Science and American Literature in the 20th and 21st Centuries

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Edited by

Claire Maniez, Ronan Ludot-Vlasak and Frédéric Dumas

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INTRODUCTION

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SINCE ITS ORIGIN, American literature has always had an uneasy relationship with science: born at a time when science was becoming a profession, it repeatedly referred to it, implicitly or explicitly, in order to assert its difference or, on the contrary, to gain a certain form of legitimacy. This specificity of 19th - century American literature continued to develop throughout the 20th century, in a different intellectual context, but with literature pursuing its epistemological exploration of fundamental scientific questions.

In a 1990 essay advocating the return to a strict division between the disciplines of science and literature in the history of ideas, at a time when the "Snovian Disjunction"—to use Thomas Pynchon's name for C.P. Snow's famous claim in his 1959 speech about "The Two Cultures and the Scientific Revolution"—was being radically questioned, John Limon used the terms "preemption," "treachery," and "alienation" to characterize the "negotiation" between the two fields (23-26, 19). Speaking of "two closely related aspects of the interaction between literature and science," Robert Scholnick turns to other metaphors:

> To use a metaphor from electricity, the first is one of resistance. Writers have opposed those destructive and controlling powers made possible by science and technology. The second is one of conduction. Writers have also drawn images and vocabularies from science and technology as powerful expressions of new ideas for their work, even as their autonomous investigations have enabled them to express ideas that have a parallel or complementary relationship to those of science. (3)

Although starting from opposite premises, the two scholars agree about the ambivalence that governs American writers' relation to a field of knowledge which is both close and alien to them. The reflection on the "permeable boundaries" between literature and science has since become a flourishing area of research, with the creation and expansion of several

scholarly associations devoted to the subject, as for instance the Society for Literature and Science, now The Society for Literature, Science, and the Arts.

The present collection of essays offers analyses on the various ways American literature has managed its uneasy relation to science and technology in the 20th and 21st centuries. Its purpose is not so much to explore the ways in which science and scientists are represented in American literature than to show how scientific discourse informs literary writing and to consider the relationship the two types of discourse have maintained: mutual metaphorization, questioning or legitimating.

The subtitle of the volume—"From Henry Adams to John Adams"—underlines the variety of the works examined in the different chapters, from autobiography to poetry, from opera to the novel, from metafiction to science fiction. It also indicates the temporal range of the collection: starting with the beginning of the 20th century and the epistemological ponderings of Henry Adams, it includes several papers dealing with the first decade of the 21st century (with the works of Thomas Pynchon, William T. Vollman, Steve Tomasula, Peter Watts, and John Adams). It appears that the epistemological crisis of the turn of the last century has acquired a renewed relevance in recent contemporary American literature.

The figure of Henry Adams looms large whenever the question of science and literature is addressed: "Adams set out to combine two histories: the history of his own efforts to comprehend the world, and the history of the human race up to the present and into the future" (Tanner, 105). It is thus fit that the first essay in this collection should be devoted to this tutelary figure. He had dealt with the political component of that "history of the human race" in his *History of the United States of America under the Administrations of Jefferson and Madison* (1884-88), and turned to the history of science in his *Autobiography.* As Michel Imbert demonstrates, Henry Adams embodies the ambivalence towards science mentioned above: "Two conflicting views of science emerged: the worship of science and the dread of apocalyptic upheavals unsettling the mindset; scientism as a latter-day mystique and catastrophism in the field of knowledge." Through a close analysis of three key chapters in the *Autobiography* ("Darwinism," "The Dynamo and the Virgin," and "The Grammar of Science"), Imbert shows how Adams both embraced the new scientific theories of his time, but also presented them as new religions, relying on implicit faith and man's "will to believe." While Darwinism merely substituted a new universal law for the Christian myth of Genesis, however, the revolution in physics at the turn of the century presented a

more serious threat to a stable world view. Awed by the dynamo, Adams compared it to an occult force similar to that of the Cross, and tried to integrate the new theory into his own conception of history, while he was acutely aware of the political and economic significance of the scientific revolution. In the *Autobiography*, electricity also becomes a metaphor to describe the mental anxiety generated by the scientific revolution and the confrontation with an unknowable "multiverse." The writer's task, however, is to expose the "grammar of science," as well as its reliance on language and on faith.

The two chapters on Thomas Pynchon which complete the first part of this volume underline the strong connexion between him and Henry Adams, explicitly referred to in the introduction to his early collection of stories, *Slow Learner*, as Bénédicte Chorier reminds us. The beginning of her article traces this relation, explaining how Adams's conception of a "multiverse" is congenial to Pynchon's vision of a chaotic universe. Indeed, Pynchon is interested in the same sciences with which Adams struggled—post-Newtonian physics, chemistry, and topology—and finds in their laws and tables metaphors for his elaborate fictions. Concentrating on his latest work, *Inherent Vice*, Chorier shows that although science has a much less visible presence in this novel, it nonetheless provides a demonic "subtext" which the careful reader can trace through physical and topological metaphors: the main protagonist, a private detective, becomes an avatar of Maxwell's Demon sorting out the data with which he is bombarded, and a "nonlinear" parking lot evokes the subversive forces at work in society.

Like Henry Adams's, Pynchon's relation to science oscillated between "defiance" and "fascination," to use Gilles Chamerois' terms. His analysis aims to show that, in the same way as Adams linked the new sciences of his day to earlier religious beliefs, Pynchon's *Mason & Dixon* traces the genealogy of science back to "earlier mythologies," in particular through "anachronistic references to twentieth century science." The eighteenth century context of the novel—the period when the "Snovian Disjunction" began—provides the perfect setting for the necessary dialogue between science and literature in order to bridge the widening gap. The anachronistic references examined by Chamerois include the recent string theory of contemporary physics, evoked in an episode about "yard-spinning," the "Butterfly effect" of chaos theory, and Mandelbrot's theory of fractals, as one of the characters reflects about the coastline of Maryland or the narrator describes the fermentation of a loaf of bread. All these examples underline the continuity between the preoccupations of eighteenth century scientists and contemporary science. But Pynchon

reaches further back by linking these to religion, Aristotelian philosophy, and the origins of time, in a movement that constitutes a criticism of the scientific desire for mastery, and a reminder that our knowledge of the world must remain provisional. Although not explicitly stated and relying on the reader's perception and understanding of the references to science, this critical assessment of science remains a constant feature of Pynchon's writing, woven into the fabric of his prose. In harmony with Henry Adams's approach, Pynchon places contemporary science within the larger perspective of the history of humanity.

If physics remains the main field of interest for Adams and Pynchon, the development of neurosciences in the second half of the 20th century has generated new questionings for the study of literary texts, some of which are tackled in the second part of this volume. Noëlle Batt calls for interdisciplinary collaboration, claiming that recent developments in neurosciences, notably the "brain-based epistemology" developed by Gerald Edelman, are relevant for the study of literary texts and can help us to better understand the emergence of literary meaning. If, following Yuri Lotman's proposal, we consider literature as a secondary modeling system, interesting analogies appear between the workings of the brain and those of the literary text. Both neurosciences and literary theory are at a loss to explain certain phenomena: the gap between primary consciousness and high-order consciousness for the former, and the gap between linguistic and aesthetic meaning for the latter. In spite of obvious differences, both the brain and the literary text can be seen as systems of communication, and language is a common element between literature and high-order consciousness. Batt thus proposes to examine the processes of consciousness and of literature from a common perspective, to the mutual benefit of science and literary theory. Her detailed presentation of Edelman's latest research emphasizes the problem of "binding," which is common to both literature and neurosciences: there appears to be no causal relationship between the processes of the two levels of consciousness, as there is no causal relationship between the linguistic components of a text and its reception as an aesthetic experience. Both phenomena result from "the complexification of the system." Edelman's formulations recall the way philosophers and writers like Deleuze and Valéry have tried to describe the differences between the "technical plane" and the "aesthetic plane of composition," or "how poetry gets written." His concepts of "re-entry" and "degeneracy" are useful to understand the reading experience and the plasticity of language when it is used by poets.

For Edelman and contemporary neurosciences, the brain is not a computer, as it used to be considered in the middle of the 20th century. It is precisely this analogy which is examined by Yves Abrioux, but from the other end of the metaphor. His essay undertakes to "deconstruct" Alan Turing's famous "thought experiment" described in his 1950 essay "Computing Machinery and Intelligence," which aimed at proving (or did it?) that computers can think. Abrioux rigorously applies to Turing's "Imitation game" the scientific procedures of validation by the hypothetico-deductive method—whose limits he first outlines—in order to show that there is nothing scientific in the Turing test as it was first presented and as it has been used repeatedly for various purposes (in particular for the Loebner Prize): Turing's development in his essay is shown to lack scientific validation, to rest on fictions, and to confuse two different steps of the hypothetico-deductive model; it also includes statistical corroboration in an invalid way. Abrioux then exposes the pragmatic logic of Turing's essay by tracing the context of its writing and publication in the philosophical journal *Mind*, and shows that Turing's argument aims at promoting research in his own field while discreetly disparaging "unscientific" pursuits like philosophy or literature. Abrioux concludes by asking whether Philip K. Dick's novel *Do Androids Dream of Electric Sheep?* could not be considered as a critical answer to Turing's question—"Can machines think?"—, claiming "that the power of the literary imagination may lie in a different direction."

Pawel Frelik's essay returns to the recent developments in neuroscience in its attempt to apprehend consciousness, in order to sketch a panorama of the ways recent science fiction has appropriated the terrain of intelligence and the workings of the human mind. In doing so, Frelik wants to correct the widespread opinion that science fiction is lagging behind in this field. He proposes grouping the various authors according to the way they deal with the issues of neuroscience. His first group includes those writers who are more interested in the performance of consciousness or cognition than in their nature; Philip K. Dick and cyberpunk fiction figure prominently among these. The second group, a subset of the first, concerns writers who are more specifically interested in Artificial Intelligence. The third group, the smallest, "is constituted by those [texts] which actively engage the concepts underlying cognitive processes and problematize their very nature." Among these, Frelik selects Peter Watts' *Blindsight* (2006) for detailed analysis, showing that the complex plot of the novel involves reflection on several neuroscientific notions, such as blindsight, the "Chinese box" thought experiment, and zombies. The author's aim is to demonstrate that high intelligence does not depend on consciousness,

whose only use is aesthetic. This reflection is also carried out at the level of narration, the novel being told by the un-empathetic voice of one of the barely human characters. What Watts suggests, according to Frelik, is "that the universe does not tolerate developments that result in creations such as art or philosophy," consciousness and self-awareness being shown to be more a hindrance than an asset in the process of natural selection and evolution.

The third part of this volume gathers contributions which examine the ways in which literature dramatizes and problematizes what could be called the ethics of science. Here again, the relation between science and literature goes both ways. Françoise Palleau-Papin shows how Vollmann uses Copernicus and his astronomical revolution as a metaphor for his own ethical and aesthetic project: finding a form of "uncentered lyricism." In her close analysis of his novel *The Altas*, she examines some of the devices which enable him to achieve his purpose, like mixing pronouns, or the palindrome structure of the work itself. The novel, which is organized as a collection of stories telling of the protagonist's encounters as he travels around the globe, records experiences of estrangement brought about by contact with nature or others. In Palleau's words, "The astronomical trope becomes a philosophical method against moribund theories or stereotyped ways of thinking." Conversely, literature, with its interrogation of language and of the limits of our understanding of the universe, serves as a reminder that nature cannot be reduced to abstract scientific descriptions. In this work and others, Vollmann plumbs science for metaphors to make his readers experience the feeling of estrangement that comes from uncentering the self.

Literature and art can also confront science with its own ethical questions, as Mathieu Duplay argues in his essay on John Adams's opera *Doctor Atomic* (2005), which stages the final moments of the first nuclear test at Los Alamos in July 1945. In the final scene of the work, the juxtaposition between the blast and its almost immediate consequence in Hiroshima powerfully underlines the ethical problem raised by scientific and technological experimentation. The opera addresses the questions of time and knowledge in its dramatization of the test whose successful outcome meant both a huge leap in man's knowledge and the threat of universal annihilation. Duplay first examines the question of *kairos*, the "right moment" which also has its dark, demonic underside, to note that in the opera the nuclear physics experiment is shown to have an anthropological dimension. Adams and his librettist Peter Sellars included in the text of the opera poems by Baudelaire, John Donne, and Muriel

Rukeyser, as well as more ancient poetry like the *Bhagavad Gita*, as a way to resist the anxiety generated by the experiment. Duplay's analysis of Oppenheimer's aria "Batter my heart" demonstrates poetry's power to create new meanings through troping, and thus to provide man with a strategy of survival in the face of catastrophe: "poetry plays a central cognitive role in this opera about scientific research: in its attempt to express the inexpressible and capture nuances of emotion and meaning beyond the reach of mathematically formalised thinking, poetry broadens the scope of enquiry" to include "the many manifestations of *logos*."

Although Steve Tomasula and Stephen Farrell's multi-media novel *VAS* claims in its subtitle—*An Opera in Flatland*—an affinity with the operatic genre, its only stage is the page, and its performance is mostly graphic. The governing metaphor is that of the text as body, and a parallel is thus established between genetics and literary creation in order, as Anne-Laure Tissut argues, "to question the serious ethical and ontological consequences of the drastic changes that have been fashioning our century." Her analysis first focuses on the textual manifestations of this metaphor, in a novel which plays with page layout to disorient the reader and prevent linear reading. Literary creation through language is paralleled and opposed to human creation and procreation, in a reflection which highlights the dangers inherent in the development of genetics and eugenics, as well as in the commodification of bodies, and uses historical contextualisation to question the very notion of progress. Tomasula also plays with polysemy, using the same words in different contexts to emphasize the instability of meaning, thus turning his novel into a history of languages. Indeed, his main purpose is not to denounce, but to make the reader experience the complexity of reality, by exposing him to myriads of data in different forms (words, images, charts) which he has to relate and put into perspective, as he "interprets" the score of this parodic, "hypertextual" opera.

Tomasula's novel, of course, is not strictly speaking hypertextual, although he breaks the linearity of reading in order to convey a global vision of scientific and human reality. Since the invention of the term in 1965, other writers have focused more specifically on the opportunities offered by hypertext to the narrative art. Although he still relies on print, Robert Coover figures prominently among those who have experimented with non-sequential writing and co-operative reading. It is Stéphane Vanderhaeghe's argument that Coover anticipated by some twenty years the technological developments which were to turn computers into narrative machines for new forms of fiction. Some of the stories in his

early volume *Pricksongs and Descants* confront the reader with mutually exclusive textual fragments which he has to organize, and Coover's subsequent novels continue to explore in various ways the role of the reader in fragmentary fictions that refuse totalization and closure. In his analysis of *The Adventures of Lucky Pierre*, Vanderhaeghe emphasizes the hypermediality of the novel which, although it relies only on print, presents itself as a pornographic film in nine reels and also includes musical variations. Textual arrangement is foregrounded, drawing the reader's attention to its arbitrariness. Coover's highly metafictional novels read as the "actualizations of a virtual text that lurks underneath the surface," thus miming the actual process of hypertext.

Unlike Coover's novels, Shelley Jackson's *Patchwork Girl* exists only as a computer program, and it is a work of art which, by the author's own admission, was strongly influenced by the application she was using at the time. As in Tomasula's *VAS*, the text/body metaphor is central, since the work presents itself as a monstrous textual body made up of fragments of other texts, notably Mary Shelley's *Frankenstein*. Arnaud Regnauld's essay offers a detailed analysis of the logic imposed by the interface to both author and "reader." The user can navigate the textual body with the aid of maps and embedded Chinese boxes, giving a deceptive impression of depth and logical connections. The text plays at the border between the visible and the legible, turning text into image and image into text. Paradoxically, Jackson reintroduces in the electronic media some features characteristic of print, like notes, emphasizing the hybrid nature of her creation in metafictional asides. Yet the user's active physical participation in the selection of links, by way of mouse clicks, also invites a form of playful involvement, although the boundary between user and text can never be transgressed.

At the beginning of the 21st century, science and technology are more than ever governing our lives and our bodies. Many American writers, although fascinated by faster and faster developments, keep an active watch to alert their readers to the high stakes this "progress" involves for humanity. They also enter into serious or playful dialogue with them, finding in the process the opportunity for further experimentations with language and narration. This volume of essays testifies to the vitality of American literature, past and present, when it comes to addressing the issues raised by man's insatiable quest for knowledge.

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PART I:

LITERATURE AS A HISTORY OF SCIENCE

CHAPTER ONE

THE GRAMMAR OF SCIENCES IN *THE EDUCATION OF HENRY ADAMS*

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THE EDUCATION OF HENRY ADAMS, published in 1907, retraced the intellectual development of a versatile mind that, somehow, could claim to be a true American scholar, almost an heir to the age of Enlightenment, though he emphatically denied being such an encyclopaedic mind. Henry Adams, who was directly related to famous American statesmen (John Adams, John Quincy Adams), had achieved personal fame through his monumental *History of the United States of America under the Administrations of Jefferson and Madison* (1884-88), that paved the way for "scientific" history. In *The Education of Henry Adams,* he analyzed the impact on his own training of two epistemic revolutions: Darwinism in the 1860s and the crisis of theoretical physics around the turn of the century. He did not claim to popularize and simplify those discoveries, let alone to be an authoritative historian; far from being well versed in those disciplines, he described himself as a dabbler in geology or electromagnetism. As he was not knowledgeable enough to be really critical of those theories, he had to take the scientists' word for it. As a result, he tended to reappraise science from the standpoint of belief, as a set of assumptions liable to be challenged and eventually disproved. What sort of credit could such tentative hypotheses get? As a historian of ideas, what struck him about Darwinism, paradoxically enough, was that it superseded Christianity as a makeshift doctrine in so far as it assumed an underlying continuity at work throughout the stages of evolution, even as it left room for the play of chance. Similarly, in "The Dynamo and the Virgin" (ch. XXV), he hailed the production of energy by dynamos as a technological miracle. The dynamo came to stand for faith in scientific progress which he described as the present-day equivalent of Christian faith in the Middle-Ages.

And yet, experimental physics also unleashed overwhelming forces that, in his own admission, he failed to come to terms with. As he sought to grasp the meaning of such groundbreaking discoveries as X-rays (1895), radioactivity (1896), or the kinetic theory of gases (from Boltzmann to Maxwell) through the work of Karl Pearson, *The Grammar of Science* (published in 1900), he was faced with an inconceivable chaos that could not be rendered through the common idiom. Pearson described complex patterns of organization that seemed to defy linguistic representation. In the chapter entitled "The Grammar of Science" (ch. XXXI), the science-lover, who launched into a far-ranging survey of the state of physics in his day, registered his impressions as a disoriented would-be scholar. The scientific terminology could no longer be translated into literary figures. Science opened up Pandora's Box, disclosing unaccountable disorders, and pioneering psychology like that of William James further revealed that the observer was also immersed in a fluctuating multi-centered milieu. Therefore, retracing one's intellectual formation involved grappling with chaos within and without.

So, the purpose of this paper is to emphasize the following polarity within the work. That there should be such a polarity is hardly surprising since Adams indulged in binary dichotomies and devised his memoirs on the model of a dynamo as it were. On the one hand, acting as a "scientific historian," Adams stated that science served as a substitute for religion in a godless universe, a modern creed that assumes the part formerly played by Christianity. In this respect, we shall emphasize the consecration of science and the dynamic of belief at work in the reception of scientific theories. On the other hand, statistic and relativistic mechanics, disrupting the principles of Newtonian physics, opened up a virtual "multiverse" which Adams, as a writer, was at pains to convey in his own inappropriate language. Two conflicting views of science emerged: the worship of science and the dread of apocalyptic upheavals unsettling the mindset; scientism as a latter-day mystique and catastrophism in the field of knowledge. The discourse of the historian of ideas was at the crossroads of those two diverging perspectives. We may wonder whether it contributed to the canonization of scientific discoveries or whether it foregrounded the literary craft of disbelief.

"Darwinism" (chapter XV)

From the point of view of the layman that sought to be initiated, scientific theses always remained, up to a point, a mystery that could not be understood, a matter of belief:

> The atomic theory; the correlation and conservation of energy; the mechanical theory of the universe; the kinetic theory of gases, and Darwin's Law of Natural Selection, were examples of what a young man had to take on trust. (224)

The budding scholar was bound to distort abstruse theories that he could not grasp by rephrasing them by means of simplistic imaginary analogies:

> He dared not venture into the complexities of chemistry, or microbes, so long as this child's toy offered complexities beyond X-rays, and turned the atom into an endless variety of pumps endlessly pumping an endless variety of ethers. (397)

For instance, he could picture the evolution of species through the ramifications of a kind of genealogical tree and even admit his own kinship with the most repellent lower creatures but, at bottom, he confessed he had literally nothing to say about their would-be common ancestor, dating back to an archaic stage that he simply could not figure out: "That *Pteraspis* and shark were his cousins, great-uncles, or grandfathers, in no way troubled him, but that either of them or both of them should be older than evolution itself seemed perplexing" (230). In this respect, he had to trust Charles Lyell's superior knowledge, even though, ironically enough, he was supposed to be learned enough to write an account of his *Principles of Geology* for a scholarly journal (398). To him, Darwin's hypotheses were unverifiable and, while they were considered as articles of faith by his disciples, Adams embraced those views simply because he found them provisionally convenient or for the fun of aping his simian fellow-beings who passed for so-called experts:

> To other Darwinians—except Darwin—Natural Selection seemed a dogma to be put in place of the Athanasian creed; it was a form of religious hope; a promise of ultimate perfection. Adams wished no better; he warmly sympathized in the object; but when he came to ask himself what he truly thought, he felt that he had no Faith; that whenever the next new hobby should be brought out, he should surely drop off from Darwinism like a monkey from a perch. (231)

By likening that branch of learning to a shaky standpoint, Adams distanced himself from the prevailing ideology by mocking it as monkey business affording little support on allegedly scientific grounds.

Adams drew paradoxical conclusions by extrapolating from Lyell's *Principles of Geology*. He underlined the fact that Darwinism by relinquishing Cuvier's theory of catastrophes and opting for a gradual process of minute

if unpredictable variations to account for the transformation of species had lent evolution a sense of continuity and consistency. True, Darwinism assumed the free play of random variation but natural selection remained the immutable rule that ultimately overdetermined the reproduction of species in the long run, sorting out subsequently viable mutations and useless misfits in the course of evolution (Hoquet, 161-191). Though Darwinism had shattered the dogma of God's Creation as described in the Book of Genesis, it had also represented the evolution of species as an uninterrupted continuum that generated and encompassed endless discontinuous variations, thus supplying the disbelieving modern man with an alternative totalizing universal law. God as the author of Creation, the prime mover, had simply been superseded by Natural Selection that acted as the final cause:

> He felt, like nine men in ten, an instinctive belief in Evolution, but he felt no more concern in Natural than in unnatural Selection, though he seized with greediness the new volume on the "Antiquity of Man" which Sir Charles Lyell published in 1863 in order to support Darwin by wrecking the Garden of Eden. Sir Charles next brought out, in 1866, a new edition of his "Principles," then the highest text-book of geology; but here the Darwinian doctrine grew in stature. Natural Selection led back to Natural Evolution, and at last to Natural Uniformity. This was a vast stride. Unbroken Evolution under uniform conditions pleased everyone—except curates and bishops; it was the very best substitute for religion. (225)

Resorting to a rhetorical twist in order to articulate contingency and continuity, Adams lumped together Darwin's evolutionism and Lyell's specific brand of uniformitarianism (Gohau, 21-23). In this respect, Christianity and Darwinism came to be seen as warring religions. In this chapter, Adams already intimated that, eventually, "the will to believe" (in William James's phrase) might be the hidden motive behind scientific research and that science might stem from the pragmatic need to produce credible theories and valuable beliefs.

"The Dynamo and the Virgin" (chapter XXV)

The second scientific revolution which he evoked, that of experimental physics at the turn of the century, seemed to undermine the stability of Darwinian Evolution and to shatter irreversibly the reassuring system of Newtonian physics. Adams assessed the changes that had recently occurred in the scientific domain. History had ceased to be characterized by continuous *transformations*, that is to say, mutations within the

framework of relatively fixed forms or structures. The epoch-making discoveries seemed to usher in an unforeseen field of *forces* that Adams fantasized in a visionary way as a kind of vast torture chamber:

> Evolution was becoming change of form broken by freaks of force, and warped at times by attractions affecting intelligence, twisted and tortured at other times by sheer violence, cosmic, chemical, solar, supersensual, electrolytic—who knew what?—defying science, if not denying known law. (401)

On visiting the Gallery of Machines at the Universal Exhibition in Paris, together with a great physicist, Langley, he experienced the full force of the blast to the point of almost losing his head: "He found himself lying in the Gallery of Machines at the Great Exposition of 1900, with his historical neck broken by the sudden irruption of forces totally new" (382).

The energy produced by the dynamo recalled occult forces, "supersensual" agencies, because electro-magnetic power was impalpable, almost immaterial. The electricity generated by the dynamo took on a supernatural aura precisely because of its invisible properties. Adams began to draw a startling parallel between two ages that seemed poles apart and that, precisely on that ground, could generate a *dynamic* theory of history (see William Jordy on Adams's tribute to "scientific" history). He asserted that the dynamo was to modern times what the Holy Virgin used to be in the age of the Crusades, the chief motive force behind the workings of history. Adams did not merely draw a parallel between two distinct eras. He coupled the machine with the mechanism of religious faith and connected them. He glorified the dynamo and, conversely, galvanized Christianity: "to Adams the dynamo became a symbol of infinity. [...] he began to feel the forty-foot dynamos as a moral force, much as the early Christians felt the Cross" (380). Though the identification relied on a mere comparison—"[a] mysterious energy like that of the Cross" (383)—, the great hall of machines turned into a modern cathedral, as if by magic. The engine seemed capable of reproducing at will God's "Let there be light."

So, Adams performed the sanctification of science which, like the religions of old, was instrumental in bringing together, unifying politically: the dynamo was supposed to polarize the masses, to electrify them for the sake of their salvation. Elsewhere in the autobiography, state education was, tellingly enough, compared to a dynamo: "All State education is a sort of dynamo machine for polarizing the popular mind; for turning and holding its lines of force in the direction supposed to be most effective for State purposes" (78). The theologico-political function of techno-science

was implicit in Adams's praise of the dynamo displayed at the world exhibition. Truly enough, the hold of the engine on modern minds was such that the overawed observer proceeded to think mechanically, to function automatically like a dynamo, owing to a kind of mental mechanism described by Pierre Janet in 1889: "Before this historical chasm, a mind like that of Adams felt itself helpless; he turned from the Virgin to the Dynamo as though he were a Branly coherer" (384). Like a dynamo, the historian's mind too seemed to consist in generating a current of sorts between the Virgin in the Ancient world and the brave new world of engineering. At this stage, the dynamo was almost turned into a model of artificial intelligence that mirrored the involuntary workings of the mind.

Throughout the autobiography, Adams expressed in an obsessional way his search for laws in history. Having imbibed Faraday's concept of the magnetic field, he was intent on charting the lines of force that underlie the "current of thought" and assessing methodically what he called "thought-motion": "his whole share in the matter was restricted to the measurement of thought-motion as marked by the accepted thinkers" (456). In this regard, he broke radically with early historians such as Bancroft or Parkman, by evolving what he called "A Dynamic Theory of History (1904)" (ch. XXXIII). He endeavoured to infer from the law of attraction laws that ruled historical mutations and to make out an underlying continuity between the magnetic lure of the Cross in the past and that exerted by X-rays in his day. He lined up historical landmarks that were far apart and thus mapped out lines of forces: "the Cross had absorbed all the old occult or fetish-power. The symbol represented the sum of nature—the Energy of modern science—and society believed it to be as real as X-rays" (479). Post-Newtonian physics was supposed to supply human and social sciences with a set of mathematical rules. The task ascribed to the "physicist historian," as he called himself in "The Rule of Phase Applied to History" (1909), was to trail the manifold *conversions* of the selfsame magnetic force which was perceived as the missing link between the Madonna in the Middle-Ages and the present-day dynamo:

> Symbol or energy, the Virgin had acted as the greatest force the Western world ever felt, and had drawn man's activities to herself more strongly than any other power, natural or supernatural, had ever done; the historian's business was to follow the track of the energy; to find where it came from and where it went to; its complex source and shifting channels; its values, equivalents, conversions. (388-89)

Energy resources in the present-day context worked wonders and appeared as the driving force transferred from God's Power and Glory.

Since scientific laws were deemed reliable, science alone could restore faith and supply valid reasons to believe in a context of financial crisis (337-338). Celebrating the electric current as a driving force around 1900 was not unrelated indeed to the implementation of the Gold Standard in 1900 that was supposed to make up for the debasement of currency ever since the financial panic of 1893. "Credit was shaken" (325). "In 1893, the issue came on the single gold standard and the majority at last declared itself, once for all, in favor of the capitalistic system with all its necessary machinery' (344). Adams pointed out that the sublime show of electric illuminations at the Chicago World Fair coincided with a major monetary crisis and that faith in techno-science, opening up a New Frontier of sorts even as Frederick Jackson Turner proclaimed the end of the Frontier, was designed as a response to this bleak economic background. The electric current that was to boost the social and economic "machinery" had to do with the circulation of trustworthy currency and the revaluation of the legal tender. Incidentally, it is not by chance that Adams who, as a specialist of economic history, had dealt knowingly with "The Legal Tender Act" (249-250, 277) and "The New York Gold Conspiracy" (282), should have been interested in the issue of the Gold Standard that revolved precisely around the question of positing a single unit of measure, a common standard as forceful as the Christian God (343). Ultimately, trade, financial flux, the literary and scientific discourses seemed to rely on trust and were, at bottom, a matter of belief. The economy of knowledge and the transfers between the various disciplines rested on the religious factor or, at least, on the willing suspension of disbelief. Around the turn of the century Max Weber similarly argued against Marx that faith, not economic conditions, shaped the course of History.

So, there was a spiritual drift underlying Adams' historical survey of the various scientific disciplines ranging from Darwin's evolutionism (bridging the gap between geology and biology) to Faraday's electro-magnetism that deftly spanned the hitherto distinct fields of electricity, magnetism and optics (Cohen-Tannoudji, 270). And yet the latter-day worship of techno-science testified to "the will to believe" brought to light in a contemporary essay by William James (1907). William James highlighted the urge to believe as a bulwark against the growing sense of inner disintegration. In an earlier work, *The Varieties of Religious Experience*, published in 1902, chapter VIII was entitled "The Divided Self and the Process of Its Unification". In this chapter, William James diagnosed a crack-up beneath stories of born-again Christians. He studied

in particular the case of John Bunyan, his split personality and the major part played by the religious drive in response to a state of mental disarray. Similarly, in *The Education of Henry Adams*, the survey of scientific development took a definitely introspective turn in the chapter entitled "The Abyss of Ignorance" (chapter XXIX), in which he referred to multiple personalities:

> Did the new psychology hold that the […] soul or mind […] was or was not a unit? He gathered from the books that the psychologists had, in a few cases, distinguished several personalities in the same mind [...]. To his mind, the compound […] took at once the form of a bicycle-rider, mechanically balancing himself by inhibiting all his inferior personalities, and sure to fall into the sub-conscious chaos below, if one of his inferior personalities got on top. The only absolute truth was the sub-conscious chaos below, which everyone could feel when he sought it. (433)

Here, the emphasis fell on a state of precarious balance, not to say inner turmoil. In Katherine Hayles' words,

> the imagery emphasizes the disjunctions that divide what was unity into discrete units, all fighting against one another in a cacophony of competing claims—the rider struggling with the bicycle, the bicycle teetering over chaos, the rider divided within himself by warring personalities held only temporarily in check. (76)

True, the mind was compared once more to an electro-magnet, but this time, the psyche was viewed as a site in which competing forces were at play and in which the unifying forces of attraction seemed to be offset by the drive towards disintegration whenever the waking mind lapsed into a state of unconsciousness:

> He woke up with a shudder as though he had himself fallen off his bicycle. If his mind were really this sort of magnet, mechanically dispersing its lines of force when it went to sleep, and mechanically orienting them when it woke up—which was normal, the dispersion or orientation. (434)

The involuntary, almost obsessional sense of lines of force could be put down to the Unconscious rather than to the fact of having been highly responsive to Farraday's theories: "Adams never knew why, knowing nothing of Faraday, he began to mimic Faraday's trick of seeing lines of force all about him, where he had always seen lines of will" (426). "The will to believe" in James's phrase seemed to conflate almost irreconcilable opposites, intentional self-determination and blind unwilling belief. Taking

those conflicting forces into account, Adams emphasized the splitting of the self into a myriad "thought centres" and the sense of instability derived from it:

> His normal thought was dispersion, sleep, dream, inconsequence; the simultaneous action of different thought-centres without central control. His artificial balance was acquired habit. He was an acrobat, with a dwarf on his back, crossing a chasm on a slack-rope, and commonly breaking his neck. (434)

The scientific historian who could boast being a belated heir to the age of Enlightenment (whose heyday in America were Benjamin Franklin's experiments on lightning) depicted himself as a sort of circus acrobat striving to maintain his balance above the abyss. So, the praise of all-powerful scientific technology hailed as a major driving force went hand in hand with an inner sense of anxiety, the sense of being a helpless burlesque subject at the hands of overwhelming forces within. While conquering science extended its empire here below and seemed to encroach on what used to be the province of religion, the triumphant willpower it evinced turned out to be undermined by a growing sense of inner tension between overruling drives. Reverting to the latest discoveries in physics (the kinetic theory of gases and radium) only corroborated Adams's acute feeling of dislocation by disclosing a swarming "multiverse" out there as well. Shifting from William James's experimental psychology (307) to Pearson's *Grammar of Science* (1900) amounted to encountering without the same indwelling chaos, but this time writ large.

"The Grammar of Science" (chapter XXXI)

When at sixty-five, on the advice of Wolcott Gibbs that, in his own admission, he mistook for his namesake Josiah Willard Gibbs (449), Adams started perusing Pearson's *Grammar of Science* in order to update his scientific knowledge and get better acquainted with the latest discoveries, he recounts how he had the impression of launching into a world of unprecedented complexity:

> In these seven years man had translated himself into a new universe which had no common scale of measurement with the old. He had entered a supersensual world, in which he could measure nothing except by chance collisions of movements imperceptible to his senses. (381-82)

Modern physics challenged his preconceptions regarding the atom for instance which, so far, had always been a purely abstract concept to him: "the atom itself had figured only as a fiction of thought" (381). Adams recounts his reactions as he read about X rays, the kinetic theory of gases, radioactivity and other phenomena that seemed almost virtual since they eluded ordinary perception. Adams had the sense of drifting away into "strange seas of thought" (453): "At last their universe had been wrecked by rays, and Karl Pearson undertook to cut the wreck loose with an axe, leaving science adrift on a sensual raft in the midst of a supersensual chaos" (452). At this point, Henry Adams seemed to have grown into a sort of Huckleberry Finn of heuristics, carried away by the troubled waters of contemporary epistemology (a word coined by Meyerson in 1908). "Catastrophe was the law of change," (313) not the gradual process of Evolution. To the self-confessed layman he was, the kinetic theory of gas spelled out rampant chaos: "The kinetic theory of gas is an assertion of ultimate chaos. In plain words, Chaos was the law of nature; Order was the dream of man" (451). And radioactivity brought equally apocalyptic revelations, ushering in a relativistic universe that dismantled the dream of the unity of science, aiming, beyond the purported unification of methods, at the unity of reality: "in 1898, Mme Curie threw [...] the metaphysical bomb she called radium. There remained no hole to hide in" (452). The self-taught amateur scientist was taken aback as his former representations crumbled, exposing him to shapeless chaos (Pétillon, 55).

The new phenomena could hardly be figured out and required a leap of faith. Adams highlighted the gap between schematic scientific representations (unfaithful if valid by definition) and their mistranslation into the common idiom. Using the same lexicon (concepts such as Willard Gibbs' "phase" for instance) might prove misleading: "psychologists are apt instinctively to study the mind as a phase of electro-magnetism. Whether such a view is sound, or not, matters nothing to its convenience as a figure" ("The Rule of Phase" 304). The mathematical formulae for instance epitomized formal logic at its best but, for the average writer, figures were apt to be translated into literary figures of speech and, by and by, into shadowy "figures" without substance: "Perhaps the effect of knowing no mathematics is to leave the mind to imagine figures—images—phantoms" (426-27). Pearson's pedagogical survey resorted now and again to metaphors ("The Brain as a Central Telephone Exchange"—p. 44, "The Mind as a Sorting Machine"—p. 106, for example), as if scientific discourse also hinged on inappropriate metaphors or catachreses (metaphors for lack of a "proper" word) for the sake of performing the

unprecedented experiment (Hallyn, 294-301). There was a hint at Pearson's simile in *The Education of Henry Adams*:

> The new psychology went further, and seemed convinced that it had actually split personality not only into dualism, but also into complex groups, like telephonic centres and systems, that might be isolated and called up and whose physical action might be occult in the sense of strangeness to any known form of force. (433)

The title of Pearson's essay *The Grammar of Science*, which somehow echoed Cardinal Newman's *Grammar of Assent* (1879), seemed to suggest that science like any literary discourse had a syntax of its own, rules that governed the formation of reasoning and the formulation of the laws of nature. Significantly enough, one of the sub-parts of chapter XII on "The Classification of Sciences" was entitled "Applied Mathematics and Bio-Physics as Cross Links" (Pearson, 527-529), thus unifying the various theoretical fields by a kind of reductionism. But even as it sketched a comparative grammar of scientific methods in various fields and claimed to spread the unified procedure by translating it into the common idiom, the title betrayed the linguistic turn of the so-called logical mind and its unacknowledged indebtedness to ordinary language: "we must, for example, use language, and our language is necessarily steeped in preconceived ideas. Only they are unconscious preconceived ideas, which are a thousand times the most dangerous of all" (Poincaré, 143). The discrepancy between the scientific "rules" (pertaining to semiotic conventions) and the "laws" of nature and, in addition to that, the divide between the two modes of expression, between scientific and literary discourse, loomed large. When mathematicians came to philosophize on their own theories, their use of words tended to be disorienting. Adams records his puzzlement on reading *La Science et l'hypothèse* by Henri Poincaré:

> Trusting to its external appearance, the traveller timidly bought it, and greedily devoured it, without understanding a single consecutive page, but catching here and there a period that startled him to the depths of his ignorance [...].
>
> […] Had M. Poincaré shown anarchistic tastes, his evidence would have weighed less heavily; but he seemed to be the only authority in science who felt what a historian felt so strongly—the need of unity in a universe. "Considering everything we have made some approach towards unity. We have not gone as fast as we hoped fifty years ago; we have not taken the intended road; but definitely we have gained much ground." This was the most clear and convincing evidence of progress yet offered to the

> navigator of ignorance; but suddenly he fell on another view which seemed to him quite irreconcilable with the first: "Doubtless if our means of investigation should become more and more penetrating, we should discover the simple under the complex; then the complex under the simple; then anew the simple under the complex; and so on without ever being able to foresee the last term."
>
> A mathematical paradise of endless displacement promised eternal bliss to the mathematician, but turned the historian green with horror. (454-55)

The meaning of such a statement drawn from chapter IX of *La Science et l'hypothèse* (164) was so esoteric that all Adams could do was trace the endless "displacement" of terms that made no sense in the end. The nominal markers proved interchangeable and equally pointless. This seemed to be a caricatural confirmation of the process of interpretation as represented by C.S Peirce: an endless deferment of meaning through the medium of "interpreters" (intermediary signs) that were inherently vague and loose. Modeling himself on Poincaré, Adams felt entitled to launch into highly confusing metaphysical speculations: "Adams proclaimed that in the last synthesis, order and anarchy were one, but that the unity was chaos" (406). So, philosophizing on Unity and Multiplicity in the wake of Poincaré meant groping towards a dark truth that seemed to imply relinquishing all the usual landmarks. *La Science et l'hypothèse* (1902) was certainly thought-provoking but, practically speaking, it entailed getting lost at sea:

> Thus, unless one mistook the meaning of motion, which might well be, the scientific synthesis commonly called unity was the scientific analysis called Multiplicity. The two things were the same, all forms being shifting phases of motion. Granting this ocean of colliding atoms, the last hope of humanity, what happened if one dropped the sounder into the abyss—let it go—frankly gave up Unity altogether? (431)

The Education of Henry Adams recorded a strange experiment prompted by literary discourse: surveying "the new multiverse" (458), having discarded ordinary instruments of measure. The dream of bridging the gap between scientific learning and literary representations and reconciling the two cultures had foundered in the process.

So, decyphering the hermetic signs of scientific lore, forever a foreign language, paved the way for this voyage out into the "unthinkable." Disorienting scientific discourse was a step towards the recognition of a chaotic multiverse that tended to be barred out or contained through the canonization of scientific theories: