Irreversible Transformations: Robert Louis Stevenson’s *Dr. Jekyll and Mr. Hyde* and Scottish Energy Science

Since its inception in the engineering diagrams of Sadi Carnot and the quest for the “perfect thermo-dynamic” engine, the scientific discipline known as thermodynamics has had at its center the question of the reversibility of physical transformations. After the second law of thermodynamics introduced the problem of the universal dissipation of energy, irreversibility became an increasingly central theoretical question in physics, especially during the 1860s and 1870s. In 1867, James Clerk Maxwell proposed one of the most famous thought experiments in scientific history, a hypothetical creature known as the “sorting demon” who could reverse the flow of heat, and thus, in theory, conquer the otherwise irreversible “accumulation” of entropy. William Thomson delivered a lecture later dubbed “On the Reversibility of Motion” in 1874 to the Royal Society of Edinburgh, and Joseph Loschmidt, responding to the work of Maxwell and Ludwig Boltzmann, first articulated his famous “reversibility paradox” in 1876. The question of irreversibility represents the point of most profound disjunction between classical Newtonian mechanics and thermodynamics, between a universe defined by balance and order and one defined by unidirectional flow and probability. The work done by Maxwell, Boltzmann, Loschmidt, and others during this period is thus not simply indicative of a paradigm shift; it is in many ways a conscious struggle to understand this shift and reconcile seemingly incompatible modes of scientific reasoning.

As we shall see, the change in thinking brought about by energy science held great significance for Robert Louis Stevenson and his novel *The Strange Case of Dr. Jekyll and Mr. Hyde* (1886). Most critical discussions of the role of science in Stevenson’s novel tend to describe it as “Science,” as a general cultural phenomenon that, most seem to agree, is indicted for overreaching, for presuming to master nature.

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**ABSTRACT** This essay discusses Robert Louis Stevenson’s use of the discourse of thermodynamics to structure the transformation in *The Strange Case of Dr. Jekyll and Mr. Hyde* as an irreversible process. Refashioning metamorphosis along scientific lines imbues the moral life of the novel with the pressure and reality of physical law and links the individual “flaws” in transformation to a vision blending scientific and theological accounts of apocalypse. / *Representations* 96. Fall 2006 © 2006 The Regents of the University of California. ISSN 0734–6018, electronic ISSN 1533–855X, pages 1–20. All rights reserved. Direct requests for permission to photocopy or reproduce article content to the University of California Press at www.ucpress.edu/journals/rights.htm.
Like Frankenstein’s, Jekyll’s experiment is an expression of Faustian hubris, and no one is surprised to see such an endeavor lead to much mischief and suffering. When the consideration of science in the novel does become more specific, and the second law of thermodynamics is discussed, it is as one factor among many in a prevailing atmosphere of fin de siècle pessimism.4 Such interpretations form the general outlines of a critical consensus.

Though both points—that the novel indicts science and links it to a host of end-of-the-century anxieties—are perfectly valid readings of the novel, such discussions of science tend to neglect the specific terms in which a scientific discipline like thermodynamics was understood, debated, and imagined in the latter half of the nineteenth century. These terms have special value in interpreting a writer like Stevenson, who came from a family of engineers, was himself trained as an engineer, and whose earliest published work includes a paper presented to the Royal Society of Edinburgh, “On the Thermal Influence of Forests” (1873).5 That paper discusses heat dissipating from forest canopies, “towards the stars and the cold interstellar spaces,” and evinces a young mind interested not just in precise measurement, but in the energy differentials obtaining between natural forms—in this case, between the forest and the atmosphere.6

Edinburgh in Stevenson’s day was at the very center of the development of energy science. James Clerk Maxwell was born there and trained at the University of Edinburgh, as was William Macquorn Rankine. During their time at university, both men were profoundly influenced by J. D. Forbes, Chair of Natural Philosophy, who emphasized the industrial application of scientific inquiry and whose own experimental work centered on the propagation of radiant heat.7 William Thomson (later Lord Kelvin) and his brother, the industrial engineer James Thomson, were also close with Forbes. William presented his landmark paper on the second law of thermodynamics, “On a Universal Tendency in Nature to the Dissipation of Mechanical Energy,” to the Royal Society of Edinburgh in 1852.8 As the work of the brothers Thomson illustrates, the close connection between practical engineering and natural philosophy was critical to the development of the laws of thermodynamics and characteristic of nineteenth-century Scottish intellectual culture. In contrast to the prevailing norms of a Cambridge education, Crosbie Smith and Norton Wise argue, the Scottish approach exemplified by Forbes, with its roots in the “Common Sense” school of Thomas Reid and John Robison, stressed “the unity of science and art, conceived in terms of the relation of mind to the material world.”9 The unity of abstraction and application, mind and matter, will be critical to our reading of Stevenson’s novel.

In Stevenson’s day, the University of Edinburgh was a thriving center of engineering and scientific research, and Stevenson attended the lectures of two notable members of the faculty. Fleeming Jenkin, Chair of Engineering, was William Thomson’s collaborator in his work on undersea telegraph lines and a particularly important figure for the young Stevenson. In later years, Stevenson would write an
admir ing biography of his teacher and friend, Memoir of Fleeming Jenkin, just after completing Dr. Jekyll and Mr. Hyde. The successor to Forbes in the Chair of Natural Philosophy was Peter Guthrie Tait, one of the century’s most prominent and lucid explicators of energy physics and another close associate of Thomson’s. Tait was also one of Stevenson’s instructors, and his Lectures on Some Recent Advances in Physical Science (1876), dedicated to Stevenson’s father, is likely what the younger Stevenson would have heard in his class as an undergraduate. Its descriptions of thermodynamic processes will therefore serve as an invaluable gloss on the tropes of energy transformation found in his fiction. Dr. Jekyll and Mr. Hyde is a novel acutely concerned with the transformation of physical forms, the scarcity of resources, and the directionality of the universe. Jekyll’s is, at heart, an experiment in human engineering, one that unlocks Hyde’s “energy of life” (JH, 100); the novel’s opening, describing the misdeeds of Utterson’s associates as the “high pressure of spirits” (JH, 1), prepares us for a work that will draw upon the principles of engineering to direct not only the course of the physical metamorphosis but also the shape of the narrative. The irreversibility of physical transformations represents one of the most critical points of disjunction between “classical” and modern science, and it informs Stevenson’s modern rewriting of Ovidean metamorphic tropes and structures of allegorical representation.

The success of Jekyll’s project depends entirely on its complete reversibility; Jekyll can indulge himself in Hyde, but Hyde must also be able to become Jekyll in order to realize the dream of the full “separation of these elements” (JH, 80). The plan seems to work at first, and Jekyll describes his initial mastery of the change:

Let me but escape into my laboratory door, give me but a second or two to mix and swallow the draught that I had always standing ready; and whatever he had done, Edward Hyde would pass away like the stain of breath upon a mirror; and there in his stead, quietly at home, trimming the midnight lamp in his study, a man who could afford to laugh at suspicion, would be Henry Jekyll. (JH, 86)

Such a system of total reversibility, imperfectly carried out though it may be, represents a departure from conventions of metamorphic writing. As Marina Warner argues, transformation in Ovid and in other mythic literature is usually a singular event, signifying a being’s attainment of appropriate and eternal form. The ability to transform oneself repeatedly and at will is a power reserved for the gods. Jekyll’s “trimming the midnight lamp” after his return from one of Hyde’s adventures is a minor detail, but one that nicely suggests his confidence in the easy manipulability of energy forms. Dr. Jekyll and Mr. Hyde is metamorphosis updated for the industrial age, for a world in which great transformative capacity was at the command of engineers, industrialists, and, increasingly, ordinary people. The agencies of heat, electricity, magnetism, chemical reaction, human and animal labor were all understood as expressions of the invariant known as energy and could thus be managed, quantified, converted one into another and back again. In The Unseen Universe, Tait
and cowriter Balfour Stewart draw upon the myth of the metamorphic Proteus to illustrate the difference between matter and energy: “The one is like the eternal, unchangeable Fate or Necessitas of the antients; the other is Proteus himself in the variety and rapidity of his transformations.”

If myth helps structure scientific understanding, science, in turn, shapes myth; Warner writes, “It is characteristic of metamorphic writing to appear in transitional places and at the confluence of traditions and civilizations. . . . magic may be natural, not supernatural, and the languages of science consequently profoundly affect visions of metamorphic change.”

Half novel and half allegory, half prose and half poetry (according to Vladimir Nabokov), Dr. Jekyll and Mr. Hyde draws upon both the possibilities and pressures of physical “realism” to restructure mythic conventions and bend the fantastic premise back to earth.

Of course, the language of energy science that describes the immense transformative capacity at human command also describes the ultimate irreversibility of those transformations, and thus the natural limits of that command. Energy forms can indeed be turned one into the other, but never without cost. Because of its genesis in industrial engineering and considerations of work and waste as they relate to profit and loss, thermodynamic discourse has always been suffused with fiscal metaphors. Tait uses specifically economic terms to describe energy use: the “expenditure” of work and the “refund” of output for a given input, for example (Lectures, 23, 114). And if energy could be understood as a kind of capital, capital, in turn, was often defined in terms of the energy it represents—T. H. Huxley’s essay on political economy, “Capital—The Mother of Labour,” published four years after Dr. Jekyll and Mr. Hyde, is a prime example. The first consequence of Jekyll’s transformation is leveled in a cost of the most literal variety, that is to say, the monetary. Hyde’s apprehenders decide to “make capital” (JH, 5) out of an incident, a hundred pounds for the family of the child he has trampled in the street. At first, money is enough to reverse (for Hyde, at least) most of the damage that has been done. As the novel progresses, however, the transformations exact a mounting psychic, social, and physical toll. Jekyll keeps a ledger detailing the increasing amount of chemical formula needed to restore himself to himself: “Here and there a brief remark was appended to a date, usually no more than a single word: ‘double’ occurring perhaps six times in a total of several hundred entries” (JH, 71). The finitude of this resource becomes a major concern: “Expense is no consideration” (JH, 55). Jekyll writes to the chemist hoping to procure the agent of transformation. But money can no longer rescue him, for what has become the most valuable commodity in his world has also become irreversibly depleted.

Chemical resources and strenuous effort—both in increasing amounts—become the cost of simply restoring Jekyll to his original bodily condition. Tait writes: “Every time that a transformation takes place, there is always a tendency to pass, at least in part, from a higher or more easily transformable to a lower or less easily transformable form. . . . Thus the energy of the universe is, on the whole, constantly
passing from higher to lower forms, and therefore the possibility of transformation is becoming smaller and smaller” (Lectures, 20–21). The moral valence of words like “higher” and “lower” will be discussed shortly, but for now, it is essential to see that Jekyll has discovered for himself what Thomson, Tait, and other thermodynamic scientists had taken such pains to explain: the energy of a closed system undergoing transformations simply cannot be restored without an input of external energy. The “perfect thermo-dynamic engine,” one that could be run backwards to restore itself to its initial state cannot be built; additional labor or a natural resource like coal or zinc must be added to effect a full reversal. And that additional input always represents more energy than the work done. So while an engine can work to “produce” motive power, it can only do so at the cost of further deranging the energy of the surrounding world.

The relationship between Jekyll’s metamorphosis and the principles of thermodynamics is more than just a happy meeting between a trope of fantastic literature and energy science at the word “transformation.” The novel differentiates the two men, at times explicitly, in terms of their energy. Jekyll describes Hyde’s “energy of life” (JH, 100) and his “raging energies of life” (JH, 100), as well as his “spirits more tensely elastic” (JH, 96). Jekyll, on the other hand, becomes “languidly weak both in body and mind” (JH, 100) and “wanting in the strength to keep to it” (JH, 91); “it” being the path of self-restraint. That last comment is critical, because it suggests one way of thinking about the relationship between energy and identity in this novel. The social world in which Jekyll moves, and the integrated persona he has developed in order to navigate it successfully, requires an unceasing application of energy. Jekyll accounts for Hyde’s younger and less developed appearance by arguing that while his has been “nine tenths a life of effort, virtue and control,” Hyde “had been much less exercised and much less exhausted” (JH, 83). Just being Jekyll is tiring; indeed, even enjoyment in this world is imagined as a kind of energy drain. “The expense and strain of gaiety” (JH, 22), echoing “the high pressure of spirits” from the opening, describes the tense joviality of a gathering of the well-heeled.19 As his experiment progresses, Jekyll begins to revert spontaneously to Hyde, and “only by a great effort as of gymnastics, and only under the immediate stimulation of the drug” is he “able to wear the countenance of Jekyll” (JH, 99).

The recognition that human and animal life is subject to the laws of energy science stems from the powerful influence chemistry and physics had upon biology in the nineteenth century. Historian of science Everett Mendelsohn writes that the nineteenth century saw “the steady invasion of the fields of functional biology by men oriented, through training, to the sciences of the inorganic realm.”20 Mediated through the metaphor of the steam engine, living systems could be understood as energy systems, as Tait argues:

It was a grand step in science which showed that just as the consumption of fuel is necessary to the working of a steam-engine, or to the steady light of a candle, so the living engine requires food to supply its expenditure in the forms of muscular work and animal heat. . . .

Irreversible Transformations
it may be startling to some of you, especially if you have not particularly considered the
matter, to hear it surmised that possibly we may, by the help of physical principles, especially
that of the Dissipation of Energy, some time attain to a notion of what constitutes Life—
mere vitality, nothing higher. (Lectures, 23–24)

What Tait, following the work of Herman von Helmholtz and Julius Robert Mayer,
makes clear throughout his lectures is that the concepts of energy conservation and
dissipation obliterate the strict dividing line between organic and inorganic spheres
of being (Lectures, 70–71). Of course, what Stevenson makes clear is that many
remained who would retain such a line; Jekyll himself deploys these terms in an
attempt to wall himself off from his alter-ego: “He thought of Hyde, for all his en-
ergy of life, as of something not only hellish but inorganic” (JH, 100). As this sen-
tence is rhetorically structured, “inorganic” provides the gravamen, trumping as
seemingly terminal an epithet as “hellish” to suggest Jekyll’s need to find grounds
of distinction beyond the moral categories that have already failed to mark his sepa-
rateness. The attempt to use “inorganic” as the final redoubt of differentiation sig-
als that Jekyll’s “transcendental medicine” (JH, 76) is another name for the kind
of discredited vitalism that Tait and others derided; this is one indicator that Jekyll’s
assumptions belong to an outmoded brand of scientific thinking. The other, of
course, is a belief in perfect reversibility.

An engine is an apt metaphor for their irreversible situation insofar as Jekyll
and Hyde together represent two poles: Jekyll, the highly structured resources, fig-
ured in both the plentiful financial capital that funds Hyde’s nocturnal adventures
and the social capital that provides cover, an alibi, a veneer of respectability for his
ersatz protégé. Jekyll’s is the world of work, and even his social circle comprises
only other professional men. The long line of acronyms trailing his name, “M.D.,
D.C.L., L.L.D., F.R.S.” (JH, 10) punctuates the point. Hyde, on the other hand,
described as “on fire with sombre excitement” (JH, 73) is indeed the fire to Jekyll’s
fuel, the one who, Enfield says, “brought out the sweat on me like running” (JH,
4–5), who burns documents, cheque books and letters (JH, 31, 101), who breaks
out “in a great flame of anger” (JH, 27) before killing Carew, who consumes money,
the chemical salts, and the good name Jekyll has “laboured, in the eye of day” (JH,
79) to construct.22 It is a simple matter to turn work into heat, Tait argues, but
another thing entirely to turn dissipated heat back into work. Jekyll’s world is pain-
stakingly put together, but it is quickly consumed.

To dream of perfect reversibility is to dream of a world in which events don’t
matter and marks on a reputation dissolve just like “the stain of breath upon a
mirror” (JH, 86). Of course, events in the world do have real consequences, and
Stevenson’s emphasis on the physicality of the transformation ties the metamorpho-
sis to a world in which energy is finite and acts cannot be undone. In fact, Jekyll’s
experiment in reversibility is not just about sidestepping the consequences for spe-
cific acts; it is also about reversing that other irreversible human problem, the aging
process. Stevenson’s interest in this theme is understated, and as a result not much commented-upon, but it shows itself at key junctures in the novel. When Hyde visits Lanyon still wearing Jekyll’s clothes, he cuts a ridiculous figure, the picture of a child playing in a father’s wardrobe: “dressed in a fashion that would have made an ordinary person laughable; his clothes, that is to say, although they were of rich and sober fabric, were enormously too large for him in every measurement—the trousers hanging on his legs and rolled up to keep them from the ground, the waist of the coat below his haunches, and the collar sprawling wide upon his shoulders” (JH, 73). This is a comic introduction to the more serious theme developed in Jekyll’s narrative, the fear of getting old. He says of his need to find an outlet for his pleasures: “I was not only well known and highly considered, but growing towards the elderly man” (JH, 85), echoing an earlier remark by Lanyon regarding his own old age (JH, 12). Jekyll describes his first turn in Hyde’s body as an experience of youthful vigor: “There was something strange in my sensations, something indescribably new and, from its very novelty, incredibly sweet. I felt younger, lighter, happier in body. . . . I stretched out my hands, exulting in the freshness of these sensations” (JH, 82). Hyde, Jekyll thinks, represents untapped energy, a “new power” (JH, 85), and his wish to move reversibly between bodies, between the power of social and financial capital and the energies of youth, is a wish to thwart the irreversible direction of time’s flow in his life. It is here perhaps that we see most clearly the deep connection to Oscar Wilde’s novella The Picture of Dorian Gray, published just a few years later. While Stevenson’s work is more interested in questions of physical energy and is, in many ways, less moralistic than Wilde’s, both have their magic flights structured according to a strict economy that proscribes the cost-free access to youth. As the saying goes, “the light that burns twice as bright burns half as long,” and Hyde has burned very brightly; at least, he has expended his energy heedlessly. But he does not represent a reservoir of additional energy, nor the reversal of time; instead, his nocturnal accesses speed up the process of their joint demise, destroying the resources and the very structure of the world upon which the existence of both depend. Despite his youthful vigor, he is imprinted with “deformity and decay” (JH, 83). Hyde is not a fountain of youth, but a constituent part of an existing economy.

Dr. Jekyll and Mr. Hyde is not the only work in which Stevenson draws upon principles of strict energy conservation (the first law of thermodynamics) to fence in fantastic events. Most pertinent for our purposes is his 1893 short story “The Bottle Imp,” in which the protagonist Keawe asks the genielike imp for a new house. It does not magically appear; instead, Keawe returns home to find the exact sum needed to hire contractors and laborers and to buy building materials bequeathed to him by an uncle who has recently died (presumably at the precise moment the wish was made). Even magic cannot create matter or energy ex nihilo; they must come from an already existing supply, and with all the moral consequences of ex-
appropriation.26 The world of Dr. Jekyll and Mr. Hyde also obeys such restrictions, as Jekyll's experiment increasingly deranges its own resources as well as those of the world beyond just to keep itself going.

In its emphasis on material resources, the novel expresses neo-Malthusian anxieties of scarcity articulated in William Stanley Jevons's influential 1866 work The Coal Question, which itself draws upon advances in thermodynamics to warn of the eventual exhaustion of England’s resource base.27 The chemical formula used to effect Jekyll's transformation changes over the course of the novel from a frothing beaker, a kind of prop, to a substance dependent upon a specific salt drawn from the inventories of chemical retailers. Jekyll simply has it in his possession at the beginning; he has “London ransacked” (JH, 102) to try to acquire it by the end. If Stevenson's vision for Dr. Jekyll and Mr. Hyde “came out of a deep mine,” the particular salt needed for the transformation does not.28 The shift in the novel’s interest in the material fact of the compound marks a growing awareness of finitude, both in Jekyll's own internal world and in the external world that is becoming more and more of a problem for him. The London streets, filled with vendors “laying out the surplus of their grains” (JH, 3) in the novel’s opening, are desolate by its end.29

The irreversible diminishment of resources, and the steam engine metaphor that focuses it, provides one set of terms through which to understand the imprint of thermodynamics on tropes of transformation in the novel. The second, related, set of terms is the gradual but inevitable transition from order, which requires energy for its maintenance, to disorder, the increase of which represents a loss of usable energy. As scientists like James Clerk Maxwell and Ludwig Boltzmann began to discuss the relationship between micro and macro states, between the motion of particles on the molecular level and the overall direction or organization of a system, the steam engine was supplemented with other heuristic devices for imagining the flow of energy and the problem of irreversibility. When discussing the behavior of gases, writers like Maxwell often posited two chambers, one hot, with fast-moving molecules, the other cold, with slow-moving ones. Such a set of circumstances is highly ordered, as it is extremely unlikely that all the molecules of one speed would randomly collect in one place. Maxwell and others are still, of course, discussing energy—heat, velocity, the difference between states that can be turned into work—but now explicitly couched in the language of organization, probability, and order.30

This is crucial for Jekyll and Hyde, who are imagined not merely in terms of their respective expressions of energy, but also as separable identity compartments—indeed this is explicitly Jekyll's project, to effect a complete division of his "elements." With the discussion of separable chambers in physics experiments in mind, the description of unmodified human nature as an "incongruous compound" (JH, 85) takes on added significance. Thus it is not simply that Jekyll represents ordered energy and Hyde dissipation and increasing disorder—though that

8 REPRESENTATIONS
is suggested too—but the separation itself represents a particular vision of order that maintains a division between disparate states of existence. Peter Garrett describes the experiment as “a process of chemical purification,” and here it may be helpful to follow Jekyll’s lead and for the moment imagine the idea of “purity” simply as an ideal, unmixed concentration, that is, Hyde as “pure evil” (JH, 84).31 In an 1870 address, James Clerk Maxwell explains the science behind separation on the molecular level with characteristic lucidity:

One of the most remarkable results of the progress of molecular science is the light it has thrown on the nature of irreversible processes—processes, that is, which always tend towards and never away from a certain limiting state. Thus, if two gases be put into the same vessel, they become mixed, and the mixture tends continually to become more uniform. . . . In the case of the two gases, a separation may be effected by chemical means.32

Although the strictness of the division between Jekyll and Hyde is certainly troubled from the very first transformation—there is, for instance, immediate confusion over pronoun attribution—the breakdown, the growing uniformity of their states, is also progressive: “When I slept, or when the virtue of the medicine wore off, I would leap almost without transition (for the pangs of dissolution grew daily less marked) into the possession of a fancy brimming with images of terror” (JH, 100). The reason for the growing ease of transition is that the Jekyll and Hyde identities, united by the fear of death, grow toward each other and seep through whatever barriers—physiological, linguistic, social, moral—that would keep them separate. Jekyll develops “a certain callousness of soul” (JH, 101) and becomes an accessory to murder, while Hyde, exposed and hunted, learns how to navigate the conventions and institutions of the social world: “Yet the creature was astute; mastered his fury with a great effort of the will; composed his two important letters, one to Lanyon and one to Poole; and that he might receive actual evidence of their being posted, sent them out with directions that they should be registered” (JH, 98). Thus while of course we never believe any “purity” of state was attained even briefly, whatever differences of concentration obtain between the two men clearly grow less stark as the novel progresses. The process is one of gradual intermingling, but not in the direction of cohesion. Rather, the amalgamation of Jekyll and Hyde represents a growing disorganization of identity, something the Beckettian struggle with pronouns—“He, I say—I cannot say, I” (JH, 98)—highlights, exposing as artificial the demarcations of the language of selfhood. When Lanyon and Poole break down the door to Jekyll’s chamber, the final barrier between himself and everything not himself, it externalizes and finalizes a process that had been occurring gradually and internally. The voice behind the door is Jekyll’s; the dead body on the floor when they enter is Hyde’s.

The plot is thus itself a kind of irreversible force in the novel. The directionality of narrative is explicitly discussed in the first chapter, when Enfield tells Utterson why he has not looked further into the strange case of Mr. Hyde:

Irreversible Transformations
I feel very strongly about putting questions; it partakes too much of the style of the day of judgment. You start a question, and it’s like starting a stone. You sit quietly on the top of a hill; and away the stone goes, starting others; and presently some bland old bird (the last you would have thought of) is knocked on the head in his own back garden and the family have to change their name. (JH, 7)

No doubt the kernel for this comparison came from a novel Stevenson knew well, Sir Walter Scott’s Waverly:

But before entering upon a subject of proverbial delay, I must remind my reader of the progress of a stone rolled down hill by an idle truant boy (a pastime at which I was myself expert in my more juvenile years): it moves at first slowly, avoiding by inflection every obstacle of the least importance; but when it has attained its full impulse, and draws near the conclusion of its career, it smokes and thunders down, taking a rood at every spring, clearing hedge and ditch like a Yorkshire huntsman, and becoming most furiously rapid in its course when it is nearest to being consigned to rest for ever.35

In both texts, the path of the stone is irreversible, but Stevenson emphasizes this aspect by tying its descent not only to public exposure and injury (however comically depicted) but also to judgment day and the end of time. In his hands, the comparison no longer describes the variable speeds of a well-told tale and a narrator in command of his material, but exactly the opposite: narrative as loss of control. This is a fitting description of the plot of Dr. Jekyll and Mr. Hyde, which employs a series of narrators and storytellers, each of whom unwittingly plays a part in bringing about the plot’s violent conclusion. The novel’s asymmetrical structure—the third-person omniscient narrator gives way to Lanyon’s letter and then Jekyll’s “Full Statement,” and does not return to close the “frame”—only emphasizes the feeling that nothing in this world returns to its initial conditions. As Jekyll ruefully notes, “The movement was thus wholly toward the worse” (JH, 85).

The downhill metaphor was also, it is worth noting, one often used in physics to describe the relationship between energy of position (potential energy) and energy of motion (kinetic energy). It was an especially critical concept for engineers designing waterwheels to harvest energy from the downhill flow of rivers. Tait writes, “When you are converting energy from the high form into the low, you can carry out the process in its entirety, but when it comes to be a question of the reversal—going up-hill, as it were—then . . . [it is] only a small fraction of the lower kind of energy which can be raised up again into the higher form. All the rest sinks down lower in the process” (Lectures, 72).

Stevenson frequently compared the methods and representational practices of science and literature, which is perhaps not surprising for a person who abandoned one discipline to pursue the other. He writes in his Records of a Family of Engineers: “engineering looks one way, and literature another,” but the grounds on which that work posits the difference in perspective is illuminating.31 Engineering and literature may look in different directions but they do so, Janus-like—or Jekyll-and-
Hyde-like—from a shared vantage point, animated by a similar set of concerns and imperatives. Both depend for their success on careful attention to the contours of the external world, using that attention to shape and manage their material according to their mandate. Stevenson writes in “A Humble Remonstrance” on the need for judicious abstraction: “Man’s one method, whether he reasons or creates, is to half-shut his eyes against the dazzle and confusion of reality.” His affectionate criticism of his grandfather’s engineering diary is leveled not because he thought Robert Stevenson’s interests insufficiently interesting, but because he thought them handled with insufficient art: “So far as the science can be reduced to formulas and diagrams, the book is to the point; so far as the art depends upon the intimate study of the ways of nature, the author’s words will too often be found vapid. . . . Of such are his repeated and heroic descriptions of reefs; monuments of misdirected literary energy, which leave upon the mind of the reader no effect but that of a multiplicity of words and the suggested vignette of a hasty old gentleman scrambling among tangle” (Records, 263–64). The phrase “misdirected literary energy” unites the worlds of literature and engineering by noting how his grandfather, dazzled and confused, has sundered them in his prose. What Stevenson admires most about the practice of engineering is precisely what he finds missing in his grandfather’s writings about it: the careful, necessary arrangements made to direct energy forms and minimize waste. He writes, “The duty of the engineer is twofold—to design the work and to see the work done. . . . Perfection (with a capital P and violently underscored) was his design. A crack for a penknife, the waste of “six-and-thirty-shillings,” ‘the loss of a day or a tide,’ in each of these he saw and was revolted by the finger of the sloven” (Records, 265–66).

In its perfectly honed and gemlike sentences, in the almost clinical precision with which the plot orders its interlocking voices, Stevenson’s novel is a work of marvelous engineering, of masterfully directed literary energy. The craftsmanship is evident in the care he takes with the textured details of his world; for example, in the pause he inserts between Utterson’s request to Hyde to show his face and the latter’s accession to it: “Mr. Hyde appeared to hesitate, and then, as if upon some sudden reflection, fronted about with an air of defiance” (JH, 16). It is a tiny moment, but in it we see Stevenson’s minute attention to psychological detail in the characters’ interaction with their own physical beings. Confronted by someone who knows Jekyll’s appearance so intimately, the fear of detection momentarily seizes Hyde; with characteristic hubris, he then declares his absolute belief in the efficacy of his experiment by throwing his transfigured face directly under the gaze of an old friend. The physical world exerts a real pressure in this novel, and if the fantastic change manages a small triumph over it in this early scene, the terms of the struggle are nevertheless set. For Stevenson, the more fantastic the story, the stronger the imperative to retain a sense of fidelity to the contours and strictures of physical reality. Robert Kiely, writing on Stevenson’s adventure tales, notes, “Stevenson refuses to leave even the trace of a possibility that dream, magic, or obscure

Irreversible Transformations  11
powers of the will may have been at work in shaping the weird worlds into which his heroes wander. There is only one way to distort dull reality, and that is by faking. Jekyll isn’t faking the transformation, of course, but over the course of the novel, “dull reality” reasserts its inviolability and refuses to be sidestepped or altered by his obscure powers. At the outset of his experiment, Jekyll believes, “the situation was apart from ordinary laws” (JH, 87), but physical law cannot be evaded by even the most ingenious engineering or fantasy; his attempt to do so brings it back upon him with a “more unfamiliar and more awful pressure” (JH, 81).

Thus far the discussion of the transformation between Jekyll and Hyde has been limited to imagining it as a purely physical phenomenon, a problem of dissipation and loss of structured differentiation. But of course those features of the novel are tied intimately to the story of a person’s loss of internal moral bearings. Jekyll cannot endlessly return himself to his original state, not simply because transformation by nature degrades energy and irreversibly homogenizes differentials, but because after so many iterations, and so much moral confusion, he begins to lose a sense of what that original state was. Who is Jekyll if he enjoys Hyde’s experiences vicariously (or viscerally), covers up his crimes, allows him the license to indulge what he otherwise thinks he condemns? This complex interplay between the physical-scientific and internal-moral domains of the novel will become more clear in the light of Stevenson’s poetics of abstraction.

“A Humble Remonstrance” was written to object, politely, to the kind of journalistic realism championed by the novelist and historian Walter Besant in his essay “The Art of Fiction.” Stevenson bases his argument for abstraction on the symmetries he finds between literature and science:

The whole secret is that no art does “compete with life.” Man’s one method, whether he reasons or creates, is to half-shut his eyes against the dazzle and confusion of reality. The arts, like arithmetic and geometry, turn away their eyes from the gross, coloured and mobile nature at our feet, and regard instead a certain figmentary abstraction. Geometry will tell us of a circle, a thing never seen in nature; asked about a green circle or an iron circle, it lays its hand upon its mouth. So with the arts. Painting, ruefully comparing sunshine and flakewhite, gives up truth of colour, as it had already given up relief and movement; and instead of vying with nature, arranges a scheme of harmonious tints. Literature, above all in its most typical mood, the mood of narrative, similarly flees the direct challenge and pursues instead an independent and creative aim. (HR, 348–49)

If Dr. Jekyll and Mr. Hyde has this abstract quality it is, curiously, to be found in its description of moral action. The novel refrains from specifying not only the nature of most of Hyde’s sins but also that of Jekyll’s, Utterson’s, and Enfield’s as well. Thus we get moral life couched in these terms:

Many a man would have even blazoned such irregularities as I was guilty of; but from the high views that I had set before me, I regarded and hid them with an almost morbid sense
of shame. It was thus rather the exacting nature of my aspirations than any particular degradation in my faults, that made me what I was, and, with even a deeper trench than in the majority of men, severed in me those provinces of good and ill which divide and compound man’s dual nature. (JH, 78–79)

It is precisely because of this essentially abstract moral discourse and the omission of specific facts about both transgressive and virtuous behavior that we can see how the physical-scientific and moral forms of transformation are essentially coextensive in this novel, and why it is important that they are so. The kind of rhetoric quoted here, found throughout the novel, structures its moral world in terms of a play of forces rather than in terms of the texture of observable and therefore appraisable action. What is emphasized is the power of certain states of mind rather than the moral details of their contents.

If, as almost all critics have noted, the novel upsets any simple allegorical attempts to index moral nature to the appearance of a body or a face, it nevertheless does insist upon a relationship between inner and outer states. This insistence is perhaps nowhere more clearly seen than when Jekyll, sunning himself on a park bench, indulges in a reverie of self-congratulation and then immediately finds himself changed into Hyde. Here, a direct avenue of influence between the moral life and a physical expression is evident. At other moments, the physical world retains a life of its own, a pressure and a reality not immediately traceable to any particular moral trigger. When Jekyll begins to change into Hyde whenever he falls asleep, for instance, there is no specific act or thought that catalyzes the transformation. But if the moral and the physical worlds are at times immediately linked, and at other times only distantly so, in all instances they track each other in general direction: the more irreversible the transgressive acts that mar their collective conscience (from physical assault to murder), the greater the moral confusion and the greater the physical instability. The way in which the moral life, however vaguely or provisionally defined in the characters’ own minds, undergoes a process of irreversible change and expresses itself in physical terms suggests that the material world of the novel is not just animated according to a system of moral reference, as in traditional allegory, but by the principles of energy as well. The energy forms underwrite moral allegory by mapping the deterioration of physical states to deterioration of moral being, where the natural tendency is always toward “lower,” “dissipated,” or “degraded” forms; but the discourse of energy also subverts allegory insofar as it always describes a continuum, one in which the singularity of states and the stark dividing lines that maintain them—good/evil, high/low, organic/inorganic—are broken down in a universe tending toward both homogenization and dispersal.

That moral transformation is structured in rough accord with the laws of energy physics does not make Stevenson a thoroughlygoing psychic materialist. The point is not that a person’s moral nature is nothing more than an energy system that inevitably and invariably degenerates over time; rather, it is that maintaining
any sense of a moral self requires constant effort, and when the effort ceases, the
moral self does not hold together naturally. We can easily imagine the moral world
of the novel structured quite differently: the transformation into both states could
have become easier over time. In that case, the novel would have suggested how
easily a person can reconcile himself to a two-faced existence. By structuring the
moral life in terms of a one-way energy system, Stevenson insists upon how palpa-
ble and undeniably real are its exigencies and requirements.

The imaginative way in which these domains are interbraided in the person of
Dr. Jekyll and Mr. Hyde may bear the imprint of Stevenson’s peculiar genius, but
the relationship between morality and energy science has an extensive history in
scientific and popular writing. Stevenson could structure the moral world of his
novel according to physical laws because those physical laws had already been thor-
oughly moralized. Most of the key terms used in thermodynamic science carry with
them moral implications: the inflection of words like “higher” and “lower” as de-
scriptors of energy in Tait’s lectures is subtle, while terms like “squandered” or
“wasted” are more overt, and “dissipated” or “degraded” unavoidably loaded. The
fact that there were also neutral descriptions in circulation—“unavailable” or “un-
usable” energy as a working definition of entropy, for example—means that the
popularity of a word like “dissipated” even more clearly highlights not simply the
presence of moral valences but also the desire for them to be embedded in scientific
discourse. As intellectual historians have shown, energy science, free-market eco-
nomics, and religion are discourses involved in a complex interchange of values,
metaphors, and assumptions: for example, all three treat as axiomatic the evil of
waste, as in “the finger of the sloven” that Stevenson’s grandfather sees at work in
the loss of form, time, and money alike. Similarly, accounting metaphors were used
to describe capital, energetic, and moral transactions, as ledgers mundane and tran-
scendent could make sense of a welter of chaotic events by organizing them into
columns of energy and entropy, profit and loss, good and evil: as in, “Hyde is gone
to his account” (JH, 62). The moralizing of energy is thus not confined to pheno-
mena like dissipation, but includes conservation and notions of universal record
keeping. For example, John Ruskin discusses the conservation of value and energy
interchangeably and in explicitly moral terms in Munera Pulveris: “The world looks
to them as if they could cozen it out of some ways and means of life. But they cannot
cozen it: they can only cozen their neighbours. The world is not to be cheated of
a grain; not so much of a breath of its air can be drawn surreptitiously. For every
piece of wise work done, so much life is granted; for every piece of foolish work,
nothing; for every piece of wicked work, so much death is allotted.”

In the human realm, one can profit through fraud, but the physical universe is exacting: the laws
that proscribe creation and annihilation of matter and energy ensure that even the
smallest transaction is being “watched” and accounted for. Energy conservation,
in this sense, becomes a surrogate for the divine.

Therefore, while the second law of thermodynamics describes the increase of
disorder, the futility of effort, the drag of imperfection stitched into all natural processes, and thus appears, to present-day minds especially, to suggest a purposeless cosmos, it was not necessarily viewed that way by nineteenth-century scientists. Entropy is an almost religious concept, not merely because it owes a good part of its genesis to the Scottish Presbyterian imagination, but because it implies a final record and therefore a final record-keeper. “Unavailable energy” means energy unavailable to humans; it does not mean altogether removed from the universe. Entropy is energy in a limbo state, but because energy is really only the context-specific ability to perform work, entropy not only reifies but also transcendentalizes it. To many thermodynamic scientists, especially Tait, it seemed likely that dissipated energy was waiting somewhere to be restored by extrahuman means.43

In a recent work on “The Moral Economy of the Ocean Steamship,” Crosbie Smith and his co-authors describe the moralization of engineering science in a particular nineteenth-century commercial enterprise. The divide between Unitarian and evangelical perspectives on efficient steamship design is stark: while both equate waste and sin, Unitarian optimism contrasts with evangelical beliefs about the inescapability of both. For evangelicals, the systemic degradation of energy is tied to a notion of the innate moral depravity of human beings and the imperfections that mar their creations. Just as the divine economy is a system in which few are saved and most are consigned to damnation, the inherent wastefulness of nature ensures that human intervention in its processes will never provide an escape from the laws of the system.44 For the evangelical William Thomson, any escape from the second law of thermodynamics could come from divine intervention alone; such a notion is in perfect consonance with a notion of grace bestowed upon an unworthy individual sinner, who can do nothing himself to win his salvation.

Along this dividing line, we can see Stevenson’s own tale of moral engineering falling squarely on the side of evangelical assumptions. The experiment in self-division is badly engineered, but it couldn’t have been well engineered. Stevenson makes clear that this rapidly unraveling existence of Jekyll and Hyde is only an extreme, externalized, and accelerated vision of the inner lives of the other characters in the novel. Hyde’s depredations flash through Utterson’s mind like “a scroll of lighted pictures” (JH, 13): “The figure in these two phases haunted the lawyer all night; and if at any time he dozed over, it was but to see it glide more stealthily through sleeping houses, or move the more swiftly and still the more swiftly, even to dizziness, through wider labyrinths of the lamplighted city, and at every street corner crush a child and leave her screaming” (JH, 14). The nightmare is not that Hyde could be anywhere; it is that he already is everywhere. The experiment, as Jekyll notes himself, reveals what was already there: “I have been made to learn that the doom and burthen of our life is bound for ever on man’s shoulders, and when the attempt is made to cast it off, it but returns upon us with more unfamiliar and more awful pressure” (JH, 81).

Just as the “flaw” in individual energy transactions led scientists directly to

Irreversible Transformations
visions of the eventual “heat death” of the universe, so does Jekyll’s story in the novel seem to portend something more calamitous for the city at large and the world beyond. We have already noted the seeming depopulation of London, and critics from Henry James onward have noticed the novel’s curious lack of female characters. Utterson, Lanyon, and the rest seem something of a terminal generation: the only reproduction effected by any of them is Jekyll’s self-reproduction (and consequent self-destruction). In one evocative, Eliotic passage, Stevenson describes the city in these terms:

The fog still slept on the wing above the drowned city, where the lamps glimmered like carbuncles; and through the muffle and smother of these fallen clouds, the procession of the town’s life was still rolling in through the great arteries with a sound as of a mighty wind. But the room was gay with firelight. In the bottle the acids were long ago resolved; the imperial dye had softened with time, as the colour grows richer in stained windows; and the glow of hot autumn afternoons on hillside vineyards, was ready to be set free and to disperse the fogs of London. Insensibly the lawyer melted. (JH, 37)

The reference to the apocalypse as described in the book of Revelation is impossible to miss (“And I beheld when he had opened the sixth seal, and, lo, there was a great earthquake; and the sun became black as sackcloth of hair, and the moon became as blood; and the stars of heaven fell unto the earth, even as a fig tree casteth her untimely figs, when she is shaken of a mighty wind” [7:12–13]), but just as evident in this passage is the interest in energy forms and chemical processes. The passage itself works by blending opposites: the word “carbuncles” yokes value and disease, fixity and decay, while the onrushing of life sounds phantasmal and vacant, the heedless and issueless expenditure of motion. The acids have inexorably merged into homogeneity; and opening the bottle will effect yet another dispersal, but one that will not, genielike, fill the room and sweep aside the fog that, we’ve already seen, is everywhere. The stored-up heat of autumn might give a warm rush and banish the gloom inside Utterson’s head, but, as with Jekyll’s tincture, the supply is limited and the effect only temporary.

The passage thus brings into relation the small physical processes taking place in the room, the fate of the larger world beyond, and the language of Christian eschatology. The second law of thermodynamics describes the flaws of any individual transaction, and from the time of its first formulation in the early 1850s, those flaws were understood to have ultimate, universal, and inescapable material consequences. This passage not only describes the irreversible merging of seemingly separate material entities, it also enacts a melding of the religious and the scientific, ancient and modern forecasts of doom. Jekyll notes: “Strange as my circumstances were, the terms of this debate are as old and commonplace as man; much the same inducements and alarms cast the die for any tempted and trembling sinner; and it fell out with me, as it falls with so vast a majority of my fellows, that I chose the better part and was found wanting in the strength to keep to it” (JH, 91). Dr. Jekyll and Mr. Hyde, a work both quintessentially Victorian and, at times, startlingly post-
modern (Jekyll’s “Full Statement,” brings Jorge Luis Borges and Samuel Beckett to mind), always seems to be looking in two directions at once. Both strange and commonplace, the transformation at the heart of the novel refashions time-honored tropes of metamorphic change and Christian apocalypticism through the inescapable physical pressures described by the science of thermodynamics.

Notes

I am very grateful to Professors Robert Kiely, Elaine Scarry, and Leah Price, whose careful reading and criticism improved this essay immensely.
2. Throughout this essay, I will refer to the Bantam Classic edition of Dr. Jekyll and Mr. Hyde (New York, 1981), hereafter cited parenthetically as JH.
4. See Donald Lawler, “Reframing Jekyll and Hyde: Robert Louis Stevenson and the Strange Case of Gothic Science Fiction,” Dr. Jekyll and Mr. Hyde After One Hundred Years, ed. Christopher P. Touney (Chicago, 1992), 247–61. Stephen Arata’s illuminating recent work delves with more specificity into links between Stevenson’s novel and contemporary scientific ideas. His focus is not on physical or energetic degradation as described by thermodynamics, but on tropes of social and biological degeneration, theorized by Max Nordau and Cesare Lombroso, Fictions of Loss in the Victorian Fin de Siècle (Cambridge, 1996).
5. Stevenson’s grandfather Robert, for whom Stevenson College in Edinburgh is named, was a well-known lighthouse engineer, and Stevenson’s paternal uncles and father, Thomas, all followed in Robert’s footsteps. Thomas Stevenson, bitterly disappointed that his son abandoned his scientific training and the family calling to pursue literature, was an active participant in the scientific culture of Edinburgh, ascending to president of the Royal Society in 1884.
10. It is worth noting that *The Memoir of Fleeming Jenkin* is almost exclusively interested in its subject as a personality and social being; there is little engagement with his work as an engineer.


13. For a valuable modern discussion of irreversibility, see Prigogine and Stengers, *Order Out of Chaos*, esp. 208–9, 310.


19. Friedrich Nietzsche, who was himself obsessed with bodily energy, describes the fatigue involved in maintaining a respectable persona: “The reason in this is that when defensive expenditures, be they ever so small, become the rule and a habit, they entail an extraordinary and entirely superfluous impoverishment. Our great expenses are composed of the most frequent small ones. Warding off, not letting things come close, involves an expenditure—let nobody deceive himself about this—energy wasted on negative ends.” Friedrich Nietzsche, *Ecce Homo*, in *The Basic Writings of Nietzsche*, trans. Walter Kaufmann (New York, 2000), 708, emphasis his.


22. As further evidence that Stevenson had engineering in mind, it is worth noting that the detective assigned to the Carew murder investigation is one “Inspector Newco-
men,” most likely a reference to Thomas Newcomen, the celebrated English inventor and “father of the Industrial Revolution” whose Newcomen engine, designed to pump water out of coal mines, was one of the first workable steam engines.

23. The adjective “old” is used again and again in the text, describing the bond between Lanyon, Utterson, and Jekyll nearly every time the topic arises (JH, 12, 16, 22, 42, 43, 67); but it is also used to describe the dissecting room (JH, 19), the revolver Lanyon readies (JH, 71), and, crucially, the chemical that Jekyll can no longer procure (“For God’s sake,” he added, “Find me some of the old” [JH, 55]).

24. Stevenson, in ailing health for most of his life, struggled continually with a feeling of bodily inanition. On his lack of “energy,” see his letter to Frances Sitwell, August 1881, in Letters, 3:221, and to his mother, 13 November 1882, in Letters, 4:24. At the age of twenty-three he wrote Sitwell: “If you knew how old I felt! I am sure this is what age brings with it—this carelessness, this disenchantment, this continual bodily weariness. I am a man of seventy: O Medea, kill me, or make me young again!” in Letters, 1:374; at the age of thirty-seven he signed a letter to a friend, “An OLD, OLD man,” in Letters, 6:71.


29. Stevenson makes a point of informing us that the “romantic maid” goes to her bedroom “about eleven” (JH, 26) and from her window sees Hyde murder Carew. She faints, doesn’t awaken until “two o’clock” (JH, 27), and then alerts the police that there is a dead body in the street below. Stevenson’s inclusion of such specific details about time indicates that Carew’s corpse lay in the street for three hours without a single person noticing. London is strangely empty.


31. Peter Garrett, “Cries and Voices: Rereading Jekyll and Hyde,” in Jekyll and Hyde After One Hundred Years, 64. For other discussions of the metaphor of chemical purification in the novel, see Vladimir Nabokov, Lectures on Literature, ed. Fredson Bowers (London, 1980), 182–84; and Ronald Thomas, “The Strange Voices in the Strange Case: Dr. Jekyll, Mr. Hyde, and the Voices of Modern Fiction,” in Jekyll and Hyde After One Hundred Years, 79.


36. For useful descriptions of Dr. Jekyll and Mr. Hyde as a kind of mechanism, → Irving S. Saposnik, “The Anatomy of Dr. Jekyll and Mr. Hyde,” Studies in English Literature, 1500–1900 11, no. 4 (Autumn 1971): 726; and Garrett, “Cries and Voices,” 60. Stevenson’s
text may be a better “engine” than his grandfather’s, but as Garrett and others have shown, its effect is to break apart settled categories and raise questions it doesn’t answer.


38. Another key subversion of magic occurs when Hyde offers Lanyon “a new province of knowledge and new avenues to fame and power” (JH, 75) if he agrees to behold the transformation. Hyde assumes the role of Mephistopheles in this scene, but Lanyon’s curiosity gains him nothing, not even the temporary access to “fame and power” usually granted to participants in such fateful pacts.


40. Unsurprisingly, the emphasis on the force of psychic states has made the novel an inviting candidate for Freudian interpretation. The focus on energy forms is, in a sense, both a revision and an elaboration of the psychoanalytic point of view, insofar as Freud’s understanding of the psychic “mechanism” was profoundly influenced by thermodynamics, especially as described by Herman von Helmholtz. The connection between Stevenson and Freud can be traced back to a shared background in energy science. See Frank Sulloway, Freud: Biologist of the Mind (New York, 1979), esp. 170, 235.

41. Crosbie Smith writes on steamship engineers and their financial backers: “In all of these cases, capital, in whatever form, could be deployed for the benefit of humankind or for wasteful and extravagant ends. From the perspective of a Christian moral economy, therefore, the parable of the talents treated capital as a gift to individuals, to be used wisely or simply wasted through a lack of use. Sooner or later, however, the individual would have to account for his actions, morally as well as materially, leaving, as Thom had long preached, true waste (manifest as either reckless extravagance or as unwise parsimony) as the ultimate sin of humankind.” Crosbie Smith, Ian Higginson, and Philip Wolstenhome, “‘Avoiding Equally Extravagance and Parsimony’: The Moral Economy of the Ocean Steamship,” Technology and Culture 44, no. 3 (July 2003): 462.


43. For example Tait and Stewart discuss the dissipation of energy in The Unseen Universe: “In fine, it appears to us less likely that by far the larger portion of the high-class energy of the present universe is traveling outwards into space with an immense velocity, than that it is being gradually transferred into an invisible order of things” (199). The term “high-class” is, of course, very relevant to this discussion; even though such a descriptor was not commonly used to describe available energy, the passage is indicative of how offhandedly scientific terms could be loaded with social and moral freight.