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Science, Medicine, Technology & the Novel, 1860-1915

Nineteenth-century science has received a bad rap: for evidence, one need look no further than the antebellum novels and stories of Nathaniel Hawthorne. Almost all of his characters who commit the unpardonable sin of violating "the sanctity of a human heart" (*The Scarlet Letter,* Ch. 17) are men versed in modern science, medicine, or technology: Roger Chillingworth, the twisted "leech" who subtly tortures the man who cuckolded him (*The Scarlet Letter*, 1850); a researcher who performs fatal plastic surgery on his wife ("The Birthmark," 1845); a botanist whose toxic experiments destroy his only daughter ("Rappaccini's Daughter," 1844). The narrator of *The Blithedale Romance* (1851) equates science with vivisection: "if we take the freedom to put a friend under our microscope, we thereby insulate him from many of his true relations, magnify his peculiarities, inevitably tear him into parts, and of course patch him very clumsily together again" (Ch. 9). Empirical study, by this account, is a cold, dissecting, third-person affair; it is the work of the man of letters to attend to the hot, relational, first-person aspects of experience.

Hawthorne wrote of his repugnance for scientific scrutiny in 1851; a scant decade later, the poet Emily Dickinson cannily made the opposite case, affirming the "prudence" of the clarifying vision provided by modern technologies:

> "Faith" is a fine invention
> When Gentlemen can *see*—
> But *Microscopes* are prudent
> In an Emergency— (F202)

Dickinson, writing on the cusp of the American Civil War, was aware of the ways that uncertain, turbulent times can outstrip the human capacity to comprehend them. Rather than eschew modern technologies, Dickinson likened her compressed, elliptical poems to "microscopes": small in circumference but powerful in their ability to magnify human insight. Science is here returned to its Latin root, *scientia*—knowledge gained through study, observation, and experience—making it the purview of the poet and biologist alike.

Although the years 1861 to 1865 were immensely productive for Dickinson, the same period witnessed a virtual moratorium on long narrative fiction in the United States. The most absorbing cultural story in the early 1860s, it appears, was the devastating one unfolding in real time. The next generation of U. S. writers either headed overseas (as did Henry James, Henry Adams, and William Dean Howells), turned to journalism (e.g. Samuel Clemens, Louisa May Alcott, Walt Whitman), or were caught up in the antislavery cause and the war effort (as with Frances E. W. Harper, Thomas Wentworth Higginson and John W. DeForest). Meanwhile, literary voices of the earlier period went all but silent. Herman Melville published his final novel, *The Confidence Man*, in 1857. Hawthorne followed with his last completed romance, *The Marble Faun*, in 1860, and died before the war was over. Ralph Waldo Emerson delivered his Concord neighbor's eulogy, as he had for Henry David Thoreau, who died of tuberculosis in 1862. (Not surprisingly, Emerson's first post-war publication was the elegiac poem, "Terminus," in 1866.) In the words of Americanist scholar Louis Menand, "The Civil War swept away the slave civilization of the South, but it swept away almost the whole intellectual culture of the North along with it" (preface).

The decade of the 1860s, however, witnessed a flourishing of the natural sciences. The United

States was entering the world stage, scientifically speaking: the internationally acclaimed zoologist Louis Agassiz founded the Museum of Comparative Zoology in Cambridge, in 1860, and by decade's end, the American Museum of Natural History opened its doors in New York. The director of Harvard College's observatory, George Phillips Bond, in 1865 became the first American to receive the Royal Astronomical Society's gold medal. Cultivation and dissemination of scientific knowledge was fostered by the passage of the first federal land-grant college bill in 1862 and the publication of James Dwight Dana's *Manual of Geology*, a milestone in the development of a specifically U. S.-based physical science.

Technology also proliferated during the volatile war years. Following the founding of the Massachusetts Institute of Technology in 1861, the first successful oil pipeline was laid in Pennsylvania, George Westinghouse devised the air brake for use on railways, and the first commercially successful typewriter was developed (employing the QWERTY keyboard in use today). Perhaps most significantly, in 1863 and at the height of the war, Abraham Lincoln signed the Act of Incorporation founding the National Academy of Sciences, creating a group of scientific elites who would serve as "advisers to the nation on science, engineering, and medicine." If we looked solely at the institutionalization of science, the 1860s could be seen as a time of stately progress and steady development. The facts on the ground, however, evoke a more equivocal story. The Civil War plunged the United States violently into the modern era, with the overwhelming demand for artillery, ammunition, and transportation fueling industrial innovation. Advances in metallurgy and allied technologies gave rise to new classes of weapons unprecedented in their precision and firepower, including rifled guns, repeating weapons, and light-weight cannons. (Dynamite, barbed wire, the self-propelled torpedo, and the Gatling gun were all patented in the 1860s—though only the last saw use, albeit limited, on American battlefields). The first clash of ironclad ships took place between the Union *Monitor* and the Confederate *Merrimac* in 1862, forever changing the nature of naval warfare. Meanwhile, the growing network of factories, railroads, and shipping routes provided the infrastructure to support an emergent corporate capitalism in the decades that followed.

During the war years medicine, perforce, became a national concern. New technologies of destruction, when combined with older military tactics geared for less accurate armaments, produced unheard of damage to human bodies. Injured soldiers, in turn, formed massive patient populations, creating a pool of unwilling experimental subjects for desperate doctors trying to repair injured minds and bodies in hastily constructed field hospitals. Henry Adams's anonymously published work, *Democracy: An American Novel* (1880), articulated the difficulty of assimilating the monumental scale of modern carnage as a young woman visiting Arlington National Cemetery

> found herself suddenly met by the long white ranks of head-stones, stretching up and down the hill-sides by thousands, in order of baffle; as though Cadmus had reversed his myth, and had sown living men, to come up dragons' teeth. She drew in her horse with a shiver and a sudden impulse to cry. Here was something new to her. This was war—wounds, disease, death. (Ch. 9)

The scene at Arlington gestures to the terrible sublimity of violent cultural transformation by depicting a character groping for a way to assimilate the deadly consequences of monumental human aspiration when coupled with mechanical innovation.

The post-Civil War U. S. novel reflected the paradoxes of progress that attended the United States' militant entry into modernity. The terrible toll of "blood and treasure" (to quote Lincoln's 1862 State of the Union Address) gave writers new license to represent the social fabric, and indeed human bodies, in tatters. There was also a felt imperative to reconstruct viable cultural narratives for changed conditions. The results

were equivocal. The extension of human power embodied in new technologies was tempered—as writers such as Rebecca Harding Davis, Frank Norris, and Edith Wharton made clear—by a correspondent sense of diminished agency as individuals found themselves immersed in brutal factory systems, enfolded in anonymous city crowds, and buffeted by a volatile economic system.

Evolutionary theory's challenge to religious precepts and traditional social structures triggered a vertiginous sense of dislocation that, as Hamlin Garland, Charles Chesnutt, and Kate Chopin would portray, led to naturalized, frequently invidious ways of sifting individuals into class, race, and gender hierarchies. As Oliver Wendell Holmes and Charlotte Perkins Gilman would document, the newly institutionalized disciplines of psychology and scientific medicine, which promised to ameliorate distress and shed light on the deepest recesses of human experience, also codified new ways of labeling and disciplining suffering human souls.

Formally, novels published after 1870 tended to mute the didactic moral voice associated with pre-Civil War prose and favor an impersonal or "objective" narrative perspective. In *Uncle Tom's Cabin* Harriet Beecher Stowe had directly addressed her readers, "I beseech you, pity those mothers that are constantly made childless by the American slave-trade!" (Ch. 45). By contrast, in *Sister Carrie* (1900) Theodore Dreiser deployed the clinical perspective of the budding social sciences**:** "When a girl leaves home at eighteen, she does one of two things. Either she falls into saving hands and becomes better, or she rapidly assumes the cosmopolitan standard of virtue and becomes worse" (Ch. 1). Scholars such as Lawrence Rothfield have linked narrative objectivity with the detached, disembodied perspective associated with modern medicine: "The observing gaze," writes French philosopher Michel Foucault, "refrains from intervening: it is silent and gestureless. Observation leaves things as they are; there is nothing hidden to it in what is given" (Ch. 7).

As we will see, many late nineteenth-century novelists employed a particular form of narrative speech known as free indirect discourse, a modification of the clinical gaze Foucault describes. Free indirect discourse, familiar to readers since Jane Austen, is a stylistic device that combines a third-person perspective with aspects of first-person direct speech. It can be likened to literary laparoscopy in its capacity to snake inside and reveal the inner workings of different minds. Henry James further refined this narrative practice in *The Portrait of a Lady* (1881) by keeping the point of view closely identified with the "exquisite consciousness" of the protagonist Isabel Archer. Other writers also used free indirect discourse to extend their narrative range: in *The House Behind the Cedars* (1900), for instance, Charles Chesnutt gives voice to the unstated, barely conscious perceptions of a racist white character, who "felt a momentary touch of annoyance that a negro woman should have intruded herself into his dream at its most interesting point" (Ch. 12). Chesnutt here presents bigotry from the inside, offering a glimpse of the private prejudices that propel individual action and that also underlie large social formations—in this case, the invidious system of racial segregation laws known collectively in the United States as "Jim Crow." Updated by writers at the cusp of the twentieth century, the technique of free indirect discourse was fertilized by novel theories about human psychology and the nervous system, modern technologies of observation, and wide-ranging modifications in the equipment of everyday life.

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The post-Civil War U. S. novel can itself be seen as an important technology for mediating—as well as meditating upon—the on-the-ground, in-the-mind, lived transformations of a rapidly modernizing United States. Section One will examine the interrelationship of technology and the novel, focusing on the literary embrace of the train and the telegraph, innovative devices that enabled human beings to fling themselves and their thoughts across vast distances. Novelists deployed a phalanx of physician characters, cultural and corporeal interpreters who also sought

to ameliorate the stresses attendant on increased speed and mobility. Narratives about technology's perceived effects on individual bodies and minds promoted the new fields of physiological psychology and neuroscience, which affirmed a link between nervousness and "civilization" that helped secure the social standing of anxious, largely white middle-class Americans. Section Two shifts from the micro-narrative of the nervous individual to the macro-narrative of the transformed and transforming human species, by examining the novel's assimilation of evolutionary theories. The novel, by providing a ready-made form for stringing along causes and effects, was well suited to the narrative, accretive sensibility of the new biology. Section Three further examines how the post-Civil War novel didn't just reflect advances in medicine or science but could itself be understood as a technology of visibility analogous to the photograph (in its realism) and microscopy (in its artifice). Before Rorschach tests and MRIs—and indeed, before the high modernist literary experiments of William Faulkner, H. D., and Jean Toomer— late-nineteenth-century U. S. writers used the novel to explore the motions of human consciousness encountering a dynamic and changing world.

1. "A NETWORK OF IRON NERVES": TECHNOLOGY, MEDICINE AND THE NOVEL

In Chesnutt's *The House Behind the Cedars,* a key plot point turns on a character's inability to get in touch with someone in a distant town, for "the train had gone; there was no telegraph to Patesville, and no letter could leave Clarence for twenty-four hours" (Ch. 11). Following the war years, the translation of military innovation into day-to-day civilian life was most visible in new technologies of transportation and communication. Lincoln had signed into law the Pacific Railway Act, authorizing the creation of the first transcontinental railroad. The train and the telegraph, novelties in the antebellum period (think of Clifford's fantastical train ride in Hawthorne's *The House of the Seven Gables* [1852]) and then essential for transporting troop supplies and casualty lists, furrowed the national landscape in the decades that followed the war. Physician and novelist Oliver Wendell Holmes likened the newly technological nation to "a single living organism" connected by "a network of iron nerves" (the telegraph) and a "vast system of iron muscles" (the train) ("Bread and the Newspaper," 1861).

Novels registered the presence of these prosthetic "nerves and muscles": the telegraph and train not only put the mark of modernity on natural settings, they seeped into the mental and spiritual fabric of American life. In Willa Cather's *The Song of the Lark* (1915), the bone-chilling winds of rural Colorado send "the naked cottonwood trees against the telegraph poles and sides of houses," while an old lady huddled in an isolated church "made long, tremulous prayers, full of railroad terminology" (Part I, Ch. 17). When characters in William Dean Howells's *The Undiscovered Country* (1881) hop on the wrong train, it speeds them northward toward a settlement of Shakers and sets in motion the novel's exploration of alternative faith communities in the industrial age.

These modes of transport took on life-like animation in nineteenth-century novels, where they both figured and fueled the restlessness, speculation, and possibility of modern life. Here is Dreiser's memorable description of Sister Carrie's physical and existential journey into a new urban existence populated by sentient-seeming technologies: "They were nearing Chicago. Already the signs were numerous. Trains flashed by them. Across wide stretches of open prairie they could see lines of telegraph poles stalking across the fields toward the great city" (Ch. 1). By collapsing distance and speeding up travel, the railway became an effective plot device for novelists' portraying the post-bellum clash of cultures between rural modes and mores and those of the city. Train travel set in relief the political and cultural divisions between North and South, as when an African-American physician in Chesnutt's *The Marrow of Tradition* (1901) is forced to switch to a segregated car once the train headed for North Carolina passes over the Mason-Dixon Line. Similarly, W. E. B. Du Bois

inaugurates *The Souls of Black Folk* (1902) with a journey from the industrial North into the "Black Belt" below Atlanta. The geographical expedition by rail structures the spiritual passage of Du Bois as he gives voice to post-War, post-Thirteenth Amendment African-American experience.

As vehicles of cultural change, trains at mid-century came under the scrutiny of scientists and physicians. The medical journal the *Lancet* in 1862 began a series of articles reporting on "The Influence of Railway Travelling on Public Health." Doctors worried about long-term nerve damage from the constant shaking and jarring; local authorities were concerned about catastrophic train wrecks brought about by single-track lines, insufficient signals, and poor braking technologies; insurance companies fretted over the lawsuits these crashes set in motion; farmers were troubled by increasingly powerful railroad monopolies; and commentators of all stripes puzzled over the effects of so much speed and motion. Oliver Wendell Holmes encapsulated a repeated concern, that "[a]ll this change in our manner of existence implies that we have experienced some very profound impression, which will sooner or later betray itself in permanent effects on the minds and bodies of many among us" (1861).

One can trace the technological, scientific, and medical aftershocks of the Civil War through the career trajectories of two men who found their vocations in the upheavals of the 1860s. Both S. Weir Mitchell (1829-1914) and William James (1842-1910) trained as physicians, though the two men weathered the war off the battlefield, the former in nearby field hospitals, and the latter in Cambridge pursuing his medical studies. Both helped to create new medical fields—Mitchell neurology, James psychology—that sought to explain the effects of modernity on human minds and bodies. As a contract surgeon for the Union army, Mitchell saw the war's casualties up close, an experience that led quickly to two influential publications: "The Strange Case of George Dedlow" (1866), a story narrated in the first person, in which a physician describes the psychological and physiological effects of having all four of his limbs amputated, and the medical work *Injuries of Nerves and Their Consequences* (1872), an early contribution to the study of traumatic nerve injuries. Decades before British doctors described the distressing toll of trench warfareon soldiers' minds, and a century before post-traumatic stress disorder (PTSD) would enter the therapeutic lexicon, Mitchell had defined the contours of shell shock—a disorder he described in physiological, rather than psychological, terms. Mitchell, a novelist as well as a physician, achieved notoriety for his work with patients suffering from neurasthenia, a specifically modern illness that came to be known as "American Nervousness." (Mitchell's rest cure for women suffering from nervous collapse, though maligned by prominent women such as Charlotte Perkins Gilman, attracted the attention of the young Viennese physician Sigmund Freud.) The founder and first president of the American Neurological Society, Mitchell drew a direct line between the modern industrial society and functional nervous disease in his medical treatise *Wear and Tear, or Hints for the Overworked* (1871): "The industry and energy" of the modern city, he affirmed, "are now at work to undermine the nervous systems of its restless and eager people."

Whereas Mitchell's neurological theories explained how technology transformed social conditions and shaped human bodies, the new psychology of William James drew on evolutionary biology to explain the embodied workings of the human mind. (Both James and Mitchell suffered from neurasthenia, the very nineteenth-century malady that their studies of the human nervous system helped to define and which Mitchell spent a lifetime treating.) James attended Harvard's medical school and in 1865 traveled with the anti-Darwinist scientist Louis Agassiz to Brazil; soon after this expedition, however, James parted intellectual ways with his mentor and began to formulate his own ideas about the importance of transformation and adaptation for understanding human psychology. James taught at the Lawrence Scientific School and in 1890 published *The Principles of Psychology*, which became the foundational text of the new

physiological psychology. "A real science of man," James wrote," is… being build up out of the theory of evolution and the facts of archeology, the nervous system and the senses." As James's biographer Robert D. Richardson observes, "Since neither the pure physiologist nor the literary person who lacked firsthand knowledge of 'nervous physiology' could really do the job, James proposes 'a union of the two disciplines' in one man, a man such as himself" (Ch. 25).

The ravages of internecine war left behind a dazed and weary population on both sides of the conflict, while the diseases and injuries related to poor urban sanitation and factory work also left their mark on people's bodies and psyches. In this context, the scientifically trained physician became someone able to make sense of, if not always to heal, the incursions of machine onto muscle. Doctors were frequent protagonists in novels written in the 1880s, where—contra Hawthorne—they signified social stability and helped to mediate new scientific theories, experiences, and dangers. Although antebellum literary physicians and scientists existed in the richly symbolic world of romance, those who populate novels such as Henry James's *Washington Square* (1881), William Dean Howells's *Doctor Breen's Practice* (1881), and Weir Mitchell's *In War Time* (1884) are professionals with specialized training. They are also ambivalent figures, vested with life-and-death responsibility but often confronted with the limits of their authority or power. James's Dr. Austin Sloper may be an acclaimed physician but he's a deeply imperfect parent, and he finds himself bested by the very daughter he found dull and weak. Howells's clever homeopath Dr. Grace Breen defers to a male "allopath" —a mainstream doctor—when she's unable to help a sick patient, eventually giving up her practice entirely to marry. And despite his talent for treating wounded soldiers in a well-equipped Philadelphia hospital, Mitchell's Dr. Wendell succumbs to avarice and money trouble.

Doctors become useful flash points for novelists seeking to register the clash of traditional values with new social imperatives; the physicians' decisions frequently point hopefully to a new moral order adapted to changing social roles, for African Americans and women in particular. In Frances E. W. Harper's novel *Iola Leroy: Or, Shadows Uplifted* (1892), a white physician wishes to marry his neurasthenic patient; but after discovering her mixed-race background, he urges Iola to pass as white. She instead marries a scholarly black doctor who has refused to pass, and together they move south to serve as teacher and healer to the black community. It is an African-American physician, in Charles Chesnutt's *The Marrow of Tradition* (1901), who embodies hope for racial reconciliation after white supremacists incite a rampaging mob against the local black community. Elizabeth Stuart Phelps's protagonist in *Dr. Zay* (1882), like the young Nan Prince in Sarah Orne Jewett's *A Country Doctor* (1884), negotiates gender norms for women; unlike Howell's Dr. Breen, these women refuse to sacrifice their profession for an offer of marriage. As Dr. Zay affirms, she is first and foremost committed to her career, and "such a woman demands a new type of man" (Ch. 12). In Kate Chopin's *The Awakening* (1899) when a New Orleans physician is called in to explain the domestic rebellion of Edna Pontellier, he suspects that there is "a man in the case" but dispenses more reassuring, though less efficacious wisdom to her baffled husband: "Woman, my dear friend, is a very peculiar and delicate organism—a sensitive and highly organized woman, such as I know Mrs. Pontellier to be, is especially peculiar" (Ch. 22).

Cultural interpreter, consummate professional, and possessor of intimate knowledge of human psychology, the doctor protagonist often served as a figure for the novelist. "A writer can no longer expect to be received on the ground of entertainment only," Howells announced in *Criticism and Fiction* (1891), "he assumes a higher function, something like that of a physician or a priest … bound by laws as sacred as those of such professions" (Ch. 22). In some instances, the physician-as-priest is almost literal, as in

Pauline Hopkins's serially published novel *Of One Blood, or, the Hidden Self* (1903). A brilliant African-American medical student, fascinated by trance states and the work of the French psychologist Alfred Binet, tests out his theories about the subconscious on a beautiful young woman traumatized during a train wreck. He discovers that both he and the mysterious woman he saves have "hidden selves"—in this case, the reincarnated souls of royal Ethiopian ancestors. Psychology, for Hopkins, was always on the verge of returning to its religious and even occult roots—marking for her the deep compatibility between mental science and the art of the novelist.

The late nineteenth century, as we've seen, witnessed the breaching of Hawthorne's romantic firewall between the man of letters and the man of science. The result, however, was equivocal: the figure of the doctor—the most visible cultural emissary from the realms of science—was demoted from a Chillingworth-esque agent of evil to a flawed, socially embedded character making provisional sense of human beings and their frailties. Intriguingly, the novelist, by contrast, achieved something of a promotion. Émile Zola, writing in 1880, famously equated the writer and the scientist, celebrating the work of French physiologist Claude Bernard (renowned for exposing inner workings of living bodies through vivisection) and the literary form he called, in a book of the same title, *Le Roman Expérimental,* Zola claimed the tools of objectivity, detachment, and the carefully constructed experiment for the writer: "Science enters into the domain of us novelists who are to-day the analyzers of man, in his individual and social relations" (Ch. 1). The novel, by this account, was uniquely adapted to display, diagnose, and even to ameliorate the ills of individuals as they circulated within the larger, newly networked social organism that constituted the United States at the turn of the nineteenth century.

2. "REALLY, UNIVERSALLY, RELATIONS STOP NOWHERE": EVOLUTIONARY THEORY AND THE NOVEL

Until recently, critical writing about post-Civil War American literature, influenced both by Hawthorne and by Zola, has emphasized the unholy alliance between science and the novel. Literary naturalism embraced "pessimistic materialistic determinism" (Becker); human beings were driven by hereditary and environmental "forces" (Martin); critics described the "determined fictions" of the 1890s (Lee Clark Mitchell); bodies were aligned with machines (Mark Seltzer). In his introduction to *American Realism: New Essays* (1982), Eric Sundquist sums up this position: "Reveling in the extraordinary, the excessive, and the grotesque in order to reveal the immutable bestiality of Man in Nature, naturalism dramatizes the loss of individuality at a physiological level by making a Calvinism without God its determining order and violent death its utopia" (13).

Clearly, a crucial event in the naturalizing of "Man" was the 1859 publication of Charles Darwin's *The Origin of Species by Natural Selection*. Although he wouldn't spell out his specific thoughts about the human species until the 1870s, Darwin's potent alignment of transmutation (the capacity of species to change over large expanses of time) and natural selection (the mechanism by which traits best adapted to an environment are preserved) suggested that there was a natural history of humankind akin to that of other life forms. Although Darwin, in an 1860 letter to Harvard botanist Asa Gray, affirmed that he himself did not believe that "this wonderful universe, and especially the nature of man" could be "the result of brute force," many commentators, both then and now, felt that evolutionary theories demoted human beings to the mud (105). For those who adopted this position, the literary modes of realism and naturalism seemed similarly base. Ambrose Bierce, for instance, defined "Realism, n." in *The Devil's Dictionary* (1911) as "the art of depicting nature as it is seen by toads. The charm suffusing a landscape painted by a mole, or a story written by a measuring-worm" (158).

There has been, then, a narrative of declension that casts the influence of science on the post-Civil War novel as unidirectional and

corrupting. Twenty-first-century literary critics such as Dana Seitler and Jennifer Fleissner, however, have increasingly attended to the ethical complexity and literary richness of the novel's encounter with evolutionary science. There is another story to be told, one that Darwin articulated in the first edition of *The Origin*. Worried about the moral, religious, and aesthetic implications of his theory, Darwin sought to draw out its transformational beauty by emphasizing the vital, expansive aspects of transformation as such:

> There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved. (490)

Using the mechanism of natural selection and the substrate of deep time, evolutionary theory produced "just so" tales that yoked together the small, the common, and the insignificant with the immense, the myriad, the sublime. The emergent science of biology and the realist novel, as literary scholars such as Gillian Beer and George Levine have shrewdly discerned, have deep and reciprocal affinities. Darwin's tenet of change-over-time installs narrative as an essential aspect of natural history; in turn, the notion that small accidental happenings can have potentially seismic importance becomes an increasingly central plot mechanism of the modern novel. Henry James tapped these dynamic connections when he wrote in the 1907 preface to *Roderick Hudson* (1875), "Really, universally, relations stop nowhere": it is up to the novelist—like the biologist, or sociologist—to delineate the relevant sphere of action and to cast the complexities of a changing world into a meaningful form.

In short, the science practiced by the most innovative, restless, curious investigators of the era fertilized the work of turn-of-the-century novelists, and vice versa. The new watch words were experiment (rather than received forms); change (rather than stasis); contingency (rather than certainty); restlessness (rather than tranquility). Darwin's evolutionary biology helped to put human beings, at the level of the species, in motion; nineteenth-century writers, in turn, developed methods for casting insights based on immense stretches of time and vast numbers of individuals into that insistently individualizing form, the novel. As literary critic Wai Chee Dimock has observed, "The novel is, in fact, of uncertain dimensions. It can be bumped up to a much larger scale… Scale enlargement here undoes human singularity and preserves it through that undoing" (88).

Oliver Wendell Holmes, Harvard professor of anatomy and man of letters, offers an early example of how the nineteenth-century novel became a venue for changing the scale for thinking about personal character and individual agency. His novel *Elsie Venner: A Romance of Destiny* (1860), updates Hawthorne's allegorical "Rappaccini's Daughter"—the tale of a scientist who transforms his beautiful daughter into a toxic creature--for a more materialistically inclined audience. Holmes's begins conventionally enough with an enigmatic young woman who has piqued the interest of her handsome teacher, who is also a medical student. A tale of courtship becomes a biological mystery as he conducts experiments to diagnose her snake-like, venomous qualities (a strangely hypnotic gaze, a desire to sun herself on rocks, a tendency to bite her enemies) and discovers that the girl was poisoned *in utero* when her pregnant mother was bitten by a rattlesnake. Dubbed a "medicated novel" (ix) by Holmes himself, *Elsie Venner* makes the case that, because a person's (seemingly) discrete identity in fact extends across generations, some flaws of character are akin to bodily illness rather than moral failings.

Holmes's novel includes the first literary reference to the theories of Charles Darwin. At one point the tale's narrator—a professor of clinical medicine, as was the author himself—breaks the story's diegetic frame to instruct his young female readers about the biological basis of courtship rituals: "Look you," he exhorts, "there

are dozens, scores, hundreds, with whom you must be weighed in the balance; and you have got to learn that the 'struggle for life' Mr. Charles Darwin talks about reaches to vertebrates clad in crinoline, as well as to mollusks in shells" (Ch. 7). Alliteratively linking maidens and mollusks, Holmes playfully confirms that a young debutante's inflated sense of a party's importance is in fact a fitting affective index of the vast yet largely unseen drama of natural selection as it plays out on an intimate, girlish human scale. Anticipating Darwin's *The Descent of Man* (1871) by more than a decade, Holmes establishes an exponentially expanded family saga in which human beings and invertebrate sea creatures are distant cousins. In *The Education of Henry Adams* [1907], Henry Adams would extend Holmes's joke by referring to "his oldest friend and cousin the ganoid fish… with whom he had sported when geological life was young" [Ch. 26].

To make visible the achingly slow work of natural selection, Darwin begins *The Origin* with the evolutionary equivalent of pressing a "fast forward" button, describing the infinitely quicker process of "artificial selection," the selective breeding of farm animals and the careful cultivation of flowers. These man-made transformations—a breed of cattle that gives more milk, a strain of orchid with an atypical blossom—were often visible after just a few generations. Author Jack London, in his dog stories *The Call of the Wild* (1903) and *White Fang* (1906), used the novel's scale-changing capacity to similar effect, first to rewind and then fast-forward the evolutionary narrative. *Call of the Wild* depicts the transformation of a house pet named Buck into a toughened sled dog and then into a primordial, wolf-like creature after a series of adventures in the Yukon Territory. *White Fang* follows a wilderness-born wolf through a series of masters and a speeded-up civilizing process in which, by novel's end, the fully evolved, selfless animal sacrifices his life to save his master's. Frank Norris, in his posthumously published first novel *Vandover and the Brute* (1914), folds evolutionary time into the human body, portraying a hyper-civilized young man whose debauched ways dampen his intellect "leaving only the instincts, the blind, unreasoning impulses of the animal" (Ch. 16) that lie dormant within. Vandover, it is revealed, suffers from bouts of "Lycanthropy-Pathesis"—a condition that sends him sliding back down the phylogenetic ladder, causing him to move on all fours and growl like a wolf.

Novelists succeeded in coiling (to invoke a term of Wai Chee Dimock) evolutionary time into a literary form known for its attentiveness to the more intimate timescale of an individual life. The post-Civil War novel also accommodated and made visible the far-flung, abstract connections brought about by a globalizing economic system. In *The Octopus: A Story of California* (1901), the first installment of Frank Norris's (never completed) "Epic of Wheat" trilogy, the interests of corporate capitalism are condensed into one metonymic figure. In the eyes of the farmers being squeezed by the railroad conglomerate on wheat prices, the company's human representative – a man named S. Behrman, who simply "*was* the railroad" (emphasis added). The novel then compresses the trope still further, casting the man as a tiny tool who nonetheless embodies the collective agency of the vertical monopoly: "S. Behrman was a screw." The almost thermodynamic potency of the "screw" is in turn likened to the evolutionary power packed into a tiny seed. The narrative voice addresses the reader directly: "Can you imagine the first—the very first little quiver of life that the grain of wheat must feel after it is sown… the very first stir from the inert, long long before any physical change has occurred,—long before the microscope could discover the slightest change[?]" (Ch. 6). Novels, in other words, could pick up tiny rumblings of future events that eluded more conventional technologies.

For authors writing after Darwin the novel offered a narrative laboratory, in which slight alterations—like a trifling variation in the beak of a finch—could be shown to have seismic effects. Edith Wharton takes Norris's notion of a "sown seed" and plays it out in the plot of *The House of Mirth* (1905). In the first chapter, the lovely Lily

Bart impulsively breaks with propriety and takes tea with an eligible bachelor at his apartment. This small act lies dormant for much of the novel, as the celebrated but impoverished Lily makes her way through New York high society, but her encounter was observed by another character who later tries to "cash in" on the knowledge of Lily's indiscretion.

Edward Bellamy's *Looking Backward: 2000-1887* (1888), a novel that is part social realism and part science fiction, tests out the narrative capacity to move both forward and backward in time, transforming "cause and effect" into "effect and cause." The central character, born in 1859, narrates the story from the temporal perch of the year 2000. A modernized Rip Van Winkle, the protagonist had slept through the social unrest and economic disparity of the Gilded Age. Upon awakening a century later he finds an efficiently run, egalitarian United States devoid of poverty. Bellamy used the novel as a form of time travel to call for sweeping social reforms. Similarly, the social activist Charlotte Perkins Gilman, whose disastrous experience of Weir Mitchell's rest cure for neurasthenic women is detailed in the short story "The Yellow Wall-paper" (1892), takes up the question of cultural transformation in her utopian work *Herland* (1912). Gilman in the novel argues that one can reform, literally and physiologically, women's agitated minds and bodies through the transformation of technology—the most striking of which involves a new mode of reproduction through parthenogensis rather than sexual congress.

Literary works during the Progressive Era were not in some way "opposed to" the emerging biological sciences. Instead, the novel as a literary form provided new ways of imagining and representing far-flung connections, of concatenating causes and effects, and of insisting on the dynamic, temporal nature of organic life. These compatibilities led writers to bring the very structure of evolutionary thinking into their literary productions, even as scientists such as Darwin were applying an evolving, contingent, narrative sensibility to entities, including the planet itself, once thought static and immutable. Novels, however, had the comforting ability to enclose and make coherent a world in motion, counterbalancing the unsettling scale of natural history, in which human beings (in the words of geologist James Hutton) could find "no vestige of a beginning,—no prospect of an end" (*Theory of the Earth* 1788).

3. A "REMARKABLE INTEREST IN MENTAL STATES": THE NOVEL AND THE SCIENCES OF MIND

Along with changes in the scale, duration, and extension of human social existence, the new biology produced a radically altered understanding of individual consciousness. In his novel *Before Adam* (1906), Jack London again traverses the evolutionary timescale, though this time it is the human mind, and not the canine body, that encapsulates what he calls "race history." During sleep, the novel's narrator is imaginatively transported to the "Mid-Pleistocene," where he has vivid, first-person experiences of climbing trees, building fires, and interacting with his prehistoric, tree-dwelling ancestors. "Evolution," he concludes, "was the key. It gave the explanation, gave sanity to the pranks of this atavistic brain of mine that, modern and normal, harked back to a past so remote as to be contemporaneous with the raw beginnings of mankind" (Ch. 2).

Before we too quickly dismiss the crudeness of London's formulation, it is worth noting that Sigmund Freud and Josef Breuer in *Studies on Hysteria* (1895) had come to a similar conclusion about metaphors for strong emotions, such phrases as "stabbed to the heart" or a "slap in the face": "All these sensations and innervations belong to the field of 'The Expression of the Emotions,' which, as Darwin has taught us [1872], consists of actions that originally had a meaning and served a purpose" (Ch. 5). The etiological narratives of novelists and scientists—hereditary accounts that traced the phylogenetic sources of domesticated dogs, atavistic dreams, and vehement passions—both drew on and seemed to confirm the evolutionary roots of human beings. The "atavistic brain," it appeared, might harbor insights into the

most sophisticated modern mind.

Jonathan Kramnick has noted that, while "[n]o one literary form has a proprietary stake in the mind, […] as genres go the novel has since its inception taken remarkable interest in mental states" (263). Especially in the hands of Henry James, the late nineteenth-century novel expands the genre's formal alignment with the human mind. The depiction of consciousness in motion reaches its apex in his *The American Scene* (1907), a travel book that chronicles the aging author's impressions upon returning to the U. S. after decades living in Europe. It is, essentially, a novel with the narrator's consciousness as protagonist.

While certainly influenced by the new psychology, Henry James also developed his famously complex and allusive prose style in collaboration with a more mechanical technology. After an injury made writing physicahaplly painful, James began dictating his novels to a secretary who tapped James's spoken words directly into a typewriter. Critics have claimed to locate the precise moment that the transition to the new technology took place, during the drafting of *What Maisie Knew* (1897), a shift made visible by the escalating complexity of James's sentences, and the increasing inwardness of his plots.

By centering so many novels on New World naifs set adrift in Europe (e.g. *The American* [1877] and *The Ambassadors* [1903]), James captures some of the cultural dislocation that many Americans felt closer to home. But it is *Maisie*, his only novel with a child protagonist, that most vividly expresses the sense of a small, wondering consciousness bumping up against a world of things and relations that appears both inscrutably vast and uncomfortably circumscribed. James uses free indirect discourse to "stream" the narrative through the child, whose mind is the reader's portal to a tawdry milieu of neglectful and vituperative adults. Maisie struggles mightily to understand her father's plans for her: "while they sat there together, there was an extraordinary mute passage between her vision of this vision of his, his vision of her vision, and her vision of his vision of her vision" (Ch. 19). This sentence is almost parodic in its depiction of "the meeting of two minds." The novel here becomes not just a medium for describing relations among characters; it serves, as critic Lisa Zunshine has argued, as a cognitive exercise machine for the reader, who (like Maisie) must send her mind ricocheting outward into multiply embedded, often conflicting perspectives. The child's eye view returns an anthropological strangeness—along with both humor and horror—to the everyday dramas of human relations.

At century's end, new scientific theories and technologies were revealing a world filled with odd mysteries and once-invisible entities that required careful scrutiny and cautious interpretation. This was especially true in the budding field of microscopy: Joseph J. Woodward and Edward Curtis, for example, in 1864 first used aniline dyes in the United States for staining slides; a decade later, scientist Robert Koch coupled this technique with photography to identify microorganisms, leading to the germ theory of disease and new insight into cholera and other epidemics that ravaged tightly-packed communities. In the 1880s, incandescent bulbs were first introduced for street lamps, illuminating urban areas and bringing to light the denizens of the late-night city. Jacob Riis's camera, along with Stephen Crane's prose, made urban spaces visible for middle class eyes, as when readers of *Maggie: A Girl of the Streets (A Story of New York)* (1893, 1896) accompanied the novel's "street rats" into "a dark region where, from a careening building, a dozen gruesome doorways gave up loads of babies to the street and the gutter" (Ch. 2). By the turn of the century, scientists had discovered electrons and x-rays, using the latter to take ghostly photographs of bones through human flesh.

While nineteenth-century geology and biology produced awareness of natural history's gradual accretion of infinitesimal changes, new visual technologies brought to consciousness everyday processes of modern life that were hard to see in real time. In the 1870s, the photographer Eadweard Muybridge was hired by a railroad magnate (and horseracing aficionado) named Stanford to settle a bet: did a horse in full stride at

some point have all four hooves off the ground? Yes, was the answer provided by a series of split-second photographs captured by multiple cameras set in a row, each with a trip wire to take an image as the horse galloped past. While Muybridge used his cameras to break motion into parts, nascent film technology reversed this process, taking still images and setting them in motion. At the Chicago World's Fair in 1893, Thomas Edison displayed the Kinetoscope, a motorized proto-projector housed in a cabinet that produced moving images by passing strips of celluloid film in front of a magnifying lens backed by a bright light.

Writers after the Civil War used the novel in similar ways, to magnify the small detail, picking up and tinting an important moment like a lab technician staining a slide. As Nicholas Gaskill has written, in the hands of Stephen Crane this metaphor proves close to literal. Crane's manipulation of color in his novels condenses scenes to their essential elements, as in *The Red Badge of Courage* (1895) when the early morning battlefield slowly comes into focus for the waking troops:

> In the gloom before the break of the day their uniforms glowed a deep purple hue. From across the river the red eyes were still peering. In the eastern sky there was a yellow patch like a rug laid for the feet of the coming sun; and against it, black and patternlike, loomed the gigantic figure of the colonel on a gigantic horse. (Ch. 2)

Crane's abstract use of color establishes the elements of battle yet strips the moment of the political positions and meanings (grey for the Confederacy, blue for the Union) of conventional war stories. Time itself, a human convention for situating human events into strings of causes and effects, befores and afters, is colorized and spatialized into an expanding splash of yellow as day breaks. Crane's novel unravels narrative temporality, distilling a series of events – soldiers waking, looking, planning, marching, fighting, dying, retreating – into a colorful tableau that takes on the logic of a chemical reaction: add a bit more yellow, and then purple will face off against red.

Crane also manipulates size in *The Red Badge*. In the passage quoted above, the morning horizon is condensed into a small "patch," while a man on a horse is "gigantic." What appears as a distortion linked to the young man's psychological immaturity—leading him to "magnify" the significance of his leader and "diminish" the background landscape—is in fact a novelistic method for quelling the mind's automatic perceptual adjustments for depth and distance. When the young soldier achieves a perch above the battle, the narrative depicts far-away objects without compensating for the effect of distance on magnitude: "Once he saw a tiny battery go dashing along the line of the horizon. The tiny riders were beating the tiny horses" (Ch. 5). Crane's manipulation of color and size works to make visible the everyday aesthetic techniques (e.g. cause-and-effect narration, or one-point perspective in painting), as well as the unconscious processes of perception, by which our minds actively shape the raw material of the world into coherent and recognizable forms, rather than merely "finding" it that way. As the French thinker Hippolyte Taine put this point in his treatise *On Intelligence* (1870), "scientific experience comes in to contract or extend [our perceptions and ideas], to adjust their corrected dimensions to the real dimensions of objects" (Vol. 2, Bk. 4, Ch. 1).

As we have seen, the same might be said of the novel. After the Civil War and before the full flowering of literary modernism, many U. S. writers used the genre as medium for thinking about—and making visible—the ways that human beings were engaging with a rapidly changing world, both inside the skull and beyond the skin. Rather than construing novelistic concerns (e.g. historical events, social relations, and aesthetic experience) as opposed to scientific ones (e.g. biological theories, technological innovations, and medical practices), these writers were deeply interested in disciplinary cross-fertilization: in returning *scientia* to its etymological root in observation, study, and experience. The novel's

representational elasticity made it both microscope and telescope, capable of revealing tiny truths as well as lending large-scale perspective, of attending—like the best scientists—to the strangeness and revelations residing in the everyday. In *The Goldbug Variations* (1992), contemporary novelist Richard Powers writes that science is "a way of looking, reverencing," and that, above all, "the purpose of science was to revive and cultivate a perpetual state of wonder" (611) —a sentiment that writers from Emily Dickinson to Stephen Crane would surely affirm for the literary artist, as well.

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