in multiple directions). Matter is continually changing, if slowly, and when Panthea twice calls these forces light, she insists on how love and light penetrate matter and thus change its perdurable appearance. The last line’s three adverbs remind us that what looks like a noun is in actuality a verb even as love’s revolutionary attractions and repulsions dynamically pit continuity—they “roll on”—against discontinuity (they are “self-destroying”). In this view, love is revolution, and thus the hour of love cannot replace the hour of revolution, as Earl Wasserman influentially argued (Shelley 325), because they are two sides of the same thing.

If force helps Shelley both to understand the appearance of matter and to think of it as analogous to the mind so the two can interact, it also provides him with a key analogy for understanding the relation between imagination and matter. And yet, no mere figure, analogy functions for Shelley as an embodiment of both the principle of attraction between discrete entities (Bruhn, “Shelley’s Theory of Mind” 403) and a principle of mind, but one that is open to development (382, 406). Analogy thus offers evidence of a probable material interconnectedness between seemingly different things. Shelley in fact explicitly compares the attractive forces within the principle of psychological association to those of gravity. He argues imagination may be considered

as mind combining the elements of thought itself. It has been termed the power of association; and on an accurate anatomy of the functions of the mind, it would be difficult to assign any other origin to the mass of what we perceive and know than this power. Association is, however, rather a law according to which this power is exerted than the power itself; in the same manner as gravitation is the passive expression of the reciprocal tendency of heavy bodies toward their respective centres. Were these bodies conscious of such a tendency, the name which they would assign to that consciousness would express the cause of gravitation; and it were a vain inquiry as to what might be the cause of that cause.
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Association bears the same relation to imagination as a mode to a source of action. (Ingpen and Peck 7: 107)

Imagination is the source of combinations of thought, and those combinations are bound by love. Similarly, matter is beholden to the law of gravitational force and thus also bound by love. Demogorgon in fact connects gravity to love when he describes the earth’s orbit in terms of “the Love, which paves thy path along the skies” (IV.522). Here, the forces of attraction pave the planetary orbit, as if an orbit can be paved in the sky. In the same way that matter needs gravity, Shelley argues that the imagination is bound by the law of association, which itself recognizes reciprocal attractions between distinct entities. Once again dynamism asserts multiple centers of action that interact, thereby insisting upon ecology.

Consciousness, however, imposes this key difference from matter: it makes association a law, not the power itself, in the same way that gravitation is a passive expression of reciprocal attraction. If bodies could be conscious of such a tendency, then this consciousness would provide the name of the force that expresses the cause of gravitation. Gravitation as force looks like a cause, but that is really a painted veil with another cause behind it. The poet’s distinction between a law and a power captures the ambiguity of force insofar as force both attracts and impels, bringing out a distinction between what is self-willed and what is coerced. Although framing association as a law would seem to demand coercion even of consciousness, the actual forms of association are not dictated, but rather the tendency to attraction is. That Shelley thinks there is a cause behind the cause of gravitation suggests that he is looking for an active cause behind gravity, and this active cause is proximate to an intentional state or emotion like love. Where Newton hypothesized God, Shelley argues that this force is what we know as love: “There is no attribute of God which is not either borrowed from the passions and powers of the human mind, or which is not a negation” (Ingpen and Peck 6: 54).

To slightly modify Sharon Ruston: that the world teems with forces of attraction “creates the necessary environment in which life can flourish and regenerate itself” (Shelley and Vitality 125). Despite Jupiter’s tyranny, matter paradoxically through force retains the potential to encourage both love and freedom. Once Prometheus recalls his curse, the Chorus of Spirits chants, “And beyond our eyes/The human love lies/Which makes all it gazes on, Paradise” (IV.126–28). Human love is both objective, in that it exists beyond the eyes, and subjective, hinting that the beyond is also internal. And yet the eyes embody that love, which in turn makes the visible world paradise, and, fittingly, the word “paradise” becomes a pun on the pair of eyes that is love that makes the paradise.
Force provided Shelley with a useful way of distinguishing between the degrees of influence of different kinds of thoughts. In his “Speculations on Metaphysics,” Shelley argued, “Thoughts, or ideas, or notions, call them what you will, differ from each other, not in kind, but in force” (Ingpen and Peck 7: 59). He elaborates, “It has commonly been supposed that those distinct thoughts which affect a number of persons, at regular intervals, during the passage of a multitude of other thoughts, which are called real, or external objects, are totally different in kind from those which affect only a few persons, and which recur at irregular intervals, and are usually more obscure and indistinct, such as hallucinations, dreams, and the ideas of madness” (ibid.). Why does Shelley eliminate differences of kind when thinking about thoughts and notions and in their place put differences of degree of force? He could not have known what we know now: that the mind processes virtual reality through the same neural mechanisms as it processes reality. However, by making the key differences in degrees of force, Shelley has an explanation for why we act upon one idea or another, and, by eliminating differences of kind between these various thoughts, Shelley grants imagination the same kind of force as a perception. Imagination, thus, is both creative and reproductive, and this difference is no longer one of kind: the end result is an ultimate monism of force that frames the perdurability of matter as appearance whose essence is love.

Force thus enables Shelley to allow mind to interact with matter; moreover, he thereby endows the mind with a tendency to such an interaction. Force produces motion, and motion, following Kant, is what allows us to encounter matter in the sense of perceiving it and in the sense of providing the basis for the hardness we think we feel when we come into contact with it. That basis is the forces of attraction and repulsion. His understanding of forces may have come in part from his reading of the astronomer William Herschel, who described the heavens “yield[ing] to my light and power, resolv[ing] into stars” (Account 5–6).123 Herschel thus proudly announces the invention of a superior telescope that could subject the forces of the stars, and the ambiguity of his verb “resolve” allows perception to shape or, if “resolve” is taken as the precursor to action, precipitate the thing. The resolution of his telescope allows the stars themselves to resolve, and this description perhaps influenced Shelley’s presentation of Asia staring into Panthea’s eyes: Is she looking at the vision already there, or does she bring it into focus so that it can be seen (Sperry, Shelley’s Major Verse 97)? To the extent that the role of the visionary is perceptive, perception now is partly creative; the twin senses of “resolve” allow the object to shape the viewer just as much as the viewer shapes the object, leveling the power distinctions between them.
Together with the mind, the forces of the universe create a “chain of linked thought, of love, and might/to be divided not” (IV.395). Shelley’s line break reminds us that a lack of division is a future experience to be enacted by the reader. This chain further “compels the elements with adamantine stress” (IV.396), and here I simply point out that he shifts “adamantine” from the res extensa of matter to the forces within it: it is the stress that compels the elements to unify, and thus this stress is matter’s very formal if shifting essence. Such essence remains appearance, and form is what the human mind can know about things.

Shelley’s belief in the interplay between the force of imagination and the forces of matter may owe another debt to Herschel. In his paper *On the Nature and Construction of the Sun and Fixed Stars*, the astronomer warns that although the spots of the moon may look like cavities, they are in fact mountains. He writes, “As soon as, by the force of the imagination, you drive away the fallacious appearance of a concave moon, you restore the mountains to their protuberance” (10). Herschel grants imagination force, even as he describes the forces that shape the universe. More critically, instead of thinking about the powers of imagination as misleading perception, he credits imagination with being able to see the moon properly beyond the optical illusion. The imagination is what will allow people to “drive away the fallacious appearance” (ibid.): Herschel adopts it to make a scientific observation, because only the imagination can factor out the optical illusion from sight.

Such an animated understanding of matter is fully corroborated by Shelley’s speaker, Eusebes, in the poet’s “A Refutation of Deism.” Eusebes, a believer in divine revelation, confronts Theosophus, who justifies his belief in God through deism and the argument by design, which claims that the intricacy of the universe demands an intelligent designer. Eusebes argues, “Matter, such as we behold it is not inert. It is infinitely active and subtile. Light, electricity and magnetism are fluids not surpassed by thought itself in tenuity and activity; like thought they are sometimes the cause and sometimes the effect of motion; and, distinct as they are from every other class of substances, with which we are acquainted, seem to possess equal claims with thought to the unmeaning distinction of immateriality” (Ingpen and Peck 6: 50). Here force unites things and thought. In *Prometheus Unbound*, he refers to the fluids of light, electricity, and magnetism as forces (IV.249). In the “Refutation,” given that Shelley is refuting deism, he is more aligned with Eusebes than with Theosophus. For our purposes here, this quotation supports the fact that Shelley seriously thought of matter in terms of forces and that he analogized the subtlety of certain kinds of matter like electricity and magnetism with thought so that thought might have influence upon the world.
But we cannot lose sight of Shelley’s immediate goal in his essay. The animation of matter and the linking of thought with matter undermine deism because, if the forces within these kinds of subtle matter are like thought, then the hypothesis of a designer is superfluous. However, Shelley’s own atheism prevents him from siding completely with Eusebes, who turns to revelation to prove God. At issue here is what the activeness of matter means. Does the activity of matter merely disprove deism? Does the failure of the argument by design prove revelation, as Eusebes hopes? For Shelley the activity of forces in the universe, the force of attraction, is love, and love is electrical. As early as 1806, Davy proposed that a “particular electric charge was an intrinsic, internal property of matter and that two bodies formed a compound only if their internal charges were of opposite qualities” (Goodstein 7). In “On Love,” Shelley defines it as “that powerful attraction towards all that we conceive, or fear, or hope beyond ourselves” (Ingpen and Peck 6: 201). Love is what attracts us to things beyond ourselves so that we can compensate for the void that is the self. In claiming that love is what we turn to when we cannot deal with an insufficient void, he refutes the need for the revelation of God, since human love alone ideally provides a sufficient alternative to the void.

Shelley stresses the activeness of matter, and his attention to its activeness disturbs various frameworks for thinking about the world. Active forces disturb necessity because both the location of any particles of matter is not easily predictable and the multiple centers of force make calculating impact difficult at best. To wit, Shelley describes the “form of love” as “scattering the liquid joy of life” (I.763, 766). Active forces further trouble any neat division between idealism and empiricism, as we have already seen with Shelley’s interest in radiant matter. He likewise describes emotion as a force that “attracts, impels” (II.ii.51), and thus it is not clear whether emotion belongs to the universe or to the individual subject. The work of the subject is to make the motion behind emotion into emotion. This activeness exceeds the subject/object binary even as it surpasses mechanism with a kind of vitality. Bruno Latour has argued that actions exceed their actors, and I would like to borrow from his sense that we need a way of talking about how objects act and how actions exceed their subjects (Pandora’s Hope 146–51). Prometheus does not initially know that his curse is a key source of Jupiter’s power, and Jupiter naïvely thinks that the forces of the universe are entirely and forever under his command. The forces of matter are thus resistant to any singular control, and though they are subject to the laws of nature, those laws cannot be mistaken for their powers. This gap between laws and powers frustrates determinism. This multitude of forces, moreover, continually seeks equality, and the attractions of sympathetic love are what make this seeking perpetual.
Shelley’s dynamic understanding of matter, however, raises both the problem of coercion and the bête noir of mechanism. Are human beings merely puppets whose strings are controlled by the forces of nature? Certainly, those forces had undeniable bodily and emotional impact. In a letter to Leigh Hunt announcing his and Mary’s arrival at Calais in “good spirits,” Shelley commented that “motion has always this effect on the blood, even when the mind knows that there are causes for dejection” (Jones 2: 458). Because force automatically invites the suggestion of tyranny, Shelley is on guard against a version of force that would make it a colonizing power even as he is aware that love must have power to have influence in the world. The relationship of analogy, therefore, allows for resemblance and difference, and in that way force can be a law but not a coercion, insofar as consciousness can attend to the forces it chooses to attend to and the difference foregrounded in analogy’s refusal of synthesis prevents a kind of totalitarian unification. That Shelley both constructs an analogy between imagination and matter and at the same time stipulates that analogy functions as a mental law of sympathetic attraction between different entities enables him to essentialize an attractive force between the two without necessitating any particular outcome. The law of analogy is not the power itself; it is the source of mental action without predicting the mode of that action. Because analogy stipulates both a relationship and a difference—otherwise the two things compared would form an identity—analogy allows the force of attraction to make allowances for differences, and these differences are the very means to prevent solipsism and colonization and a return to Jupiter’s tyranny.

The physics and chemistry of force not only influences the structure, machinery, and ideas of *Prometheus Unbound*, but they also reinforce the rhetorical goals that drive the drama. In his preface, Shelley announces that the “cloud of mind is discharging its collected lightning, and the equilibrium between institutions and opinions is now restoring, or is about to be restored” (Reiman and Fraistat 208). Earth explains that we fail to see these restorations because the grave obscures “the shadows of all forms that think and live,” especially what she calls “light imaginings of men” (I.200), which, when contracted, becomes lightning. This contraction posits a shared electrical materiality between imagination and lightning. Davy wrote, “Electricity as chemical agent, may be considered not only as directly producing an infinite variety of changes, but likewise as influencing almost all which take [sic] place” (*Consolations* 9: 376). Although Jupiter had used lightning and thunder to enchain Prometheus, Shelley warns that it will not be so contained. At the very moment that electrical and magnetic lecturers fashioned their expertise by the control they had over such natural forces (Fara, *Sympathetic At-
Shelley limits control even as he defines mind as the ultimate source of Promethean fire. The poet further alludes to the principle of conservation of electrical charge, the very principle that Benjamin Franklin exploited to tame electricity. This principle demands that charges here must be discharged there and the account balanced: the larger implication is that the universe has a logic, balance, and symmetry to it. The conservation of charge has implications for the poet’s ideal of equality, and, as Jerry Hogle has argued, Shelley is not so much interested in a blanket leveling of differences as he is in calculating “how much interplay is going on at one time between givers and receivers” (233). The degree of interplay is his central gauge of enlightenment, and the shift from corpuscles to dynamism not only makes this interplay cosmically possible but also makes possibility itself possible. Dynamism substitutes a network of relationality between forces for the necessity of immediate contact between atoms in order for action to take place.

Shelley thus treats opinion and institution as if they were electrical poles, which allows him to understand the relation between mind/opinion and matter/institution in terms of an economy whereby any discharge of opinion must entail an equally compensatory consequence, though the form of that consequence cannot be predicted. Here he may be alluding to Davy’s use of the galvanic battery, which split compounds by drawing their elements to the positive and negative poles, and thus allowed Davy to isolate new forms of matter in 1807 like potassium and sodium, and barium and calcium. To the extent that Shelley frames institutions as contingent upon opinion—he applauds the “awakening of the public mind which shook to dust the oldest . . . form of the Christian Religion” (Reiman and Fraistat 208)—opinion/mind shapes or destroys institutions. The principle of the conservation of charge, then, allows him to think of ideas and thoughts as Promethean electrical charges with consequence but without known outcomes, since all that we can know is that the charges and discharges must balance. In that way, the electrical attractions of matter can interact with the attractions of the imagination. Electrical attraction, moreover, is both fundamental and necessary to matter itself, for, without it, matter would fly apart. In the same way that electrical charges seek equilibrium, enlightened human beings repeatedly choose to transfer the individual desire for equality to all beings.

Priestley worried about how the soul might engage the body if one were immaterial and the other material; Shelley thinks about force as having a special, subtle kind of materiality, one that transfers from matter to spirit. He even invents a term like “inter-transpicuous” to describe its necessary interrelationality. Like Davy, who sought to unify heat, light, electricity, and matter into one single force,
Shelley sees these forces as versions of each other, versions as he later puts it that will inspire “difference sweet where discord cannot be” (III.iii.39). Where difference within the various forms of material forces—electricity, magnetism, love, effort, will—can be and eventually are harmonized into unity, Shelley’s insistence upon difference without discord explicitly does not allow that unity to eliminate difference, just discord. That this difference is owing not to language but rather to matter allows difference to remain more than a decentering. It becomes a harmony, a place where different notes all have their place. Earth refers to man as “one harmonious soul of many a soul” and later makes clear that this soul includes “his Will, with all mean passions” (IV.i.400, 406). Once again equality gets rid of differences at its own peril; who would choose a monotone over harmony? In insisting upon difference, Shelley’s version of matter, thus, turns to harmony to resist both tyranny and logocentrism.

With this in mind we can now examine Shelley’s declared purpose in *Prometheus Unbound*: “simply to familiarize the highly-refined imagination of the more select classes of poetical readers with the beautiful idealisms of moral excellence” (Reiman and Fraistat 209). The idea is to “familiarize” readers’ imaginations with examples that he hopes will quite literally be attractive without being coercive. Think here of how the imitation of virtue in the “Defence of Poetry” gradually leads to possible identification with it. The poet’s declared distaste for didacticism allows him to renounce coercion, and in fact he insists, “It is a mistake to suppose that I dedicate my poetical compositions solely to the direct enforcement of reform” (ibid.). Given that he frames Prometheus as the opposition to Jupiter’s force, that he is aware that such forces must come to an equilibrium, his denial of “direct enforcement” nonetheless captures the necessary but unpredictable impact of the force of his writing, insofar as it does not eschew an indirection that invites, but cannot impose upon, the participation of the reader’s imagination.

As I will show, Shelley allows for the development of humanity’s sensitivity to the forces of attraction by showing that moral interactions lead to happiness, partly because selfishness allows kindness to be felt as reproach (I.393). If one is initially innately attracted to many things, one learns how to respond to the right attractions because the right attractions provide happiness. Prometheus himself initially only sees and feels Jupiter’s force—“the falsehood and force of Him who reigns” (I.127)—but, as he forgives, he learns to feel and allow himself to be compelled by the force of love. His Torturer, by contrast, arms himself “with the strange might of unimagined pains” (I.366), making him oblivious to empathy and thus any forces of attraction. Thus, when Prometheus chooses to withdraw his curse, he chooses to allow “Love [to]/Burst in like light on caves cloven by the
thunderball” (IV.354–55). Shelley’s trochaic substitution at the start of the line signals intent as it disrupts the habitual accentual force of the line. Prompted by Prometheus, love comes to fill the void annihilation, and it takes the form of lightning and thunder, smashing the caves open and instilling light over darkness.

Within Prometheus Unbound, Asia asks Demogorgon, who made all the universe contains—“thought, passion, reason, will, / Imagination” (II.iv.10–11)? The editors of the Norton Shelley warn readers that “the metaphysical implication of Asia’s statement is that all the universe is made up of mental activities, yet this—like Asia’s other assertions—is neither confirmed nor denied by Demogorgon and should be seen as a useful myth rather than a declaration of Shelley’s beliefs about reality” (Reiman and Fraistat 247n8). While I agree that one should not assume that Asia stands for Shelley, I think that “myth” neither takes seriously the poet’s complex understanding of matter nor understands the ways in which “force” works to bridge imagination and matter while recognizing their differences. The components of mind populate the universe, and they do so because it is mind that recognizes that forces are behind the solidity of matter, and because it is mind that knows it has an analogous force to love, as captured in Shelley’s depiction of mental charges that can oppose the forces of nature.

Demogorgon apostrophizes “ye elemental Genii, who have homes/From man’s high mind even to the central stone / Of sullen lead, from Heaven’s star-fretted domes / To the dull weed dome sea-worm batten’s on—” (IV.539–42). Even as Humphry Davy struggled to decompose matter into its constituent elements with Volta’s battery, Shelley makes “element” into an adjectival modifier of genii, not a noun. The lines end with a reference to iodine, an element Davy named after its violet color. Those animating spirits/forces are elemental insofar as the poet grants them “homes” in everything ranging from “man’s high mind” to “stone/of lead”; matter and mind are linked by force, and the enjambed line breaks the monolithic stone of lead to show the interstices where force lurks. Perdurability is once again the home of forces, and it is not to be mistaken for the identity of matter. The choice of “home” is particularly apt insofar as forces make their home in the interstices of matter, but to reside in a place is not the same thing as to be that place. In this view, homes are Shelley’s anticipation of our concept of supervenience. That forces are at home in matter but do not constitute matter allows Shelley to think of materiality as porous and continually changing, but ultimately unknowable, and therefore necessarily imagined. To wit, even Earth pronounces her own suffusion with force. She is “with love and odour and deep melody/Through me, through me!” (IV.330–31). Here, Shelley’s medial caesura in the final line testifies to that infusion.
The continually attractive powers of love further demand that individuals seek community, and thus the dynamism of matter was a means to temper self-love, which Shelley recognized could be selfish. The poet muses:

Man, one harmonious Soul of many a soul
Whose nature is its own divine controul
Where all things flow to all, as rivers to the sea;
Familiar acts are beautiful through love

(IV.400–404)

In the previous stanza, Shelley had described the forces of love and might, and here he makes those forces the ground of the harmonious soul that is itself the ground of many a soul. Force is what interconnects; love as force does not expunge “mean passions, bad delights” (IV.406), but rather those entities give love’s attraction its work. By highlighting the way in which love takes familiar or habitual acts and makes them beautiful, Shelley shows how physical causality and habits take on states of mind. And in making “divine controul” part of the soul’s own nature, Shelley allows for free will even as he makes the individual a metonymy for the world soul, but one separate from it, although the same force interpenetrates them. Disavowing the possibility of idealism as a form of solipsism, Shelley insists, “Let it not be supposed that this doctrine conducts to the monstrous presumption that I, the person who now write and think, am that one mind. I am but a portion of it” (Ingpen and Peck, “On Life” 6: 196). The poet’s metonymic understanding of the self as part of the forces of the universe is precisely what prevents that solipsism. At the same time as he unites self and world soul but with a difference, divinity becomes human as it is now part of the soul’s nature.

Shelley often uses “shape” to describe what would be matter, and deconstructionists have insisted that this term refers to figurality itself. According to Paul de Man, the shape is “the figure of the figurality of all signification” (Rhetoric of Romanticism 117). Elsewhere I have argued that deconstruction indulges in a mattercentrism so that language can be the undoing of matter. The deconstructionist understanding of shape perfectly illustrates my point, because it turns out shape was in fact an important descriptor within Romantic physics. John Anderson’s Institutes of Physics, for instance, explicitly names “shape” as one of the variables he has repeatedly tested. Famous electrician George Adams argued that “whatever is material must have figure or shape” (3: 5). Physicists then further studied how the shape of a magnet altered its attractive powers. Even Shelley’s own teacher, Adam Walker, in a section on optics, treats how the particles of light, “by striking the retina of our eyes, excite in our minds the idea of light: and when they fall upon bodies, and are reflected to our eyes, they excite in us, the idea of the colour
and the shape of these bodies” (63). He is trying to describe how the world becomes consciousness.

Rather than standing on the side of figuration, I argue, shape was an especially useful descriptor within a dynamic theory of matter, because force could and did change the shape of matter, and since the states of matter—solid, liquid, and gas—meant that the shape of matter was inconstant. Its imprecision made it especially useful to describe the forms matter could take. Arguing for the usefulness of Boscovich’s definition of atoms as centers of force, Michael Faraday wrote, “The term shape would now be referred to the disposition and relative intensity of the forces” (“Speculations” 2: 292). Shelley himself linked shape to the phenomenality of matter: “When we look upon shapes in the fire or the clouds and imagine ourselves the resemblance of familiar objects, we do no more than seize the relation of certain points of visible objects, and fill up, blend together” (Ingpen and Peck 6: 107). Shelley’s term “shape,” then, refers to the essentially protean appearance of matter, the familiar thing we imagine as we perceive a relation between certain points and fill them in. Kant, of course, downplayed the significance of shapes when he showed that all attempts to derive the different qualities of objects from the shape of primary particles was doomed to failure. Shelley has no need to turn to shape as a kind of figure for figurality because matter itself was flexible, appearing in gaseous, liquid, and solid states, and the active forces within matter made it possible to see that our sense of the solidity of objects was in fact the work of a deluded imagination. Hence, the furies acquire their shapes from the shade of their victim’s agonies, without which they “are shapeless as their mother night” (I.472). When Asia looks into the eyes of her sister, Panthea, she sees “a shade, a Shape, tis He, arrayed in the soft light of his own smiles/which spread like radiance from the cloud-surrounded moon” (II.i.120–22). She sees reflected the shape of Prometheus, transformed by his retraction of the curse, literally “arrayed” with the radiance of his smiles. That radiance exudes a force that transforms a shade into a shape.

Thinking about matter as an interaction between forces allows the poet to let matter become something that unfolds within time. Hence at the start of act IV, Shelley describes matter that is in the process of fading away: the dark forms and shadows “bear the bier/Of the Father of many a cancelled year!” (IV.9–10). Materiality thereby is in process of materialization or evanescence into forces. Astronomer Herschel credited force for having formed various star clusters: “Having then established that the clusters of stars . . . are of a spherical figure, I think myself plainly authorized to conclude that they are thus formed by the action of central powers” (Catalogue 9). He proceeded then to call this power “centripetal
force” (ibid.). Hence Shelley’s semi-chorus chants, “We whirl, singing loud, round the gathering sphere” (IV.169). Their whirling is part of the momentum that allows the sphere to gather. Shelley insists that action creates matter. And hence the chorus bids Panthea and Asia:

But now—oh weave the mystic measure  
Of music and dance and shapes of light,  
Let the Hours, and the Spirits of might and pleasure  
Like the clouds and sunbeams unite.

(IV.77–80)

Usually understood as a given empirical fact, and one of the goals of science, “measure” is here transformed into the artful product of weaving, a transformation that allows the measure of song (in the sense of duration of a note) to encapsulate the measure of matter. By once again stressing force and effort in the infinitive form of “weave,” Shelley insists upon matter as a process, a point underscored by the fact that force determines the measure of a shape. Heightening that claim is the previous stanza, which depicts the hours as they once were: “hounds/which chased the Day, like a bleeding deer,” but those appearances have vanished. Shelley’s simile here then works as not so much a form of figurality but rather as an indication of the dynamism of form. Describing her own birth, the moon recounts being “Borne beside thee by a power/Like the polar Paradise,/Magnet-like, of lover’s eyes” (IV.464–66). Even as love, eros, polarity, and magnetism are brought together as one shaping force—so that even the symbol of chastity is not immune to love—Shelley describes how force leads to the very birth of the moon: once again force in the form of action precipitates matter as the effect of force. Matter is thus not the cause but the effect of force.

All this has manifold implications for Shelley’s relation to idealism and skepticism. Though the recent critical history has stressed his skepticism, that skepticism is based upon a theory of language that misunderstands the poet’s relation to matter. By reconnecting his skepticism to matter and not to language, I argue that Shelley’s decentering skepticism could never be nihilistic. Rather, the inevitable changes in the forces that compose matter offer both hope and fear, but with this difference: matter remains in the form of dynamic forces, and love is one such form of force. Stuart Sperry defends Shelley as primarily a poet, not a philosopher, and he argues that the poet’s “primary allegiance is by definition not to the things of this world but to what may become, and their eye is not on the earthly object but on the imaginative and ideal” (Shelley’s Major Verse 70–71). My treatment of Romantic matter demands no such choice between things and ideals, because
force circulated between things and ideals, description and prophecy. As the very effect of force, matter can be changed.

Shelley’s critics have mistakenly understood Shelley’s dilemma. Take, for example, Michael O’Neill’s reading of Demogorgon’s lines in act IV: “Fate, Time, Occasion, Chance, and Change? To these/All things are subject but eternal Love” (lines 119–20). O’Neill argues that “eternal love” is “an abstraction that the entire act has striven to incarnate in its fictions” (109), and he links abstraction to that which “does not exist beyond the individual will” (ibid.). Because it is based on the force of attraction between two things, love is no abstraction, which means that Shelley need not struggle to “incarnate . . . fiction” (ibid.). Its electrical materiality makes it highly reactive, creating a force field that compels but does not command. The same holds true for his understanding of the discharging imagination. In this way imagination and love are forces but not tyranny. That the lines are rigidly iambic pentameter both undermines our sense of abstraction and suggests that while love may not be subject to the five actors named, it is still beholden to metrical force. Love, therefore, is not about the transcendence of the laws of nature, but neither does it materialize in any concrete permanence. It materializes as an interaction, influenced by what it interacts with. In a later reading of the Spirit of the Hour’s speech, O’Neill tries to credit physics and figuration too: he insists, “‘Spiritual physics’ work lucidly here, adequately imagining transformation by refusing to be wholly figurative” (117), at the same time that he asserts, “Figurative language sharpens rather than devitalizes the force of [Shelley’s] argument” (ibid.). O’Neill waffles between the strengths and limits of figuration: in the former, physics compensates for the limits of figuration; in the latter, figuration sharpens. My point is that Shelley did not have to choose between the strengths and weaknesses of figuration because a dynamic physics of force teemed with action, making figuration ancillary.

When Shelley argues for difference without discord, he eschews the violence of difference but retains difference because it challenges what would otherwise remain egocentrism or Alastorian solipsism. To the extent that Shelley understands an ultimate unity of force in a harmony that nonetheless makes a space for difference, Demogorgon’s violent overthrow of Jove is analogous to Prometheus’s attempt to recall his curse, which, in turn, is analogous to Prometheus and Asia’s marriage through the forces of attraction. Here, the deconstructive understanding of analogy as a figure that disrupts any essential relation between the two terms being compared will not account for the fact that Shelley considers analogy to be a law of the imagination, one that both recognizes and embodies the tendency of
the forces of nature to attract and repel one another. The binary thus acquires an ontological relationality that will permit neither the privileging of one over the other nor the claim of ontology beyond relationality. For Shelley, then, analogy literally matters because it specifies a relationship whose material basis has yet to be discovered or understood but takes the name of love. It allows for the concurrent presence of idealism and skepticism, since analogy embodies the attractive forces, the electrical matter, between two things.

One key question ensues: If love is a force that holds together aspects of the universe, when is force necessary, and when is it a product of tyranny? Shelley insists that “love and might [are] to be divided not” (IV.394), and this means that he recognizes that you cannot have one without the other. For Shelley then, freedom is not the absence of compulsion, since we are surrounded by the forces of nature, which are in turn governed by laws, but rather we are free to choose the forms of compulsion we are compelled by, and, lest we forget, love is itself a force of compulsion that one must choose.136

Although force “compels the elements with adamantine stress,” Shelley argues, “As the Sun rules, even with a tyrant’s gaze, /The unquiet Republic of the maze / Of Planets, strugg[es] fierce towards Heaven’s free wilderness” (IV.397–99). The sun rules even with a tyrant’s gaze. However, the order of the universe is a republic, one without a king, a tyrant. Shelley ironizes the foundational alexandrine of line 399 into a wilderness of space, hardly the stuff of conventional foundations, but that foundation is held together not by solidity but rather by gravity and metrical force. Because force in physics begins as a term analogizing human will and effort, that will becomes a force that can reckon with the forces of matter, making matter into a fait accompli, the result of action.137 Shelley sees gravity as a force that quells the planets into as much order as a maze can provide, but he insists on the eternal struggle against that force. “Even” indicates parallel forces and makes omnipotence a fantasy. Hugh Roberts’s application of chaos theory to Shelley offers an especially helpful gloss on these lines: Shelley recognizes that disorder emerges out of order as much as order emerges from disorder (251), and this again makes it possible for him not to choose between idealism and skepticism.138 The poet therefore insists on simultaneous order and disorder: mazes are an especially bewildering form of order, even as active forces impose temporary order on matter. Roberts suggests that this disorder is what inspires the ordering of imaginative creativity, once again reinforcing an attraction between matter and imagination, but such creativity is disordering as well.139

When Shelley refuses to separate power from love and might from peace—Panthea refers to peace as “a mighty power” (IV.510)—he underscores force as
both love and might, and peace and might. Likewise, Demogorgon announces that “Love from its awful throne of patient power... folds over the world its healing wings” (IV.557, 561). That healing power would not be effective without the “awful throne.” The key then would be to choose love and peace rather than allow oneself to be passively determined by them: the very fact that love is a force means that its attractiveness needs to be dealt with. This recognition that love and force necessarily belong together returns us to what Shelley critics like Tilottama Rajan have seen as the displacement of Demogorgon’s violent upheaval of Jupiter by Asia and Prometheus’s marriage (241). My attention to force, however, allows us to see both these events as two sides of the same coin, and Shelley’s conception of love supports such an analogy because it is both force and love. Where Rajan reads *Prometheus Unbound* in terms of “the disconnection of acts, agents, and ideas,” which expresses a narrative “semiotics in which vehicles exist without clear tenors, so that characters and their actions become figures for the form of a content rather than the content itself” (246), I locate this disconnection within force and matter, and thus within Shelley’s understanding of force as having a home in matter. Because within force there is a fundamental ambiguity about the source of the action, a dynamic theory of matter necessitates a struggle between human effort and physical laws. Thus, Shelley can have his content and reflect upon it, too, since the mobility of that content foregrounds the problem of what is acting and what is acted upon. If Rajan’s Shelley is traumatized and haunted by the continual incongruity between tenor and vehicle—trauma is the psychological equivalent of endless deferral—my version of Shelley is not suffering from a lack of content, or what is essentially a linguistic disease, because love as attractive force literally counteracts the force of tyranny. The moving presence of force provides a changing content but not monolithic meaning, and in fact the relative order or disorder of matter within the universe means that change will come. The question for Shelley is how to prompt it. It is also how to obey the force of love and have sovereignty at the same time.

Shelley argues this point fairly explicitly: “If we permit our imagination to traverse the obscure regions of possibility, we may doubtless imagine, according to the complexion of our minds, that disorder may have a relative tendency to unmingled good, or order be relatively replete with exquisite and subtle evil... Order and disorder are expressions denoting our perceptions of what is injurious or beneficial to ourselves, or to the beings in whose welfare we are compelled to sympathize by the similarity of their conformation to our own” (Ingpen and Peck 6: 52). In a remarkably prescient Nietzschean move, Shelley worries that our designation of order as either good or evil results from our psychological perception of
our individual benefit. Here, Shelley urges that the imagination be trained to see the order of matter beyond individual benefit by looking to a collective good that is not merely self-regarding. The imagination must be willed to do what it does: Shelley’s verb is “permit.”

Part of what Shelley is trying to dramatize is the work of tyranny and how it might be overcome. His turn to force, then, undermines the subject/object dichotomy, even as it frames the work of love as a force that must counter tyranny. After all, if matter is composed of forces, then how can one side be an actor and the other side merely passive? Tyrants like Jupiter ignore the larger forces of the universe and instead seek to dominate by designating subjects as objects: he proudly declares, “all else has been subdued to me” (III.i.4). By connecting the division of subject and object with tyranny, Shelley anticipates Heidegger’s argument that the subject position is necessarily one of dominance. In the opening scene, for example, Prometheus’s splayed body renders him a virtual object.

This emphasis upon dynamism and action makes the universe and the self continually revolve and change, but how then does one know good from bad changes? More critically, how does one spur changes for the better? Under tyranny, the danger is that one forgets the dynamism of the universe. Hence, Prometheus perceives “no change” in the opening scene of the lyrical drama, and hypostasis makes for pretty boring drama. And yet he is surrounded by change, as he admits without knowing it. He describes, for instance, the “crawling glaciers,” and he is surrounded by whirlwinds. More to the point, in his initial blindness to the changes around him, Prometheus values his identity and endurance, and these resist change rather than foster it. What Prometheus cannot initially see is what the chorus will later remind him: “Ruin now Love’s shadow be” (I.780). Although he cannot perceive it, that does not mean love does not exist in the world, especially if ruin is really love’s shadow. And hence Jupiter does not understand that his thrones, altars, scepters, and tiaras “were like those monstrous and barbaric shapes,/the ghosts of a no more remembered fame” (III.iv.168–69). “Shapes” here captures the dynamism of force, and thus the permanence of such things is actually a mirage.

Shelley provides an important clue to how he thinks human beings can foster positive change when he shows earth to be animated by love. He makes it clear that circumstances, and even poetry, can awaken us to action. He understands action and emotion both as forms of motion, motion being the external symptom of force. Kant, we recall, defined matter as the moveable because movement was what allowed us to perceive it. Prometheus opposes Jupiter’s omnipotent force, and thinking about the emotions in terms of force allows sensibility to shade into action. And yet Shelley insists that love too forces: “Love rules, through waves
which dare not overwhelm. Forcing Life’s wildest shores to own its sovereign sway” (IV.410–11). Framing love as a force accords it power, a power that can look suspiciously like tyranny, a suspicion fueled by Shelley’s choice of verb: “rules.” And yet this similarity is what allows force to fight force, for, without power and rule, love would be feeble. What Shelley’s detractors have seen as naïveté or sentimentalism is in reality much more complex. Shelley dramatizes the power of love by both refusing enjambment here and by making force into a gerund. If his commas reign in the waves, the wildest shores are “forced” to “own” their sovereignty. If Shelley envisions one being forced into the embrace of one’s own sovereignty, the coercion of force is mitigated by the fact that one can and must choose one’s sovereignty. In so doing, Shelley defines free will in terms of willing the attractions we act upon: so long as one wills what one is being willed by—in this case, love—one thus holds onto free will while willingly being reined in by love. Because action straddles the physics of force and the emotion of the subject, the physics of force becomes the backdrop against which human will can be found and measured.

Shelley expands beyond love to consider the forces of emotion generally; his physics includes a physics of emotion, what I have elsewhere called the “motion behind emotion.” Here he probes the fact that motion is part of emotion, and, since dynamic thinkers thought of motion as the symptom of force, Shelley understands the emotions as forces that we allow to move us. Shelley has the Chorus of Spirits announce:

We come from the mind
Of human kind
Which was late so dusk and obscene and blind;
Now, 'tis an Ocean
Of clear emotion,
A Heaven of serene and mighty motion. (IV.93–98)

Of key interest here is the rhyme almost riche between “Ocean,” “motion,” and “emotion,” a triplet that underscores links among mind/imagination, natural force, and emotion. This rhyme replaces “mind”/“kind”/“blind.” Thinking about emotion as both a force that moves us and a force that we allow to move us complicates the relation between emotion and subjectivity by rendering emotion both exterior and interior to the self, both willed and forced. The fact that Prometheus does not will his pity for Jupiter but pays attention and acts upon it means that emotion need not be originally self-willed to be moral. The crucial thing for Shelley is first to feel it and then know what to do with it. Emotion thereby be-
comes almost an externally imposed root of the collective, working through a kind of contagion of motion. When Shelley pits a clarity of emotion against blindness, he demands that his readers reflect upon how the individual can better be in harmony with the shaping forces of the world. Stuart Sperry has argued that Shelley knew “that if change were ever to come, it would come as emotional realization” (Shelley’s Major Verse 68), and I would add that his sense of emotion as a force enabled him to understand emotion in relation to the physics of the universe. The fact that we are impelled by emotion does not make it morally bankrupt, because we can choose to feel it or not, to be moved by it or not, and we can own it as if we originated it, even if the feeling is originally not quite our own. To wit, Shelley makes evil characters like Mercury parasitic on the emotions of their victims without ever really owning those emotions (84), thereby offering a negative example of what he hopes to encourage.

Hence, after Prometheus has triumphed over Jupiter, his mother, Earth, celebrates:

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The joy, the triumph, the delight, the madness,
The boundless, overflowing bursting gladness,
The vaporous exultation, not to be confined!
Ha! Ha! The animation of delight
Which wraps me, like an atmosphere of light,
And bears me as a cloud is borne by its own wind! (IV.319–24)
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The emotion or force of joy will not be contained even within the vastness of earth. Shelley’s caesura between the metrical foot less/o highlights this overflow—underscored in his open “o”—as does his insistent gerund forms of the verbs, not to mention extra syllables in lines 320 and 321. Moreover, earth refers to the “animation of delight” as being external to herself—she is after all wrapped in it, transforming her from acting subject to enunciated object, borne by its own wind. The animation of delight, as it were, breaks down the borders of subject and object because its origins are without, and yet it animates her. As she becomes a cloud borne by its own wind, she is transformed into a force that is nonetheless forced by a force that she will come to own. Not only does Shelley thereby show how the subject/object binary consolidates power in the form of violence; he also diffuses power/force so that it resists the kinds of containment we can imagine because it is a forced force, which initially wraps the earth only later to become part of it. Simultaneously, he argues that claiming ownership of the forces that move us—ownership of emotion in this case—amounts to a potential exercise of authentic free will. Earth is, after all, inspired and borne like a cloud by her own
in-spired wind. The borders of the subject have been obliterated, with the goal of rendering the subject a form of energy that performs work in the world.

Even though earth describes her experiences as a kind of rapturous disorder, the poetic lines and their insistent commas absolutely order all of this joy. Shelley suggests thereby that disorder is perceptual. Since forces of emotion regularly exceed the subjects who would try to contain them, this turn to perception begins to reconsolidate the subject. Such excess defies the permanent containment of forces, demanding a continual readjustment of activity that reshapes the subject. What can hide man from Mutability, indeed?! At the same time, such disorder is in fact metrically ordered, reminding us that force and love can be beautiful.

This raises the question of how does one know the difference between good and bad changes? The answer: by how one feels, as measured against how one should feel. Prometheus tells the second fury, “I weigh not what ye do, but what ye suffer/Being evil” (I.i.480–81). Action has an emotional impact, and suffering is the sign of evil. When Prometheus kisses the Earth, otherwise known as his mother, she responds:

I hear—I feel—
Thy lips are on me, and their touch runs down
Even to the adamantine central gloom
Among these marble nerves—tis life, tis joy,
And through my withered, old and icy frame
The warmth of an immortal youth shoots down.  

Without the force of love, earth takes on the form of barren matter, all hardness and adamantine. The kiss injects some much-needed warmth, awakening otherwise dead matter that appeared to have lost its vitality into joy and life. Matter moves beyond mechanism, and Shelley’s enjambment highlights the positive force of love as marble earth is liquefied into life. Insofar as the warmth of youth “shoots down,” she now feels a vitality beyond mechanism: “shoots” hints at the organicism that she was always supposed to feel, and, by implication, mechanism is not true feeling.

Thus, the Spirit of the Earth, previously identified with atmospheric electricity, notices how the recall of Prometheus’s curse leads to “All things put[ting] their evil nature off” (III.iv.77). Forgiveness transforms an evil nature into something that can be put off, or an appearance. “Adamantine” suggests the life of Adam was always present. The spirit then comments, “So with my thoughts full of these happy changes/We meet again, the happiest change of all” (III.iv.84–85). In describing changes for the larger good in terms of “thoughts full of happy changes,”
Shelley insinuates that good will allow the form of happiness to appear in thoughts. Contrast this happiness to Mercury, who, because he is acting on behalf of evil and knows it, feels nothing but remorse when he summons Prometheus’s torturers. Initially the Spirit of the Hour records the cosmological change resulting from Prometheus recalling his curse: “There was a change . . . the impalpable thin air/And the all-circling sunlight were transformed/As if the sense of love dissolved in them/Had folded itself round the spher’d world” (III.iv.100–104). It perceives a change, but it has no instantaneous meaning, and it is only the Hour’s “as if” that allows him to see these changes in terms of intentionality. As he wanders “among the haunts of mankind,” he remarks:

And first was disappointed not to see  
Such mighty change as I had felt within  
Expressed in outward things; but soon I looked,  
And behold! Thrones were kingless, and men walked  
One with the other as spirits do,  
None fawned, none trampled; hate, disdain or fear,  
Self-love or self-contempt on human brows  
No more inscribed.  

(III.iv.128–35)

The Spirit of the Hour expects an immediate transfer of inner feeling to outward manifestation, and such a transfer is only possible if there is an intermediary between the two: namely, forces. The feeling of the change in emotional terms triggers the search for an outward expression of those inner forces. As the emotions of hate, disdain, and fear evaporate, they are indeed replaced by love. Shelley’s insistent repetitions of “none” recall Prometheus’s initial perception of absence when he is chained upon the rocks and indicate a symmetrical rebalancing of forces that unfolds with the drama, shunting aside tyranny. Because he understands matter in terms of dynamic forces, Shelley remains optimistic that changes, although inevitable, hold the possibility of the good, and one can know so when emotion synchronizes with the dynamic forces of the universe, thereby increasing signs of vitality.

In sum, then, thinking about matter as dynamic allowed Romantic writers to enlist matter in the process of change and, in that process, demand reconceptualization of both the human subject and agency. As the essence of matter shifts from solidity and permanence to the forces of attraction and repulsion, matter is reimagined in at least two ways. The version of matter that is corpuscularity becomes evidence of a deluded imagination, one that relies on a material link from body to body, and in so doing dramatically limits possibility to action without dis-
tance. That is, in this physics, only things that are touching can influence one another. Both electricity and magnetism posed great difficulties for such a theory. By contrast, the disciplined imagination understands the forces underlying the surface of matter to be both the ground of our ability to encounter it and an ecological stance in which everything is involved with everything else, and thus agency has reciprocity and consequence in the universe. And yet, because this ground is always shifting, matter neither allows for the simple reification that is ideology nor the refusal of thought, since this change must continually be reapprehended. In varying ways, then, Boscovich, Kant, Davy, Priestley, Marcet, Faraday, and Shelley turn to dynamic matter to reconceptualize the subject as continually dissolving and being remade, which, in turn, remakes the objects that bring the subject into being. Shelley, in particular, further rethinks human agency, whether this takes the form of the collapse of dualism, or the recognition of how to interact with the forces of the universe, or the willing acceptance of being moved, or the making of the self merely one center of dynamic interactions. The Romantic imagination’s central role in the very reimagination of matter further demands our rethinking of what its materiality means and does, and undermines the claims of figurative language to undo ideology, because matter already is believed to have the necessary resources to do away with logocentrism and the politics that ensue from it.