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The Creation of Scientific Wonder : Jules Verne's Dialogue with Claude Bernard

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Abstract

This essay reconstructs a speculative but inevitable dialogue between writer Jules Verne and French scientist Claude Bernard. This dialogue results, in Verne's seminal novel *Voyage au centre de la Terre* (1864-1867), in the creation of a genuinely *scientific* adventure whose essential quality is what later SF calls "sense of wonder." In contrast to the classifying sciences of his time, Claude Bernard, in his writings and courses at the Collège de France, defined experimental science as itself an adventure, a passionately conducted scientific voyage through the physical unknown, a voyage of wonder. Claude Bernard's ideas were widely circulated and published in the 1850s and Verne must have known them. They were codified in Claude Bernard's *Introduction à l'étude de la médecine expérimentale* (1865). This work was a literary event, and there is evidence Verne read it between revisions of his novel.

Verne was mandated by his editor Hetzel to create a narrative that was both an extraordinary adventure and a vehicle to give young readers the desire to pursue scientific careers. Claude Bernard appears to provide Verne with the means of recasting the extraordinary voyage narrative as the adventure of science. For Claude Bernard, scientific discovery "is only a flash that briefly illuminates other horizons, toward which our ever-unsatisfied curiosity drives us on with passion. This is why in science... the known loses its attraction, while the unknown is always full of wonder." For Verne, this sense of wonder provides the key to a genuinely scientific adventure.

But how does Verne adapt Claude Bernard's vision to the adventure novel? For the sake of adventure, he could not make his protagonist a real scientist. Instead he seizes on Claude Bernard's flawed scientists. Lidenbrock is Claude Bernard's theorizer; center of the earth is already known to him. His apprentice Axel is over-emotional, yet still open to contact with the unknown. Verne makes Axel his narrator; sense of wonder is generated by his encounters with the physical unknown. But Verne not only creates wonder, he uses it for rhetorical effect. Out of the interaction between the raw facts of an unhuman landscape, and Axel's inadequate but all too human reactions, Verne develops a rhetoric of wonder, whose effects are directed at the reader. Axel's encounters with the unknown leave the reader alternately charmed, awed, or terrified. At the same time, the incomplete nature of Axel's engagement with the physical unknown incites the reader to further curiosity and awe, to re-imagine the scientific adventure. Verne's dialogue with Claude Bernard did more than fulfill Hetzel's need for adventure that inspired young readers to take up scientific careers. His scientific wonder and its literary uses will become an essential element in twentieth century SF.

Résumé

L'éditeur Hetzel avait demandé à Jules Verne d'écrire pour de jeunes lecteurs des voyages d'aventures extraordinaires où ils puissent découvrir de nouvelles visions scientifiques qui les passionnent et leur donnent envie de poursuivre des carrières dans les sciences. Or, une relecture du *Voyage au centre de la Terre* à la lumière des écrits du physiologiste Claude Bernard, contemporain de Jules Verne, montre une influence profonde de la vision des sciences du savant sur l'auteur des *Voyages extraordinaires*. Dans ses cours au Collège de France dans les années 1850, et dans son *Introduction à l'étude de la médecine expérimentale* (1865), livre retentissant à l'époque, Claude Bernard, à la différence de bien des savants français de son temps, ne conçoit pas la méthode scientifique comme l'élaboration d'un système clos mais plutôt comme un voyage passionnant à travers l'inconnu du monde physique, exploration faisant naître émerveillement, doute, curiosité, ce que les anglo-saxons appellent "sense of wonder". Or, ce voyage est infini puisque d'expérience en expérience l'inconnu devient le connu, révélant de nouvelles zones inconnues, et ceci ad infinitum. En effet, le connu "n'est qu'un éclair dont la lueur nous a découvert d'autres horizons vers lesquels notre curiosité inassouvie se porte encore avec ardeur. C'est ce qui fait que dans la science même le connu perd son attrait, tandis que l'inconnu est toujours plein de charmes".

Nous avons cherché à démontrer dans cet article que Jules Verne a transposé dans son *Voyage au centre de la Terre* le "sense of wonder" scientifique dont parle Claude Bernard, afin d'attirer le lecteur vers les "charmes" de la recherche scientifique. Il le fait en utilisant comme narrateur du voyage le jeune Axel, élève du professeur Lidenbrock. Axel est sans expérience scientifique sérieuse, mais du même coup il est ouvert à l'inconnu, à la différence du professeur enfermé dans ses théories et pour qui le centre de la terre n'a rien d'inconnu. Le récit d'Axel raconte sa perception d'un monde plein de beautés, mais effrayant, incompréhensible et indifférent, ce qui suscite en lui toute la gamme des émotions du "sense of wonder": émerveillement, extase, frayeur, curiosité, "charmes" sans cesse renouvelés au cours du voyage.

Jules Verne a donc accompli la tâche que lui avait assignée Hetzel. Mais en transposant la vision de Claude Bernard dans un récit de voyage extraordinaire, Jules Verne a créé avec le "sense of wonder" scientifique une des dimensions fondamentales de la science fiction du XXe siècle, en particulier celle qu'on appelle "hard SF."

The term "sense of wonder" is seen by many as a phenomenon unique to SF, indeed as a defining element of the genre. Yet the words used to describe it, from the vague terms "amazing" and "astounding," to suggestions by critics like Peter Nicholls and Cornel Robu that it is a modern form of the "sublime," all point to effects and areas outside SF, to aesthetics, philosophy, religion in general. [1] The dictionary gives us, as definition of "wonder," general words like "curiosity," "surmise," "doubt," "awe" and "marvel." Indeed, wonder has been associated to literary tales of travel since the Greek "Indian wonder" tales and the voyage of Odysseus. It applies to the imaginary voyages of Cyrano, Swift, and others. But if we can speak of a form of wonder specific to SF, then science would somehow have to be the element that sets it apart. This new sense of wonder would arise from a meeting of the wonders of the humanist tradition with a new form of wonder, one generated specifically by scientific activity. We would like to locate the origin of scientific wonder in a single event, Jules Verne's *Voyage au centre de la Terre*. The creation of wonder in Verne's work occurs at the intersection of two vectors: Claude Bernard's vision of experimental science, and Verne's need to create a new kind of adventure fiction, where the adventure is that of science, and the result something we can call, perhaps for the first time, *science-fiction*.

Science Meets Fiction

If Verne's *Voyage au centre de la Terre* represents a fusion of science and fiction, what then were the cultural conditions that allowed such a fusion to take place? What conditions existed that might favor a convergence of the realms of science and of fiction. By the nineteenth century, materialist science reaches a prominent position in human thought, such that it appears to challenge, if not contradict, the views of Western humanist culture, which are traditionally those of "fiction" in its various forms: epic, tragedy, comedy, novel. The nature of this relationship, however, plays out differently in England and in France. In England, we see the Romantic poet Wordsworth's attempt to join poetry and science rejected by the physician-poet John Keats. For Keats, "cold philosophy" (science) is the enemy of poetic wonder: "Philosophy will clip an Angel's wings,/Conquer all mysteries by rule and line,/Empty the haunted air, and gnomed mine... (*Lamia*, II, 234-36). Frankenstein's experiments are judged an abomination against humanity and the human form divine. Indeed, except for an apostle of scientific advancement like Tennyson, experimental science and poetic wonder remain apart throughout the century. The triumph of experiment, in Darwin's theory of evolution, only serves to widen the distance, to create a "two cultures" gap.

On the contrary however, in nineteenth-century France in general, writers and thinkers are active in bringing together science and the humanities. The rise and rapid development of the sciences in nineteenth century France, their growing prestige and the new ways of conceiving of mankind's relation to nature that they offered, strongly impacted the world of letters. History, in the works of Hippolyte Taine and Ernest Renan, aspired to scientific rigor. Sainte-Beuve, in the realm of literary criticism, strove to be scientific in his portraits and biographies, where he sought to establish "des familles d'esprit." Balzac, in the "Avant-propos" to his *Comédie humaine* (1842), claimed as organizing principle for his novels Geoffroy Saint-Hilaire's theory of the influence of "milieu" as cause that generates differences between zoological species. Gustave Flaubert wrote, in a letter of 1853, that "la littérature prendra de plus en plus les allures de la Science. [increasingly literature will take on the forms of science]" [2] From the point of view of the poet, this fusion was clearly in place by the end of the century. Here is the young Paul Valéry, in his first essay "Sur la technique littéraire" [On Literary Technique] (1889), describing the difference between the romantic poet and the modern poet: "Ce n'est plus le délirant échevelé, celui qui écrit tout un poème dans une nuit de fièvre, c'est un froid savant, presque un algébriste, au service d'un rêveur affiné. [The modern poet is no longer the dissheveled madman, who writes an entire poem in a single feverish night, he is a cold scientist, almost an algebraist, but now at the service of a refined dreamer]" [3]

We see, in Valéry, the poet becoming a scientist. But does the scientist, on the other hand, have the same desire to merge with the poet? It would seem, at first glance, that the dominant scientific vision of nineteenth century France, "positivism," would wish to conquer the wonders of nature by rule and line, moving to classify phenomena, to subject them to taxonomical control. By the middle of the century, however, a new form of "experimental science" was developing. Its major spokesman was the physiologist Claude Bernard, who outlined his experimental method in courses at the Collège de France, and elaborated on its implications in his *Introduction à l'étude de la médecine expérimentale* (1864). Reino Virtanen calls this book an "event" in French culture, one that had a profound influence on Émile Zola, Henri Bergson and others at the end of the century. [4] Bernard's central idea is that scientific

activity itself, in its constant pursuit of the unknown, generates wonder. Here he describes scientific discovery: “Ce n’est qu’un éclair dont la lueur nous a découvert d’autres horizons vers lesquels notre curiosité inassouvie se porte encore avec ardeur. C’est ce qui fait que dans la science même le connu perd son attrait, tandis que l’inconnu est toujours plein de charmes. [It is only a flash, that briefly illuminates other horizons, toward which our ever-unsatisfied curiosity drives us on with passion. This is why in science itself the known loses its attraction, while the unknown is always full of wonder]” [5] When Claude Bernard describes the physical unknown—the object of scientific experiment—as something “plein de charmes,” he is stating not only that the inexplicable is attractive, but that this attraction—wonder—is what sustains the scientist’s desire to pursue its mystery. Such a statement seems to point the way to a confluence of science and fiction in a shared sense of wonder. He seems to be suggesting nothing less than the creation of a science-fiction, a form of fiction that would recount the *voyage extraordinaire* of scientific discovery itself.

But the same seems true of the *voyage extraordinaire* as was true of sense of wonder: the literary form Verne chooses is simply another example of the age-old narrative of travel and exploration, with examples from *The Odyssey* to the real-life voyages of Captain Cook. What we are talking about, however, in the context of France in the second half of the nineteenth century, is the specific fusion of modern science with a particular narrative form. Significantly, Claude Bernard uses the language of the travel narrative to describe the “adventure” of experimental science. He speaks of a *point de départ*, and presents science itself in terms of a never-ending voyage. Discovery may advance, but there is never absolute knowledge; there is always more to discover, its pursuit generates ever more sense of wonder. As if in response to this, Verne appears to create, for the first time perhaps in literary history, what is a specifically *scientific* extraordinary voyage. By this we mean a voyage whose motivation, course, and resolution are concretely set by the tenets of experimental science.

To bolster our argument, we hope to demonstrate that Verne’s narrative is *scientific* in four precise ways. First, travel and adventure in the novel are motivated essentially by scientific experiment—the verification or refutation of Humphry Davy’s theory of volcanic origins—and not by more conventional reasons for exploration—gold, colonial acquisitions, pure adventure. Saknussem’s claim to have made the journey is a “fact” to be verified; it opens the possibility that the earth is hollow. But the only scientific way to prove or disprove both the theory and the claim is to go there physically. Second (and corollary), the adventure here is primarily travel to a place where there are no human beings, no marks of human culture, however primitive. Axel says he sees a giant “herdsman,” but he is seeing through the eyes of Vergil and Homer, and the reader never knows what this being is, or if it even exists. Otherwise, there are neither cultures nor peoples to study beneath Verne’s earth. It is a place where mankind encounters Descartes’s *res extensa* in all its otherness. Third, as the protagonists penetrate the earth, increasingly they encounter phenomena that not only cannot be incorporated into humanist patterns of thought, but *would never be perceived at all* were it not for ways of inquiry that are specifically science-based. Despite attempts by the explorers to “get their bearings,” to plot their course in relation to known landmarks of surface geography, the material landscape they enter, void of all human markers except the questionable “runes” of Saknussem, is increasingly seen as a-human. The voyagers face an unknown that obeys no human agency; they engage what later SF will call “the cold equations.” Finally, the sense of wonder found throughout Verne’s narrative is an effect generated, specifically, from the encounter of human beings with landscapes revealed by the

activity of experimental science. Moreover, Verne uses the wonder that results from these brushes with the material unknown for a clear rhetorical purpose. For as Verne's explorers confront, but fail to grasp, the unknown, the reader is enticed—by a concomitant sense of curiosity, doubt, and awe—to revisit the place of encounter in imagination, to redo the experiment, in short to rise to the challenge of wonder. A close analysis of the workings of Verne's text will show this rhetoric of wonder at work.

Verne and Claude Bernard: The Genesis of Wonder

Up to now we have been talking about a general intellectual and cultural climate in the second half of the nineteenth century in France, and specifically about the fusion of science and humanities in Claude Bernard's pronouncements and Jules Verne's seminal novel *Voyage au centre de la Terre*. But we are not dealing here simply with a shared cultural milieu, or with synchronicity. There is at least speculative evidence of a specific connection between the scientist and the writer, a connection that occurred at this particularly seminal moment in the latter's career. Bernard's *Introduction à l'étude de la médecine expérimentale* [Introduction to the Study of Experimental Medicine] appeared in 1865, a year after Verne published the first version of his novel. Even so, there is, in the material added in three chapters (37-39) in the 1867 edition, both mention of a current crisis in experimental science (the so-called Moulin-Quignon Man), and a heightening of the level of unknown encounters and wonder that could reflect a reading of Claude Bernard's seminal book.

Such speculations are not necessary however. For many of the reflections on experimental method in *Introduction à l'étude de la médecine expérimentale* are merely elaborations on statements made previously by Claude Bernard, during a decade of public courses at the Collège de France, and in publications that reproduced these lectures, such as the 2-volume *Leçons de physiologie expérimentale appliquée à la médecine* [*Lessons in Experimental Physiology as Applied to Medicine*], published by Baillière in 1855-1856. [6] The majority of these lectures detail experiments on the pancreas, the body's production of sugars, and diabetes, all of which represent major breakthroughs in medical science. Each set of lectures however is prefaced with general statements of method, where Claude Bernard, again and again, contrasts what he calls the theoretical scientist, whose deductive approach loses sight of the material fact in endless "scholastic" disputations, with the experimenter, who generates hypotheses from active observation of raw material from the laboratory or hospital. We know that Verne, during this same decade (1851-1861), the one that preceded the publication of his first novel *Cinq semaines en ballon* (1862), spent many hours each week in libraries like the Bibliothèque nationale, doing research on science and technology, and writing popularizing articles for journals like the *Musée des Familles*. Throughout this decade, Claude Bernard was increasingly recognized as spokesman for the new experimental science. His statements of method are highly readable. It would seem quite unlikely that they did not draw Verne's attention.

But drawing attention is not enough. There has to be some element or event that catalyzes a relationship. And indeed, there is another aspect of Claude Bernard's remarks on the experimental method that would seem to make them especially memorable to Verne at the time he began to write for Pierre-Jules Hetzel. Arthur B. Evans emphasizes the interest Hetzel and his colleagues had in pushing for reform in the French education system, notably in the

teaching of science: “Hence, the central position of science pedagogy in the thematic makeup of Hetzel’s post-1850 publications and the persistent moralizing tone of these texts are the direct result of his personal views concerning the society of his time—what he saw as the crippling political and educational policies of the Second Empire... ” [7] Claude Bernard addresses precisely this question of science education in the first of his lectures, semestre d’hiver 1854-1855: “Tout le monde sait que l’enseignement du Collège de France est d’une autre nature que celui des facultés... Ici, le professeur, toujours placé au point de vue de l’exploration, doit considérer la science, non dans ce qu’elle a acquis et établi, mais dans les lacunes qu’elle présente... Dans les facultés, au contraire, le professeur, placé au point de vue dogmatique, se propose de réunir, dans un exposé synthétique, l’ensemble des notions positives que possède la science, en les rattachant au moyen des liens que l’on nomme théories, destinées à dissimuler... les points obscurs et controversés qui troubleraient l’esprit de l’élève qui débute. [Everyone knows that the method of teaching at the Collège de France is totally different from that of the universities... Here [the Collège de France] the professor, always considering things from the point of view of exploration, has to see science, not in terms of what it has acquired and established, but in terms of what is lacking, what remains to be discovered... On the contrary, in the universities, the professor, taking a dogmatic view of things, gives himself the goal of reuniting in a synthetic structure the body of positive notions acquired by science, linking them together by means of theories that are intended to hide... the various murky and controversial points that would otherwise trouble the mind of the beginning student]” (2) We note here that, as early as 1854, Claude Bernard explicitly associates this new science and method with the pursuit of the unknown: “Le professeur du Collège de France... doit avoir les yeux tournés vers l’inconnu, vers l’avenir. [The professor at the Collège de France... must have his sights turned toward the unknown, toward the future]” (2) For Verne, the future author of the *Voyages extraordinaires*, a number of strands would seem to merge here. He would see that both physical exploration and scientific pursuit share a common goal: the unknown. What is more, he would realize that, to the degree that the new fictional combination of adventure and science envisioned here *mirrors* the method of experimental science itself, as Claude Bernard describes it, the story itself can be the means of doing what editor Hetzel required: teaching science. This is not just science “fact,” the old science of the faculties, but it is science in action, the new, open-ended search for knowledge Claude Bernard calls for.

Verne, during his years of research, was apparently working on the idea of writing a new kind of novel, a *Roman de la Science*. [8] Claude Bernard’s remarks, cited above, could indeed give Verne a powerful set of elements to work with. For if, as Claude Bernard emphasizes, the object of any scientific experiment is the unknown, might not any story of travel and adventure be made into a story of scientific pursuit? In the first novel he published with Hetzel, *Cinq semaines en ballon* (1863), Verne seems not to have fully grasped this fact. Despite descriptions of balloon technology, *Cinq semaines* remains a conventional travel narrative. Many of Verne’s readings during the 1850s, if we judge from the articles he wrote, dealt with contemporary travel and technologies of travel. *Cinq semaines en ballon* gives us English adventurers exploring Africa. They use a form of transportation—the heavier-than-air balloon—that was hardly new at the time, merely untested for long-range travel. At the very best, this adventure qualifies as a positivist mapping of the center of Africa, a place already being explored at the time. Verne may have sensed that his comments on balloons would be proven wrong by future developments. In like manner, keeping the “heart of darkness” dark, a

place unknown, seems here more a defensive tactic on Verne's part. Were the author to make too-specific statements about a place soon to be known, he would run the risk of errors that render a piece of fiction totally obsolete for future readers. Verne we could say, in his first novel, shows a nascent sense of the power of the unknown. But here the "unknown" is little more than the stuff of Captain Cook and the colonial explorers. It has nothing to do with science.

An indication that Verne was not satisfied with English explorers and the conventional adventure formula for his "scientific novel" is the submission of *Paris au XXe siècle* to Hetzel as subsequent novel. Hetzel rejected this novel with the following comment: "C'est à cent pieds au-dessous de *Cinq semaines en ballon*. [This one's a hundred feet below *Five Weeks in a Balloon*]" [9] Hetzel's reason, no doubt, was that he liked neither the vision of a technocratic future where science has become mechanics and money (things he found stifling in Second Empire France), nor a protagonist who looks backward, as a classicist, to the retrograde educational system that Hetzel would hope to modernize. Verne was possibly bringing to the table a problematic closer to the remarks of Claude Bernard. Bernard's scientist, in his constant pursuit of the unknown, could suggest a romantic figure. Verne's future Paris then opposes a protagonist of decidedly late-romantic temperament to a world (very much like his own) where all romantic sentiments are being crowded out by utilitarian practices in science and technology. These of course are practices admirably served by the entrenched classifying sciences of Claude Bernard's "facultés." Hetzel of course wanted something quite different from Verne: an adventure that somehow teaches the methods of the new experimental sciences. Even so Verne, in his search for a protagonist to function in this world, will remember his romantic anti-classifier Michel.

The refusal of Michel Dufrénoy as protagonist may have led Verne to rethink the role both of science and the humanities in his age. The 1850s in France saw a number of poems by late-romantic writers that stress a very different relationship between mankind and nature than the early romantics. In works like Leconte de Lisle's "Midi" (1852) and Victor Hugo's *Les Contemplations* (1856), nature no longer resonates to human desires and emotions, but has become indifferent to them. In the wake of scientific discoveries in all domains (the sciences concerned are, specifically, geology, paleontology, and medicine), the problem itself has shifted away from a Michel Dufrénoy and his plight among the philistines. It is no longer the materialist classifiers that are the adversary; it is material nature itself. This new context would make Verne even more receptive to Claude Bernard's statements about science engaging the material world as something *unknown*. The experimental scientist's vision proves here to be quite compatible with late-romantic fears of a physical world, menacing and empty of human content. Verne's task now, in this second half of the nineteenth century, was to design a scientific adventure along the lines of Claude Bernard's pursuit of an unknown *res extensa*. To execute this adventure, he needs a "team" that represents an anatomy of scientific attitudes at his time. For this as well, he could turn to Claude Bernard, who sets experimental science against two sorts of inadequate scientific response to the unknown.

Professor Lidenbrock is the exact incarnation of Claude Bernard's systematizer, who reduces observed facts to known paradigms, rather than seeing them as possible beginnings for new hypotheses. Axel poses as his scientific apprentice. Axel fits a number of profiles: he is the educated young man of scientific pretensions in Verne's post-romantic age. As such, he is not only an example of the young reader Hetzel hopes to reach, but an example of the sort

of young student who might have attended Claude Bernard's lectures. Claude Bernard has a warning for this sort of emotionally engaged scientist as well: "En un mot, le savant qui veut trouver la vérité doit conserver son esprit libre, calme, et si c'était possible, ne jamais avoir, comme dit Bacon, l'oeil humecté par les passions humaines." (73) Axel retains certain things from Michel. He is a Latinist. And in his mockery of his uncle's a priori theorizing, he follows Michel in his rejection of the architects of twentieth-century Paris. But where the latter blindly revolts against an establishment that mechanically applies the classifying sciences to all levels of experience, [10] Axel's reactions are more complex, more rooted the science of his time. As a comfortable resident of Hamburg, he shows an interest in his uncle's science, and wields the specialized language of geology with ease. But he is not allowed to stay in Hamburg; he is thrust into an adventure in the most unknown place of his time, and possibly the most "romantically" fearful: the depths of the earth. [11] Axel is plunged into a situation where he is literally forced to deal with a series of unknown phenomena. His challenge is to function in that totally new world, where science's awareness of *res extensa* as fundamentally unknown casts doubt on the fundamental adequacy of conventional cultural responses to material nature.

A question arises: given the above, why didn't Verne simply choose as his protagonist, and as Lidenbrock's opposite, a real experimental scientist as Claude Bernard set forth? The reason has to be a practical one. For if Verne's task as a writer is to narrate the adventure of science, he surely realized that a scientist, as Claude Bernard defines his practical task, cannot be the agent of adventure. Had Verne made Axel an experimental scientist, he would resemble the mutant-narrator of J.H. Rosny aîné's *Un Autre monde* (1896). Rosny's protagonist tells of teaming up with a scientist to observe and hypothesize about beings he perceives in another dimension. We have a story of the laboratory, of experiment and patient observation, told in the slow time of experimental science. Verne, however, had the task of inventing a way to dramatize the adventure of science, much as the television series *Nova* has to do today. [12] His solution to the problem of creating scientific adventure, was a stroke of literary genius: he made Axel the narrator of his story. If the adventure is a scientific adventure, it is told from the highly unreliable point of view of a young man of alternating scientific and romantic propensities, who at the end of the adventure does not become a scientist but a writer, the author of the story we read. The reader experiences both his companions, and their encounters with unknown phenomena, through Axel's eyes. Lidenbrock is Axel's character. He is presented, alternately, as an authority figure and as a foolish scientist, both in his theoretical blindness, and in his impulse to rush off, on the slim evidence of a note in a book, to crazy and dangerous adventure. In like manner Hans, whose pragmatic doings actually bring the trio through the adventure alive, is glossed over by Axel as some mysterious shamanic figure. In all cases, in Axel's presentation of characters and descriptions of phenomena, the reader becomes increasingly aware of how limited and unreliable his point of view is.

Even so, because of his central position as narrator, Axel locates himself between two forms of closed "science"—theory and magic—hence presents himself as more open to a dynamic engagement with the unknown. He is positioned as the figure of scientific promise. This positioning allows Verne, if he cannot show experimental science per se at work, to use Axel's first person narration to present the *effects* produced by the various encounters with the unknown this journey entails. These effects, filtered through Axel's extremely unstable personality and unreliable vision, are those of wonder, on a scale from curiosity and

uncertainty, to awe and terror. Taken by his uncle, with fear and trembling, on a dangerous expedition, Axel recounts what he sees and experiences. But if he reacts emotionally, he rarely examines. Disorienting phenomena are encountered, their meaning increasingly avoided. What the reader retains from these encounters, however, are instances of wonder. The reader literally becomes Axel's companion, led to question and doubt what is set forth in his narrative. In this sense, it is the reader of Axel's account who learns to act as the experimental scientist. Hetzel's didactic imperative is not destroyed; on the contrary, it is carried, in the form of sense of wonder, to the higher plane of rhetorical effect on the reader.

Axel's Story: The Rhetoric of Wonder

Axel and Lidenbrock embark on their journey to the center of the earth, in order to give experimental proof or disproof for Humphry Davy's "alternate chemical theory of volcanic action," which posited the cause of volcanic eruptions as a chemical reaction between metallic oxides and water at the surface of the Earth. The conclusion Lidenbrock draws here is that, if eruptions are caused at the Earth's surface, and not by heat from the depths of the Earth, then a journey by humans to the center of the earth is possible. Questions of course remain: Is the center of the earth hollow? Is the temperature there cool enough to allow some form of exploration? An informed reader of the time might know that Davy's theory had been seriously challenged by the time depicted in the novel. [13] Lidenbrock however is given a new "fact" to contend with—the note by Arne Saknussemm claiming he has gone to the center of the earth.

This opening sequence establishes both Axel and Lidenbrock as opposite and, at the same time through the workings of Axel's narrative, complementary types of bad scientist, as defined by Claude Bernard. Lidenbrock is the "scholastic," who reasons from theory rather than observed fact. Throughout the voyage, Axel delights in staging scenes that show Lidenbrock's blindness to fact: "Cela contredit singulièrement les théories du professeur Lidenbrock. Je ne puis m'empêcher d'en faire la remarque: 'Eh, bien,' réplique-t-il, 'qu'est-ce que cela prouve contre ma doctrine?' 'Rien,' dis-je d'un ton sec, en voyant que je me heurte à un entêtement absolu'[This is singularly in contradiction with Professor Lidenbrock's theories. I cannot resist pointing it out. 'Well,' he says, 'what does that prove against my theory?' 'Nothing,' I reply dryly, seeing that I am up against an implacable stubbornness]." (164) [14] The opening pages of the narrative prepare the reader for such moments. On finding the note, Lidenbrock announces he is the kind of scientist who would "go and see for himself," to verify by observation and experiment Saknussemm's account. In his initial decision, Lidenbrock seems to abandon the official science of Cuvier, the authority he later cites again and again. Instead of Cuvier, he now appears to echo Claude Bernard, for whom observation and experiment are both active and complementary processes. [15] And yet, Lidenbrock does not stop to observe the facts of the note, which offer slim evidence for the trip to the center of the earth. This initial blindness allows Axel to present him, on repeated instances during the voyage, as one who simply refuses to see: "Mais regardez, examinez, observez! Je forçai le professeur à promener sa lampe sur les parois de la galerie [But look, examine, observe! I made the professor shine his lamp on each of the walls]." (98) Axel creates scenes throughout where his uncle, in his own words, reveals his scientific blindness. Near the end of their subterranean adventure, Lidenbrock now presents himself, in Axel's staging, as one who

categorically refuses to look (“Il ne s’agit pas de voir. Je me suis proposé un but, et je veux l’atteindre! [Seeing is not the question. I set myself an objective and I mean to attain it!]” [155]).

As he stages his uncle in this opening scene however, Axel reveals himself to be not only Lidenbrock’s opposite, but Claude Bernard’s other type of bad scientist. If Axel derides his uncle for letting theory blind him to fact, he offers the opposite kind of blindness, the eye distorted by emotional haste, the classic bypassing of facts in a rush to judgment: “Je n’avais pas fait cent pas que des preuves incontestables s’offrirent à mes yeux [I hadn’t gone a hundred yards further before incontrovertible proof appeared in front of my eyes].” (98) In terms of scientific method, Axel presents the world in terms of absolute extremes. At the same time, however, he gives no voice whatsoever to the one person who might fit Claude Bernard’s description of the researcher as free and calm spirit, never swayed by human emotions to faulty judgment. This is Hans, the Icelander who literally takes them through the underground region. The loquacious Axel rushes to judgment again and again, seeing Hans as a servant, then as a shaman, finally as a figure of classical myth. What he never recognizes—but which comes through in his account—is the potentially experimental method that underlies Hans’ actions.

Only about three-fifths of the narrative takes place under the earth. It takes some 150 pages to get there. Any scene along the way however offers a microcosm of the effects Verne’s narrative works on the reader. A good example is the opening scene in staid Hamburg, that of the discovery and deciphering of Arne Saknussemm’s runic message. Established here is a rhythm of engagement and deferral of discovery that not only leads Lidenbrock and his nephew “à entreprendre la plus étrange voyage du XIXe siècle [to undertake the strangest voyage of the nineteenth century],” (6) but defines the mechanism by which Verne will generate sense of wonder during this strange journey. Axel introduces himself both as a scientific dreamer—spending hours among the neatly classified mineral specimens in his uncle’s cabinet—and as a philistine, who sees all these stones as the means of making an extra room for himself in his uncle’s house, “avec une belle chambre de plus, dont je me serais si bien arrangé! [with a fine extra room, which would have suited me down to a T]”. (7) Axel’s subsequent presentation of Lidenbrock looks down on him as a harmless antiquarian: “Cette exclamation me rappela que le professeur Lidenbrock était aussi bibliomane... mais un bouquin n’avait pas de prix à ses yeux qu’à la condition d’être introuvable, ou tout au moins illisible [This exclamation reminded me that Professor Lidenbrock was a fanatical book collector in his spare time. But a volume had no value in his eyes unless it was unfindable or, at the very least, unreadable].” (7) This seems the most sedate of worlds. What a surprise, then, when Saknussemm’s message falls out of one of these old books. The slightest crack in this comfortable world of well-organized specimens and books, and Axel and his uncle are embarked on an expedition into purest *res extensa*. This is a lane to the land beyond the dead, to a place where categories of order, books of knowledge, all human dreams themselves, prove ineffectual.

Before they begin, however, the *illisible* runes must be deciphered. In presenting this process, Verne uses Axel’s narrative to establish a rhythm of interaction—between the reluctant pupil, the suddenly authoritarian professor, and a series of minor but “fatal” events—that will recur, in other contexts and at increasing levels of intensity, throughout the novel. Lidenbrock’s response to the note that falls from the old Icelandic book is not that of a

collector and classifier. He is suddenly, as scientist, as impetuous as Axel is cautious. Lidenbrock hails Arne as an “alchimiste célèbre.” He never asks if he or the note are hoaxes (Arne’s given name “Saknussem,” despite the learned Icelandic double m, means “sack of nuts”). Lidenbrock asks only one question: “Pourquoi ce Saknussem n’aurait-il pas enfoui sous cet incompréhensible cryptogramme quelque surprenante invention? Cela doit être ainsi. Cela est [Why might this Saknussem not have hidden some surprising invention in the incomprehensible cryptogram? That must be the case. That *is* the case] “(13). Against all experimental method, the scientist declares certainty. In perfect deductive fashion, the sole task now is to crack the code. He rearranges the runes from horizontal right-left to vertical top-bottom, and then begins what Axel sees as an impossible task: going through the permutations of the 132 letters in the message. On this small scale, that of Saknussem’s note, rational science is thrown overboard, middle-class stability collapses. The unknown looms large, as the stodgy classifier, Lidenbrock launches on a mystic quest to calculate an answer on the magnitude of Arthur C. Clarke’s nine billion names of God. The world of the all-too-human is suddenly invaded by the possibility of wonder.

We see here, as in the rest of the novel, that all forms of scientific inquiry—false or true—are ultimately subject to a “fatality” of events, things happen that invariably deviate the protagonists from discovery. Axel is certainly capable of asking rational questions: “car rien ne prouve l’authenticité de ce document [for nothing proves that the document is genuine].” (27) Yet his overheated imagination soon leads him to embrace the professor’s fantasm heart and soul. He too begins to count permutations, possible words dance before his eyes: “Je me débattais contre une insoluble difficulté; mon cerveau s’échauffait... [I was struggling with an insoluble problem; my brain started overheating...]” (19) Feeling faint, Axel fans himself with the document, and lo, as the paper passes back and forth before his eyes, he suddenly sees that the message is written not only top to bottom but backwards. This is sheer accident. Yet Axel irrationally claims he has discovered a scientific law: “J’avais découvert la loi du chiffre! [I had discovered the law of the numbers]”. [16] (33) When he reads the message however, his boasting yields to fear and trembling: for what Saknussem is actually describing is a voyage to the center of the earth! Again, his imagination carries him away, this time with feelings of claustrophobic terror: he sees his uncle wanting to make the voyage, taking his nephew with him. Fearing the worst, he resolves to destroy the document. He is about to do so when, *coup de malchance*, his uncle enters the room, and he has barely time to set the document down.

Axel now knows the key to the text. But instead of telling his uncle, he watches, sadistically, as Lidenbrock wrestles with his permutations: “Je pouvais d’un geste desserrer cet étau de fer qui lui serrait le crâne, d’un mot seulement! Et je n’en fis rien! [With a single act I could undo the iron hoop wrapped tight around his brain—with just one word. I did nothing]”. (22) [17] Yet, in neatly intertwined manner, Lidenbrock’s torture becomes Axel’s torture, for there is no telling how long the former might have stuck to his futile task, had not more events intervened to move things along. Forgetting all else in his obsession, Lidenbrock has locked the house and lost the key; Axel and the maid are trapped inside without food. As hunger begins to gnaw at Axel, he looks for excuses to retreat from his position (“Je commençais à me dire que j’exagérerais l’importance du document... [I started to tell myself that I was exaggerating the importance of the document...]” (23-24). Finally, he persuades himself that he alone, not physical circumstances, has made the decision to give Lidenbrock the key to the puzzle in exchange for the key to the door. Despite all the keys, locks and mini-crises in this scene, the door to the unknown remains open here. Saknussem’s statement remains

untested. The only way to prove or disprove this ‘I was there’ is to go in person and verify. If all these twists and turns may seem amusing, they reveal however that what claims to be a scientific adventure has a fortuitous, if not patently irrational, beginning. The reader sees that the unknown can abide in something as insignificant-seeming as a piece of paper in an old book. The reader also sees how foolishly inadequate two people of apparently scientific pretensions can be, who make the unknown all the more wondrous by their inability to engage it.

Axel's Descent to the Underworld: Humanity Engages *res extensa*

As Axel undertakes this journey, he reveals himself, in his fears and emotive response to the places he travels, to be the descendant of the French romantic hero, of Senancour's Oberman and Chateaubriand's René. For such a figure, nature is a spectacle, exterior landscape and events are met with effusive personal reactions, observation is always centered in the observer's self. At the same time, Axel's discourse reveals a person steeped in what the Western world calls humanist culture. This culture provides him with the mythic and literary structures that accompany him as he encounters the unknown. They provide, in a sense, pre-packaged models for explaining whatever phenomena may arise. In this sense, then, Saknussem did not make the first voyage to the center of the earth. Seen through Axel's eyes, any number of mythic figures, writers, and epic heroes have made this journey before him. One in particular is cited by Axel at strategic moments—Virgil. In Book Six of *The Aeneid*, Aeneas descends into the land of shades via Lake Avernus to confer with his father Anchises. Later, in Dante's *Divina Commedia*, Virgil himself, now a character in his successor's poem, continues to guide pilgrims and visitors through the labyrinth of the Inferno. This labyrinth is a Christianized version of the one depicted by the original artificer, Daedalus, on the sibyl's door through which Aeneas enters the lower realm. Axel begins his descent thus: “C'était le *facilis descensus Averni* de Virgile [It was Virgil's *facilis descensus Averno*].” (92) [18] However easy the descent, it becomes increasingly difficult for Axel to make these cultural models “stick” to the phenomena he encounters. Lost in the underground tunnels, he uses the term “labyrinth” to describe the location he is in. Yet it is clear that no Daedalus, no human hand, has touched this place. Axel's humanist responses raise an important *scientific* question: is it possible for someone carrying such cultural baggage to make direct, unmediated contact with the material unknown, in this case a place never physically visited by mankind?

Axel's reaction to Lidenbrock's project is one of fascination and utter terror. He expresses his emotions in a romantic effusion, tinged by science, but echoing the morbid dread of an Edgar Allan Poe tale: “Je la passai [la nuit] à rêver de gouffres! J'étais en proie au délire. Je me sentais étreint par la main vigoureuse du professeur, entraîné, abîmé, enlisé! Je tombais au fond d'insondables précipices avec cette vitesse croissante des corps abandonnés dans l'espace. Ma vie n'était plus qu'un chute interminable [I spent (the night) dreaming of chasms. I was the creature of delirium. I felt myself seized by the vigorous hand of the professor, dragged along, engulfed, bogged down! I was falling to the bottom of unfathomable pits, with the increasing speed of bodies abandoned in space].” (37-38) [19] On the long preliminary journey that takes him via Denmark to Iceland, and once there across the volcanic wasteland to the crater of Mt. Sneffels, Axel looks to literature for guides. Rounding Elsinore, he invokes

Hamlet, who spoke of the undiscovered country. Iceland is a place, he notes, the very opposite of his familiar green classical landscape. For example, he is unable to see Hans for what he is, one who scales the barren rocks in search of bird eggs. Instead, he camps him in his familiar culture, as “un fermier qui n’avait ni à semer ni à couper sa moisson, mais à la récolter seulement [He is a farmer who doesn’t have to sow his seed or cut his harvest, but merely gather it in].” (56)

Axel in Iceland is already in terra incognita, a stranger in a place where he does not speak the language, and where his only communication with his host M. Fridriksson, takes place, significantly, in Latin. Equally he faces, in Iceland, an entirely new geological landscape. But rather than study it as new phenomena, he layers this landscape with textbook knowledge, interiorizing and familiarizing the unknown rather than confronting its newness: “En véritable neveu du professeur Lidenbrock... j’observais avec intérêt les curiosités minérologiques étalées dans ce vaste cabinet d’histoire naturelle; en même temps je refaisais dans mon esprit toute l’histoire géologique de l’Islande [As a nephew of Professor Lidenbrock’s... I examined with interest the minerological curiosities displayed in this vast natural history collection. At the same time my mind ran through the whole geological history of Iceland].” (76). As well, Axel covers the real terrors of the ascent of Sneffels with romantic posing in the manner of Oberman or Byron’s Childe Harold. His musings however reflect the more mystical visions of Victor Hugo: “Je me plongeais ainsi dans cette prestigieuse extase que donnent les hautes cimes... J’oubliais qui j’étais, où j’étais, pour vivre de la vie des elfes ou des sylphes... Je m’enivrais de la volupté des hauteurs, sans songer aux abîmes dans lesquels ma destinée allait me plonger avant peu [I plunged into that high-blown ecstasy produced by lofty peaks... I forgot who I was, where I was, and lived the life of elves and sylphs. . I was intoxicated by the voluptuous pleasure of the heights, oblivious to the depths my fate was shortly going to plunge me into].” (81) [20]

Thus far, Axel seems able to find cultural guides for his experience, guides that divert his gaze from empirical scientific examination of phenomena he encounters. The result however, for the reader, is a clear disjunct between his literary responses, and the actual physical facts that, despite his cultural masking, filter through his effusions, raw “things” that, untouched, retain their unknown status. This masking however becomes increasingly difficult to do as Axel penetrates into the completely unknown territory underground. Here cultural guides must be replaced by mechanical devices: compass, barometer, chronometer, the Ruhmkorff lantern, all of which seek to reproduce the natural rhythms of night and day, of light and darkness, which can no longer be counted on to provide the familiar landscape of culture: “Il aurait dit plus justement ‘glissons,’ car nous nous laissons aller sans fatigue sur les pentes inclinées... La boussole, que je consultais fréquemment, indiquait la direction du sud-est avec une imperturbable rigueur [He should have said ‘off we slide,’ for we were able to simply let ourselves go on these inclined slopes... The compass, which I often consulted, showed the direction as southeast with an unflinching precision].” (92) The irony of this citation will soon extend to all these mechanical aids by which Axel and Lidenbrock seek to map their journey in relation to familiar places and landscapes above ground. The Ruhmkorffs go out. The chronometer and thermometer seem an absurdity as the voyagers encounter the vast underground cavern, water that obeys no tides, a cavernous granite vault, which Axel misnames the “firmament,” and finally “light,” produced by some unknown source, that resembles nothing familiar on earth. Finally, there is the compass in which Axel puts such absolute faith, and which proves to be totally wrong, its polarity reversed by the “electrical

storm” on the “sea” that in fact brings the voyagers back to their point of departure, just when they believe they have reached the other shore. In terms of all known maps—physical and cultural—our voyagers become completely “déboussolés.”

All along, the voyagers are giving unknown places familiar names: Port Gräuben, the Lidenbrock Sea. Yet, increasingly, there are encounters with material phenomena where no name or cultural model fits, where nothing exists that can offer the least sense of orientation. We are in the presence of Descartes’s *res extensa*, “things” that bear no mark of the human mind. The crucial scene here perhaps is the one where Axel takes a wrong turn in the tunnels, and finds himself suddenly alone and lost, with his physical Ariadne’s thread, the Hans-Bach, suddenly gone: “Je me baissai donc pour plonger mon front dans l’eau du Hans-bach... Je foulais un granit sec et raboteux! Le ruisseau ne coulait plus à mes pieds! [I bent over to wet my forehead in the water of the Hans-Bach. Under my feet was dry and uneven granite. The stream was no longer flowing at my feet!]” (125) We notice that as Axel reaches down and physically confirms there is no water, his terms shift from the humanizing “Hans-Bach,” to the objective ones of “granit sec et raboteux.” The “ruisseau” has become water, pure physical necessity. Death from thirst is neither a product nor a figment of the cultural mind. At first, Axel attempts to humanize his situation with terms like “labyrinth.” But what he now experiences cannot be covered with poetically loaded terms, or Poe-like effusions about being buried alive. All at once, he finds himself face to face with the cold equations of the natural world, and his language conveys this objectively: “Ces trentes lieues d’écorce terrestre pesaient sur mes épaules d’un poids épouvantable. Je me sentais écrasé [Those 70 miles of Earth’s crust weighed down on my shoulders with a terrible weight. I felt I was being crushed].” (125)

But this is not all. Without a lamp, Axel now confronts a situation that not only no poet had ever imagined, but no human before him had ever experienced: a degree of physical darkness that exceeds any found even in the deepest night of earth. Axel faces the truly unknown here; and his situation forces him to face it with scientific objectivity. Note how his description again modulates away from poetic discourse to discussion of physical levels of light and the retina: “Sur terre, au milieu des plus profondes nuits la lumière n’abandonne jamais entièrement ses droits! Elle est diffuse, elle est subtile, mais si peu qu’il en reste, la rétine de l’oeil finit par la percevoir! Ici, rien. L’ombre absolue faisait de moi un aveugle dans toute l’acceptation du mot [On Earth, in the middle of the darkest nights, light never entirely gives up its rights. It is diffuse, it is subtle, but however little remains, the retina ends up receiving it. Here, nothing. Absolute darkness made me a blind man in the full sense of the word].” (128)

As Axel experiences what appears to him an absolute void, one is tempted to say he experiences Pascalian terror. But if this were the case, he is still approaching this moment as a humanist, in terms of what Pascal calls *la condition humaine*. In reality, however, Axel is physically forced, by the absence of all perceivable light, to act as an experimental scientist would. Indeed, it is only because he has physically lost all cultural bearings, all romantic sense of self, in the dark, that he is able to engage *res extensa*. Here, in the total absence of known forms of light, he is forced to attempt to measure the degree of an unknown form of darkness, and in doing so, becomes suddenly aware of the inadequacy of his own sense apparatus in terms of the objective nature of light. The point here is that Axel’s terror is a scientific terror. What he perceives could only be conveyed because he has enough scientific training, not only to grasp, but to seek to measure the *degree* of uniqueness of his situation.

The scientist in Axel returns in a sort of “thought experiment” that immediately follows from his uttering the word “labyrinth,” as if he suddenly realized that the relativizing process of science is perhaps the only way out of the closed systems (“*les entrailles*”) of our culture: “Et, chose étrange, il me vint à la pensée que, si mon corps fossilisé se retrouvait un jour, sa rencontre à trente lieues dans les entrailles de la terre soulèverait de graves questions scientifiques! [And strangely enough, it came into my mind that if one day my fossilized body was found again, encountering it 70 miles into the bowels of the Earth would raise serious scientific questions].” (127) In the midst of what could be defeat and despair, a glimpse such as Axel gives of the future continuity of scientific experiment opens a brief window onto a form of wonder that inspires future readers to continue the pursuit of the unknown.

Verne gives the reader this small glimpse of scientific wonder here. And then, exterior forces intervene. We saw “chance” in action in the opening scene—Axel fans himself and accidentally breaks Arne’s code; in the nick of time Lidenbrock enters the room before Axel can destroy the message. In this instance however, something akin to what Robert A. Heinlein will call “serendipity,” a clear device of wonder, intervenes. Axel suddenly hears his uncle’s voice, a possible but highly improbable acoustic event. Then, even more improbably, Axel falls down a precipice in the dark, only to emerge on the shores of an already-named “Lidenbrock Sea,” as his uncle and Hans have gotten there first. Axel has displayed the romantic penchant for dreaming. Now, he can only explain his fall, how he arrived safely “au milieu d’un torrent de pierres, dont la moins grosse eût suffi à m’écraser [in the middle of a torrent of stones, the smallest of which would have been enough to crush me],” (136) in terms of “providence,” or as a dream: “Je me demandai si j’étais bien éveillé, si je rêvais encore... [I began to wonder if I had woken up properly, if I wasn’t still dreaming]” (135)

Axel may wish to see himself as having fallen down an Alice-in-Wonderland rabbit hole. In fact, he finds himself confronted with a landscape of increasingly unknown phenomena, each crying out for careful scientific examination. What for instance is the nature of this great “sea” they encounter? Why is it there? Saved by an act of wonder, only to be plunged into a world of increasing physical wonders, Axel begins to realize, in the heightened tempo of things, that the language of human culture no longer fits the things he is observing: “Le mot ‘caverne’ ne rend évidemment pas ma pensée pour peindre cet immense milieu. Mais les mots de la langue humaine ne peuvent suffire à qui se hasarde dans les abîmes du globe [The word ‘cavern’ is clearly insufficient for my attempt to convey this immense place. But the words which make up human language are inadequate for those who venture into the depths of the Earth].” (139) Incorrigible Axel still throws his romantic diction (“les abîmes du globe”) at the unknown. But the reader now increasingly sees the uselessness of this language of poetic exaggeration, and with it the overwhelming inadequacy of the humanist observer in the face of patently new phenomena: “Mais qu’étaient ces cavités auprès de celle que *j’admirais* alors, avec son ciel de vapeurs, ses irradiations électriques... Mon imagination se sentait impuissante devant cette immensité. Toutes ces merveilles, je les contemplais en silence. Les paroles me manquaient pour rendre mes sensations... Je regardais, je pensais, j’admirais avec une stupéfaction mêlée d’une certaine quantité d’effroi [But what were these holes compared to the one I was now admiring, with its sky of clouds, its electric illumination... My imagination felt powerless before this immensity. I reflected on all these marvels in silence. Words to describe my feelings failed me completely... I looked, I thought, I admired, in a stupefaction mingled with a certain amount of fear]” (139-40) [our italics]. [21] What is already an effect of wonder however is augmented here by the obvious disparity between word

spoken and thing glimpsed, by the fact that this unexplained *res extensa*, like the dark cavern, gradually engulfs Axel's verbiage, erases his familiar models from poetry and religion: "Au lieu d'un *firmament brillant d'étoiles* [our italics], je sentais par-dessus ces nuages une *voûte* de granit qui m'écrasait de tout son poids [Instead of a firmament bright with stars, I felt the granite vault above these clouds crushing me with all its weight...]." (138)

At the same time, events increasingly happen that leave Axel little time to contemplate an increasingly unknown world. "Things" intervene that keep the scientific explorer from getting close enough to phenomena in order to study them. For example, they discover a forest of what they call giant "white mushrooms." They mount an expedition with the intention of studying these objects close-up. They are prevented from doing so, because this underground "light" cannot penetrate their shade. Events intervene in like manner, when the expedition on the Lidenbrock Sea is interrupted by a battle of what appear to be sea-creatures. Axel first refers to them as "monstres marins," a term taken from art historians of the time. Then he and Lidenbrock seek to identify them as living specimens of presumably pre-historic sea monsters, as reconstructed by contemporary paleontologists. In fact, in the melee that ensues, their exact forms of these beings are never determined. The rhythm of such "impediments" accelerates until the final "eruption" that ejects them from below the earth. In all of these incidents, as Axel and his uncle are prevented from getting close to these phenomena, their attempts to describe and define, in their obvious inadequacy, gives fleeting glimpses of "something" unknown that lies endlessly beyond their reach, but draws the reader's curiosity, doubt, and often awe. We have another technique for generating sense of wonder.

Experiment and Dream: The Moulin-Quignon Man

It is on the shores of this subterranean "sea" that the center of Axel's and Lidenbrock's scientific journey is reached. A clear shift is seen in these episodes from geological considerations to questions of paleontology, from issues of the age and the constitution of the earth, to issues of the nature and evolution of life. The shift is quite noticeable in Chapters 37-39, where substantial material was added in the 1867 edition. If the issues raised by Humphry Davy, Humboldt and others belong to an earlier generation of scientific speculation, questions about the age of life forms, and especially of *homo sapiens*, were burning issues at the time of Verne's novel, not only in France and the England of Darwin, but all over Europe. This was an arena of genuinely experimental science, and the advent of debates about origins may have brought Verne, during the period between first and revised publication, to read Claude Bernard's *Introduction*, a work that transcends Claude Bernard's own specialties of medicine and physiology, to discuss the nature of scientific experiment in the broadest terms.

On the shores of the Lidenbrock sea, Axel's party makes direct contact with an ever-accumulating mass of data, fossil and otherwise, that, if subjected to experimental science, promises to alter much of what the 19th century knows about the evolution of life and mankind. But in order for scientific experiment to be valid in this case, they would have to study this data *in its own context*, in its under-earth environment. But this is exactly what these two examples of Claude Bernard's bad scientists avoid doing. The more alien the

phenomena encountered, the more they seek, in increasingly sophisticated maneuvers, to relocate this data in familiar contexts. The reader sees abundant promise of scientific discovery. That promise, however, is ever dissipated as the protagonists seek to convert unknown facts into known events.

After the episode with the “mushrooms,” Axel and Lidenbrock come across an entire area of giant plants, a landscape that the latter at once magnifies into an Alice-in-Wonderland dreamscape: “Étonnant, magnifique, splendide!... Voilà toute la flore de la seconde époque du monde... Voilà ces humbles plantes de nos jardins qui se faisaient arbres aux premiers siècles du globe! Regarde, Axel, admire! Jamais botaniste ne s’est trouvé à pareille fête! [Astonishing, magnificent, splendid!... Here we have the complete flora of the Secondary Period of the World... Here we have those humble garden plants in the first centuries of the Earth. Look, Axel, admire! No botanist has ever been invited to such a display!]” (142) Despite the apparent passion of discovery, the effect on the reader is that of betrayed sense of wonder, for at the core of the professor’s effusions is the embedded assumption that these flora are simply larger versions of today’s domestic varieties. How can he say, in fact, that no botanist has ever confronted such a spectacle, when he himself, as a botanist, is looking at it face to face, and rather than emoting, should be asking questions about the nature of these plants. Lidenbrock’s vision appears schizophrenic here. One half of him stands in the presence of unknown flora. The other half is absent, as he travels in imagination to the familiar earth of garden plants, where of course no botanist has ever seen such plants. It is of course most unlikely that these are simply larger versions of known plants. Their real evolutionary differences should be investigated, but our two scientists never propose to do so.

The professor dodges such questions by placing himself in two locations, and speaking from the one where the evidence is not at hand. Axel, as he presents the situation, finds it all but impossible to keep Lidenbrock in the underground location, with his eye of the facts at hand. For example, on examining some skeletal remains found in this soil, Axel notices an anomaly: “Je ne comprends pas la présence de pareils quadrupèdes dans cette caverne de granit [I cannot understand how such quadrupeds came to be in this granite cavern]”. (142) His caveat would seem crucial, as the animals in question are not known to be found in sedimentary soil. Lidenbrock however waves away the question with another gesture toward familiar territory, as he makes a fantastic-seeming application of Davy’s theory, asserting that, in fact, the out-of-place sediment has fallen underground due to a volcanic rift in the earth’s surface.

But Lidenbrock soon after faces a more startling anomaly: the presence of the fully preserved skeleton of a “quaternary man” in this same sediment. Did it too fall down through a volcanic rift? Lidenbrock’s response this time is to relocate his find in the context of a scientific controversy going on at exactly the time of the publication of Verne’s novel: that of the Moulin-Quignon Man. If there are still doubts that Verne had an interest in the methods of experimental science, the discovery of supposedly human remains in quaternary sediment at Moulin-Quignon was seen, at the time, as a prime example of what Claude Bernard calls a “découverte imprévue,” a discovered fact that could cause previous theories—in this case those of Cuvier—to collapse, in Claude Bernard’s words, to *crouler*. [22] Verne dates the event exactly: “le 28 mars 1863, des terrassiers fouillant sous la direction de M. Boucher de Perthes les carrières de Moulin-Quignon, près d’Abbeville... trouvèrent une mâchoire humaine à quatorze pieds au-dessous de la superficie du sol. [On 28 march 1863, French

workmen under the direction of Boucher de Perthes had unearthed a human jawbone at a depth of 14 feet below the soil in a quarry at Moulin-Quignon, near Abbeville (Somme)]” (179) The authenticity of this find was hotly disputed at the time. In a letter to Charles Darwin, dated May 24, 1863, J.D. Hooker remarks: “What a mess Falconer, Busk, Carpenter & Prestwich have made of it!... I regard the position of all 4 as humiliating. Falconer is of his original opinion saving solely that no fraud was played (how he reconciles this to his facts I cannot conceive). Busk believes a little more than F[alconer]. Carpenter more than either, and P[restwich] is ready to believe anything. Falc[oner] assured us that his whole conversation with Lartet in the train from Paris to Moulin Quignon was, how so to word the report as to give least umbrage to France’s susceptibility!” [23]

The point here is not that the find was a fraud, or even that it was not *the* paradigm-shifting event it was thought to be. What is important for the understanding of Verne’s text is that this question of the quaternary man was already being resolved, new finds verified, all over the world at the time of the novel’s first publication. It was current, but hardly revolutionary news at the time of the second edition of *Voyage* in 1867, when large sections of this chapter and the two following chapters were added to the text: [24] As Andrew White puts it, “Research among the evidences of man’s existence in the early Quaternary, and possibly in the Tertiary period, was being pressed forward across the board. In 1864 Gabriel Mortillet founded his review devoted to this subject; and in 1865 the first of a series of scientific congresses devoted to such researches was held in Italy. These investigations went on vigorously in all parts of France and spread rapidly to other countries. The explorations which Dupont began in 1864, in the caves of Belgium, gave to the museum at Brussels eighty thousand flint implements, forty thousand bones of animals of the Quaternary period, and a number of human skulls and bones found mingled with these remains. From Germany, Italy, Spain, America, India, and Egypt similar results were reported.” [25]

Even so, Lidenbrock has before his eyes what he believes to be a *complete* skeleton of a quaternary man. His colleagues, given the state of contemporary paleontology, could at best hope to reconstitute such a specimen from fragments. In this context, Lidenbrock’s artifact, found and studied *in situ*, is a significant scientific find, one which would surely bring new, and clearly transformative data to the ongoing question of mankind’s origins. But once again, and now quite dramatically, Lidenbrock turns his back on his data and the mysteries of its being. At once, he transports himself, in a sort of waking dream, back to his classroom at the Johannaum, where he now displays, in a formal lecture, his quaternary specimen to skeptical colleagues. If he first speaks in the conditional tense: “Les Saint-Thomas de la paléontologie, *s’ils étaient là*, le toucheraient du doigt (italics in Verne’s text)... [The doubting Thomases of paleontology, if they were here, would be able to touch it with their finger].” (181) he soon invests his own fantasy: He is actually *there*, speaking in the present tense. In a strange foreshortening that breaks all links with a prehistoric past, the “skeleton” of the underground world now becomes a “cadaver,” an object of dissection, in the familiar classroom: “Le cadavre est là! Vous pouvez le voir, le toucher [The corpse is there! You can see it, touch it].” (182) In the real present of his scientific voyage, imagination fails Lidenbrock. In his imaginary trip to his familiar lecture hall, however, he now goes boldly where no man has gone, putting flesh on the creature whose bones he has never really examined. If Lidenbrock now asks hard questions, he is asking them in the wrong place, to an audience that has never seen their context: “Mais de vous dire par quelle route il est arrivé là, comment ces couches où il était enfoui ont glissé jusque dans cette énorme cavité du globe, c’est ce

que je ne me permettrai pas [But by what route it arrived here, how the strata it was enclosed in, slid down into this enormous cavity of the globe, I am unable to tell you].” (183) We can see this disjunctive scene as the supreme example of Axel “staging” Lidenbrock. This time however, Axel is “captivated” by his own dramatic skills. For, in the act of recounting the scene, he is literally “there,” present in the lecture hall, describing the expressions on imaginary faces, applauding as the professor finishes his lecture. In a sense, in this scene, the reader is the only one who sees both worlds. Able to do so, the reader finds its way back from the minor seduction of Lidenbrock’s “dream” to the greater mystery of this amazing skeleton, snatched away before its eyes, leaving a strong moment of doubt and wonder, in the form of the thousand questions never asked.

Up to now, the two scientists at least asked questions about phenomena they encounter. They are either turned away from answering these questions by intervening events (e.g. the “electric” storm). Or they satisfy themselves with patently inadequate answers (e.g. the Davy hypothesis of volcanic sediment). From this point on however in the narrative, our scientists no longer make even the minimal effort to describe phenomena, let alone analyze them. Lidenbrock’s “lecture” is a prelude to a broader series of experiences, in which description and dream become one. For example, in Andrew White’s comments above, we saw that huge quantities of fossil fragments were being found during the mid 1860s by paleontologists across all Europe. Axel comes across just such a field of bones. As such places were being found, one would expect his response to be more measured. Instead, he transforms the place into a vast “plaine d’ossements... un cimetière immense, où les générations de vingt siècles confondaient leur éternelle poussière [a plain of bones. . an immense cemetery, where the generations of two thousand years mingled their eternal dust].” (178) As the bones of long lost creatures crunch under his feet, he reacts as if in a dream, multiplying both the vastness of the field, and the number of objects in this field, much like De Quincey’s opium eater summoning ever-proliferating crocodiles in the dream sequence of *Confessions of an English Opium Eater*. To deal with this exploding vision of factual objects, he multiplies the number of scientists needed to deal with it, calling upon “mille Cuvier” to take up the impossible task of recomposing “les squelettes des êtres organiques couchés dans ce magnifique ossuaire [the skeletons of all the-once living creatures which now rested in that magnificent bone-graveyard].” (178)

As the two move away in their raft from this “cemetery,” Axel, who up to this point has shown himself to have some scientific knowledge of the nature of light, suddenly views changes in light in a very different, non-scientific, indeed patently “fantastic” manner: “Par un phénomène que je ne puis expliquer... la lumière éclairait uniformément les diverses faces des objets [By a phenomenon I cannot explain, the light was uniformly diffused so that it lit up all the sides of objects equally].” (184). Less important than his inability to give a scientific explanation, is the fact that his cultural model—Hoffmann’s Erasmus Spikher, the man who loses his mirror image—does not even fit the occasion. His earlier lesson of total material darkness in the cavern seems lost on him here. Axel now appears to see the physical world in a totally new light, that of dream, in which he loses all ties to physical reality, himself no longer casting either shadow or image. Now entering what seems a vast cluster of living tertiary vegetation, his mind no longer perceives the objects before his eyes. Instead, as in a waking dream, he sees these fossils turn into living plants before his very eyes. The categories of conventional science clearly no longer have relevance here: “C’était à confondre la raison des classificateurs les plus ingénieux de la botanique terrestre [It was enough to upset the sanity

of the most ingenious classifiers of terrestrial botany].” (185) All at once, the evolutionary scope of the dream widens; where there were plants before, now forms of living prehistoric animals seem to appear. Axel questions his senses as one does in a dream: “J’avais cru voir... Non! réellement, de mes yeux, je voyais des formes immenses s’agiter sous les arbres! [I thought I saw... No! I really *did* see, enormous shapes wandering around under the trees]” (185)

At this point, Axel has no other referent but his own earlier “dream”—“ce rêve où j’avais vu renaître tout ce monde des temps anté-historiques [the dream where I had seen the rebirth of this complete world from prehistoric times]” (186) [the “dream” itself is found in Chapter XXXII, 243-246]. But where the earlier episode was clearly seen by Axel as a dream, the dream now appears to take on flesh, and he can no longer distinguish between dream and waking “reality.” Suddenly, among this patently improbable flora and fauna, a giant living hominid seems to appear before his eyes. Axel throws at this apparition the ultimate weapon of his cultural arsenal—Vergil. The creature is seen as a “berger antédiluvien,” a herdsman of flocks from the poet’s Eclogues. But this new Golden Age proves to be but a dream of a dream. Vergil proves powerless, and awe and wonder are now one with derangement of the senses. In fact, though Verne is writing long before the idea of the “unconscious” was formulated, a deeper dream logic seems at work here. Axel, whose Latin was more or less accurate till now, makes a significant “slip” as he tosses a quote at the creature: *Immanis pecoris custos, immanior ipse*. The word in Vergil (Eclogue 5:44) is *formosi/formosior*, beautiful, referring to Daphnis. In a note to his translation, William Butcher identifies the misquote’s source as Victor Hugo’s *Notre Dame de Paris*. [26] This however does not detract from the fact that, in Axel’s mind, at this moment of psychic shock, a misquote of this sort signals the surfacing of something repressed, now made visible in what appears an unconscious substitution of a (medieval-romantic) vision of monstrosity for that of Daphnis and the harmony of Vergil’s bucolic vision. Some terror, operating on a deeper psychic level than any of the previous dream visions Axel has conjured, causes him to misspeak, to utter the word *immanis*, “savage,” instead.

The question, of course, is Lidenbrock’s role here. Axel’s account assumes that Lidenbrock too saw this creature. For he tells us that, whereas always before Lidenbrock led and Axel followed, now it is Axel, in total rout before the terrifying giant, who drags Lidenbrock away, “qui pour la première fois se laissa faire! [who for the first time in his life did not resist].” (187) But how do we really know whether Lidenbrock was a physical witness to a real scene, or simply another figment of Axel’s dream? We remember that it is Axel who is telling the story. Given his described relation to his uncle, it would seem tempting for him to reverse roles here, in what might be a totally imaginary scenario, and see the otherwise fearless explorer fleeing himself before the unknown. The greater unknown in this episode, however, is not the narrative’s unreliability, but its silence. Usually Hans is physically present, if silent, at these moments of encounter with unknown phenomena. Here he is completely off-stage, waiting with the raft on the shore. Axel flees the “antediluvian man” and drags Lidenbrock with him, whom he suggests is more terrified than himself. But what did Hans think as these two come running up? If this was Axel’s dream, Lidenbrock figures in it, but Hans, the figure of calm experiment, is left completely out. By this time in the story, the reader no longer trusts Axel’s account. The reader, hoping to leave the realm of dream, now eager to see this underground world through more objective eyes, turns to Hans, but he is physically not there at all.

Hans as Experimenter

Let us recapitulate here. Lidenbrock, as seen by Axel, is Claude Bernard's much criticized scholastic, who favors theory over observation. Axel is his young, post-romantic pupil, equipped to ask scientific questions, but fearful of engaging the unknown, kept from doing so by the inadequacies of his humanist responses to the raw facts of *res extensa*, and, increasingly, by a growing propensity to cover physical reality with dreams. Verne has turned what seems a paradox into a stunning literary device: he uses Claude Bernard's two bad scientists and their failure to engage the unknown to create moments where the disparity between perceived fact and inadequate response generates a sense of wonder. This in turn inspires the reader to rethink the situation, to demand a more thorough scientific approach to material fact. Hans is not given a voice in the novel's scientific debates. Because of his silence however, and through the glaring disparity between his deeds and Axel's account of them, it may be Hans who is the prime generator of scientific wonder in the novel. Hans has the makings of an experimental scientist. Indeed, he could not have achieved the results he gets without using an experimental method. But all this activity is occluded by Axel. The reader is left to wonder what has gone on, concerning Hans, in the silences of Axel's text.

When Lidenbrock and Axel first hire the Icelander Hans Bjelke, as guide to take them into the Sneffels crater, Axel describes him as "ce personnage grave, flegmatique et silencieux." Hans does seem to be verbally challenged: he speaks only Icelandic, and in that language utters only an occasional monosyllable. To the educated bourgeois Axel, Hans is a servant. And for Axel, once a servant, always a servant. For despite the fact that Hans renders extraordinary service to the two scientists on this hazardous journey, and even saves their lives on a number of occasions, Axel is still unable, even toward the end of their adventures, to see Hans as little more than a devoted servant: "Cet homme, d'un *dévouement* surhumain dont on ne trouverait peut-être pas d'autre exemple, avait travaillé pendant que nous dormions et sauvé les objets les plus précieux au péril de sa vie [This man of superhuman devotion, one that would perhaps never be equalled, had worked while we slept, saving the most precious articles at the risk of his life]." (172)

Throughout the journey, however, Hans's ability to perform successful experiments on nature becomes increasingly evident. Hans first observes, then devises ways to guide his companions safely through seemingly impossible obstacles. In order to do so, he certainly has to know a lot, and be willing to learn more. Despite this, Axel presents him as a blank sheet. This offers an important clue as to the nature of Verne's depiction of science in the novel. Claude Bernard sees the awakening of the scientific method in mankind as a desire to pass from just seeing to the controlled activity of observation: "Mais l'homme ne se borne pas à voir; il pense et veut connaître la signification des phénomènes dont *l'observation* lui a révélé l'existence." (2) Axel and Lidenbrock certainly see, and occasionally observe. But they never even come close to knowing the meanings of things. But, as Verne knew, if they were to pursue scientific inquiry to its end, we would have a story about doing science, not an adventure. This is where Hans enters the scene. Hans is Verne's ultimate stroke of genius in telling his tale of scientific wonder. For Hans clearly incarnates Claude Bernard's first step in reforming the sciences: the *tabula rasa*.

An extraordinary statement leaps out at the reader of Claude Bernard: “L’homme *peut donc plus qu’il ne sait*, et la vraie science expérimentale ne lui donne la puissance qu’en lui montrant qu’il ignore [Man then can do more than he knows, and true experimental science only gives him power over things by showing him how much he does not know].” (85) Neither Lidenbrock, nor even less Axel, measure up to this standard. For essentially, they know little and do less. To Axel, Hans is the man from Iceland, a barren land he describes as void of all traces of Western culture. In contrast however to the faulty science of Lidenbrock, and to the clear inadequacies of Axel’s cultural models in the face of the physical unknown, Hans’s silence, his absence of theories and cultural responses, takes on a positive value. Claude Bernard makes another important statement that could apply to Hans: “Un homme ignorant, qui ne connaîtrait pas la théorie, serait, en effet, sous ce rapport, dans les meilleurs conditions d’esprit [A man who is ignorant, that is who would have no knowledge of theory, would in fact, in this respect, be in the best state of mind].” (71) “Ignorance” refers to *tabula rasa*, which for Claude Bernard is the best condition of mind from which to begin the experimental journey. During this journey however, Hans the blank sheet begins to fill, at least in the reader’s mind. Though Axel does not describe him doing so, Hans, to get the results he gets, *has* to study the landscape and draw significant experimental conclusions from analyzed data. If Axel simply accepts Hans’s deeds without comment or curiosity, the reader is left to extrapolate from Hans’s actions whatever methods of investigation might have informed them, to reconstruct his silent encounters with the unknown.

Hans’s first major feat is the discovery of water in the subterranean caverns that saves the lives of the adventurers, a feat Axel glosses over by simply naming the stream Hans discovers the “Hans-Bach.” As the trio penetrates deeper into the earth, they predictably run out of water. This is their first encounter with the cold equations of nature, and Axel at once succumbs to laments of hopelessness: “Enfin mes forces m’abandonnèrent. Je poussai un cri et je tombai. ‘A moi! je meurs! [Finally my strength left me. I uttered a cry and fell down. Help! I am dying!]” (109) But as Axel the romantic lies despairing, Hans the man of action rises and goes off: “Pourquoi ce départ? Hans nous abandonnait-il? [Why is he leaving? Is Hans abandoning us?]” Hans returns to wake Axel from his delirious sleep, with the single word “Vatten.” He leads Axel and Lidenbrock to a place in the cavern wall where he has determined there is water. He then takes up a pick, and opens the wall, letting out a stream of hot water, that cools as it begins to flow downward. As the water traces its path, even Lidenbrock the theoretician is obliged to see Hans’s actions as following the ways of material nature: “Eh, bien, laissons couler cette eau! Elle descendra naturellement et guidera ceux qu’elle rafraîchira en route [Well then, we will let the water flow. It will work its way down naturally and guide those who drink from it on the way]!” (114) Axel however, though admitting that Hans may have conducted “des recherches,” rapidly passes him off as a shamanic *sourcier*: “Guidé par un instinct particulier aux montagnards, aux hydrosopes, il ‘sentit’ ce torrent à travers le roc... [Guided by an instinct particular to mountain men, to water-diviners, he had ‘felt’ the presence of a stream through the rock. .]” (111) Characteristic of Axel’s approach to unknown phenomena is a quickness to assimilate them to known activities on the surface of the earth. Hans however is not in his native mountains here; it is not at all certain that what works on earth will work here in this new subterranean environment.

The fact here remains: Hans did discover water, hence had to conduct successful research in order to do so. Axel remains silent, and both scientists incurious. Even so, filtered through Axel’s account, the reader picks up signs that Hans possesses a strong empirical sense, a

keenly experimental approach to phenomena. Later for example, when Axel, lost in his “labyrinth,” hears voices and seeks to orient himself, he hears Hans utter several times, from different locations, the word “forloräd.” Axel realizes this is a form of experimental triangulation, “qu’il fallait précisément parler le long de cette muraille qui servirait à conduire ma voix comme le fil conduit l’électricité [that I too had to speak along the side of the gallery, which would carry the sound of my voice just as wires carry electricity].” (130) Here for once (he is totally unaware of it himself), Axel is translating into “scientific” language what appears to be Hans’s unspoken hypothesis, derived from experiment, that describes the acoustic properties of sound in this particular cavern. Another product of Hans’s silent experimental activity is his healing ointment. Axel has survived his fall to the seashore with life-threatening wounds, which Hans treats: “Hans a frotté tes plaies avec je ne sais quel onguent dont les Islandais ont le secret, et elles ont cicatrisées à merveille [Hans has been rubbing your wounds with some sort of ointment known only to Icelanders, and they have closed up marvelously].” (135) Neither Lidenbrock nor Axel are curious about the nature of this wondrous “je ne sais quoi” salve. Did he bring it with him, or, more likely, concoct it from “native” materials? Again, it is by no means a given that a medicine made of Icelandic herbs will work at all in this new environment. If Hans did concoct his salve from new, underground, ingredients, how did he do it? Again the two scientists pass this off as unworthy of scientific investigation. Of all the “marvels” they encounter underground, Hans’s silent skill is by no means the least. His companions remain blind to it. The reader, however, asks the questions they do not ask, shares in the sense of wonder that surrounds Hans unseen scientific activity.

The most important scene with Hans is his building of the famous raft that ultimately carries the voyagers up Stromboli’s crater and back to the Earth’s surface. Here for the first time, clearly stated, Hans *has to* work with “indigenous” materials, in this case petrified fossil wood. When Axel asks what sort of wood this might be, and whether it floats, Lidenbrock at once limits the field of investigation by using the Icelandic word “*surtarbrandur*.” “Black wood” in Icelandic, this is a combustible lignite used for heating, whose origin (as Lidenbrock says) is the “mineralization” of certain northern species of trees. In answer to Axel’s question: how can such petrified wood float? Lidenbrock picks up a piece of fossil wood *at his own feet*, which is clearly not Icelandic wood, and tosses it in the water. The wood floats, Lidenbrock is satisfied. Yet this could be just a lucky toss, heads or tails; the next piece may not have floated. Axel is not convinced, and discussion ends. A “scientific” discussion has taken place, but none of the questions as to how, and with what material, Hans has built the raft is addressed. The reader knows Hans certainly did not have any *surtarbrandur* at his disposal. He had to work with unknown types of fossil wood. He surely did not proceed by tossing samples into the water; he had to test each kind of fossil material for its properties: does it float? Can it be made waterproof? Is it durable?

One thing is later made clear: Hans could not have used a material like *surtarbrandur*, as this is a combustible substance, and as such could never have withstood the intense heat of the ascent through Stromboli. Axel describes Hans at work among piles of different kinds of wood: “Il y avait là de quoi construire une marine entière [There was enough [wood] there to build an entire navy] (Our translation, omitted from Butcher’s text).” Hans obviously has been engaged in a long process of testing, making sure, to the best of his ability, that his boat is adapted to the conditions of this new environment. Hans is denied a voice to describe his method., the reader can only re-construct his experiment *ex nihilo*, from the silence that surrounds it. It is at this moment that Axel forever puts aside inquiry into Hans’s activity by

elevating him to the status of cultural icon: guide, steersman, silent Vergil to this talkative scientist-companions. The process of doing science is forever silenced by making it an image. Verne's engraver Edouard Riou, however, responds to Hans as a reader might, by drawing an image that emphasizes his presence as experimenter-adventurer. The Riou engraving depicts Hans standing tall at the helm of his raft, holding steady, facing the unknown with resolve, while his two passengers, mere spectators, sit and look on. This iconic drawing, which presents varieties of scientific mankind as they face the sheer mystery of the physical unknown, will set the tone for other depictions of silent experimenters in later novels. [27] In *Vingt mille lieues sous les mers*, we have varieties of this iconic image: the well-fed Professor Aronnax (an Axel successfully grown up) standing arms folded on the deck of the *Abraham Lincoln*, staring out to sea, his back turned to a table upon which rests various telescopes and instruments; later, the famous engraving of a wiry, energetic Nemo standing on the deck of the *Nautilus*, surveying unknown seas with his sextant in hand. Experimental science passes in Verne from the *tabula rasa* of Hans to Nemo's equally silent mastery of all scientific knowledge of his time.

Stromboli: The Ascent of Wonder

The rest of this narrative of scientific discovery—the rout from beneath the earth—reads like a frenzied dream. The voyagers come across what seems another Saksussemm rune, indicating a cave. They set off on their raft, only to find the passage blocked by a giant stone. Against all caution and logic, these geologists set off a charge of dynamite, which triggers a violent volcanic reaction that propels them out of the crater of Stromboli. The string of “mishaps” that begins with Lidenbrock's lost key ends with this volcanic crescendo. Hugo Gernsback, who introduced Verne into what would be the American SF mainstream, was highly sensitive to the potential for wonder in Verne's narratives, to the point of sometimes urging the reader, in his editorial comments, to redo the author's experiments using more accurate methods. [28] But even Gernsback had an issue with the ending of *Voyage*: “It is possible that some of our readers may find fault with the vehicle that Verne chose to bring back the travelers from the earth's interior... At least it is logical, although the chances are that our heroes would not have survived such an ordeal. But we should not be too critical on such points... ” (361) It is certain the characters could not have withstood the physical forces as described. The description however is Axel's. As such, it appears to describe a dream sequence, a voyage through the narrator's unconscious. [29] The chaos and destruction of a physical ascent has become a dream dance of the four raw elements of *res extensa*: earth, water, fire, and finally air. And if the ascent is “amazing,” the landing is more astounding yet, in the same green world that once inspired Vergil's golden age. Given Axel's propensity to dream, and what seems here a final oneiric voyage through the primal forces of life to a safe awakening, one is tempted to see the entire story as the narrative of a dream, or of a nightmare.

Yet, in terms of sense of wonder, Verne's ending is highly significant. We need not dismiss the story as a dream—or a mere fiction. For it is doing something that only science fiction will later do: it takes characters on a voyage through the unknown, only to return them to the known, but in such an improbable, nay impossible, manner that the return now seems more wondrous than the voyage itself. Verne's protagonists come back to the zone of mankind's

“mastery” of nature, a space now all the more narrow in comparison with the extraordinary scope of their journey. They find the familiar temperate zone, but only after they experience how precariously it sits, between the extremes of ice and rock (Iceland) and the fire of the subterranean forces. Life resumes as it was. Lidenbrock, who has seen nothing, made no scientific discoveries, is honored by the university. Axel returns to his fiancée, and no doubt a literary career that is based on his story of a failed expedition. Hans takes his pay, and goes home. The final wonder, however, is the fact that, after such an improbable voyage and an impossible return, they do return home.

The wonder of Verne’s ending will have a long career in subsequent SF. The voyagers to the center of the earth have encountered along the way the blank, a-human forces of nature—*res extensa*—the world of the cold equations, a world that, as Pascal said, has no *knowledge*, no awareness of us or our science and culture. The final wonder then of such a voyage is that, given the impossible odds of our ever relocating ourselves once we have experienced pure quantity and extension, we miraculously find a world to our measure. This is something often criticized in SF’s “generation starship” tales, as with Heinlein’s *Orphans of the Sky*, where human beings who have lost their bearings in the void, by some improbable course of things, find themselves on a planet that is even better than the Earth they left behind forever, where they start over again in a new golden age—“good eating, Alan.” Even so, such endings, read in the light of Verne’s *Voyage*, may in fact be the quintessential SF experience. Take the example of Poul Anderson’s classic *Tau Zero* (1970). Here the generation starship, humanity’s Noah’s ark, breaks the Tau barrier, and in doing so actually produces a new “big bang,” through which the crew sails on to find a new and better world on which to begin again. In Anderson’s novel, the protagonists survive the same raw physical forces Axel and Lidenbrock encounter, now augmented to the nth degree. As with the ascent through Stromboli, the physical universe throws everything it has at them, and yet they come through alive, to find a world theirs for the taking. In this ultimate form, the sense of wonder is generated by the “reprieve” given over and over, to protagonist and reader, in the scientific voyages of Asimov, Heinlein and other classic SF writers.

In contrast to what has been the critical consensus, a very different view of Verne’s work and its impact on later SF emerges from our placing Claude Bernard’s idea of science at the heart of his seminal scientific adventure, *Voyage au centre de la Terre*. A neverending search to know the unknown drives Claude Bernard’s experimental method. In an opposite manner, French critics like Roland Barthes and Michel Serres tend to place Verne, for good or bad, in the culturally dominant Cartesian mode, in which science is seen to master the physical world by “appropriating” nature to its logically formulated categories. [30] There are indeed many such “catalogues” of natural phenomena in Verne. But this does not explain the persistent encounters with the unknown in his work, from which the scientist who observes and experiments comes away empty handed. In order to explain this constant sense of wonder that surrounds the unknown in Verne’s scientific adventures, we turn instead to Claude Bernard. In contrast to the classifying sciences of the time, Claude Bernard was first among commentators on science in France’s 19th century to offer a view of science which is essentially that of modern practitioners. Unlike Comte’s systematizing of physical reality under the “laws of phenomena,” or Laplace’s “demon,” which posited that science could calculate all the permutations of the natural world, Claude Bernard focused less on the product than the process of science, the *search* for knowledge, in which the experimenter is ever drawn to the wonder of the unknown. Claude Bernard’s experimental science was not an anomaly in

French science. Instead he gave voice to actual experimental science *as it was being done* in France. His was the practical voice of science in contradistinction to the Cartesian ghosts in the machine, that still, in complex ways, continue to haunt French criticism today. Verne would not be revered and emulated by SF today if it were only for his catalogues of known facts, or for Nemo's library (which, by the way, remains an unknown). He is read because, in the wake of Claude Bernard, he infused scientific adventure with its sense of wonder. It is this same sense of wonder that causes particle physicists in modern times to name a particle the "charm quark," something that decays into a "strange quark." It is this impulse that brings a physicist-writer like Robert L. Forward to want to imagine "life" on a neutron star.

Verne, Wells, and the Sense of Wonder

We have made the case that the sense of wonder Verne develops in *Voyage au centre de la Terre* is born of a transposition, to the novel of travel and adventure, of Claude Bernard's vision of experimental science as unending pursuit of the physical unknown, driven by "une sorte de soif de l'inconnu, et le feu sacré de la recherche qui ne doivent jamais s'éteindre chez un savant [a sort of thirst for the unknown, and the sacred fire of research that must never go out in a scientist]." (307) Many critics however would give the role of creator of sense of wonder instead to H.G. Wells and his Time Machine. Jean-Jacques Bridenne, for example, compares Verne with Wells along the lines of the "fancy" and "imagination" distinction of Wordsworth: Verne rearranges the furniture of present knowledge, while Wells offers "prophetic" extrapolations: "Du point de vue scientifique, [Wells] se permet... de traiter en réalités assises les hypothèses les plus étonnantes, mais les plus constestables [From the scientific point of view, he allows himself to treat as established reality the most astonishing and controversial hypotheses]." [31] Verne himself may be the source of such distinctions with his famous remark: "[Wells's] histoires ne reposent pas sur une vraie base scientifique... j'utilise la physique, il l'invente [Wells's stories do not rest on a true scientific foundation... I use physics, he invents it]." (108) We propose however to take Verne at his word here, and see the "base scientifique" he speaks of here as the experimental science of Claude Bernard. Sense of wonder then, for Wells, would be generated by bold if dubious extrapolations, whereas for Verne it is the product of mankind's ongoing encounter with the material unknown.

But is Bridenne's really an accurate description of Wells's sense of wonder? Wells's Time Traveler is an investigative scientist. And the time machine—seen as Wells's device of wonder—would appear to allow its user to do investigations anywhere in time, past or future. But that said, what exactly is the scope of scientific investigation in *The Time Machine*? Let us look first at the Traveler's theory on which the machine and time travel is posited. If time is the fourth dimension, then "there is no difference between Time and any of the three dimensions of Space except that our *consciousness* moves along it." [32] The time machine then limits travel to the time of an *individual* consciousness, that of the Traveler. In terms of space, the Traveler remains confined to his laboratory, located in Richmond, in the Valley of the Thames. If he travels, in "time," to the year 802,701 AD, then on to the end of the earth, he remains in the same location. Over the span of time, things have changed radically around this three-dimensional locus. But why, once he is in the future, does he not leave this location

(just as he could do in his present), and explore other places and climes? Instead, the parameters of his travel appear to be governed by the spatiotemporal stretching of Mrs. Watchett. He perceives her, entering his laboratory as he leaves, as zooming forward. Upon his return, he sees her retrace her initial trajectory, arriving at the same *place*, the laboratory door, from which she began *her* journey back and forth in time. The entire adventure of the Traveler in the future can be measured as the distance from one corner of the laboratory to another, the distance the Morlocks dragged his machine inside their compound. The implication is that he is spatially tied to the location of his machine. By the same logic, had he moved it laterally, to the old English Channel for instance, he would have returned there, not a comfortable thought.

Frank Scafella speaks of the Traveler as one who investigates the future using the methods of experimental science. [33] But again, we must ask: what is the scope of the Traveler's investigation, the reach of his scientific queries? Verne's explorers go to a place where there are no humans, and where they eventually lose all contact with the familiar human world. Wells's Traveler, on the other hand, chooses (accidentally or perhaps obeying some unconscious desire) a location in the future where humans, if degenerate, still exist. It may be true that the Traveler, in the world of Eloi and Morlocks, proceeds by observation, the formulation of hypotheses, and the correction of those hypotheses as he discovers new, contrary data. But he has limited his exploration to a single human landscape. And within that landscape, he applies to his encounter with the unknown a few social models, all taken from his own time. In terms of evolutionary spacetime however, 802,701 AD is so far in the future that it is all but impossible that either humans or their institutions would still exist, let alone follow patterns of behavior linked to this observer's specific culture and time. Within these narrow parameters, his investigation of the Morlock mystery has only one issue—the impasse of horror. His only resource is to flee in the dark, to clamber on the seat of his machine in the nick of time as his last match goes out. In short, there is very little sense of wonder in the Eloi and Morlocks; seen through the Traveler's eyes, their world and doings is more like *déjà vu*.

The final vision of the terminal beach would seem more appropriate for wonder. But if we think of it, this is not really an encounter of mankind with pure *res extensa*. What the Traveler experiences instead seems more an encounter, at one and the same place, with his own evolutionary future and past. As he looks out over the flat landscape, dying sun and giant crabs, the last vestiges of devolved life on a barren earth, he sees what Richmond must become, a place without mankind. At the same time however, because he, the man of 1895, still stands in this future place, he is able to look back, down the evolutionary chain from himself to mankind's origins on a similar beach: "Silent? It would be hard to convey the stillness of it. All the sounds of man, the bleating of sheep, the cries of birds, the hum of insects, the stir that makes the background of our lives—all that was over." (86) He hurries back to the safe drawing room in 1895. And in the end, we could say he has not moved at all. For wherever he stands, on the terminal beach or in his drawing room, the future and past he sees remain quite predictable. If we evolved from nothing, we will devolve to nothing. All that is left of the Traveler's extraordinary voyage is a beard and torn clothing, marking the passage of several days of biological time, the personal "time arrow" that no time machine can alter.

What then is different from Axel's encounters with the physical unknown in the cavern? Or his meeting with the "herdsman"? A main difference is that Axel's brushes with the unknown are temporary, not terminal, his trajectory open, not closed. Doors are constantly closed on

the Traveler: he barely escapes the Morlocks as they close the door to their compound, imprisoning his machine. The door to the future is closed by the dead earth. Indeed, the door to his own laboratory, that opens with Mrs. Watchett, closes as she retreats backwards on his return, shutting the door to time travel at the very same time she opens it. The Traveler has the entire future at his command, but only within the closed space of the Thames Valley. Wells's reader is never challenged by the potential wonder of what lies beyond this limit.

Wells's extraordinary voyage is no voyage at all. The time loop brings the future Traveler back to his present. If he never returns from the second trip, to the past; if the loop is broken, it is probably because Richmond was a more dangerous place in the past than in the future. But the reader learns nothing of this. Verne's reader, on the other hand, is taken along with Axel from one place to another. The reader sees what Axel sees and feels, senses the potential wonder of his encounters with the unknown, but (like Axel) is never given the time to ask significant questions, to examine evidence, draw conclusions. The reader of *The Time Machine*, on the other hand, is warned away from asking such questions by Wells's primary narrator. After telling his tale to his circle of friends in his present, the Traveler asks those who do not believe his account, to take it as a lie, or as a prophecy, or even as a story. Unlike Axel's readers however, the Traveler's audience does not have this latter option. They (and Wells's readers) are not encouraged to take it as a story, because the narrator, who believes the Traveler, takes it as a prophecy, and in doing so, shuts the door on Claude Bernard's never ending story of science. Telling his listeners to live "as though it were not so," Wells's narrator discourages all further stories and wonders. If Axel's readers end the story still wanting to continue the journey of experiment and discovery, the reader here is told such journeys are futile.

Let us make one final comparison between Wells and Verne around the problem of sense of scientific wonder. When the Traveler arrives in the time of the Eloi and Morlocks, he finds the landscape presided over by a sphinx-like statue, its features worn by the ravages of time. This figure stands at the portal of all spacetime exploration, and seems to imply in its mute blankness that, however great the reach of human experiment, the result must always be enigma, the natural world will never reveal its secrets. Claude Bernard, at one point, seems tempted by an equally futile vision of scientific inquiry. But if at one point he cites the "fable de Sisyphe," it is only to reject this figure of silent suffering, endlessly rolling the rock of scientific investigation up the slope, only to see it roll forever back to the bottom. Instead, in a significant variation of the never ending task of science, Claude Bernard cites Pascal: "Nous ne cherchons jamais les choses, mais la recherche des choses." (307). In light of this sense of things, Verne's sphinx is cast as Hans. Hans may seem silent, enigmatic. And yet he acts, and in doing so opens future doors to scientific wonder instead of closing them. Hans shoulders the burdens of nature, and in the silent wonder of his toiling points the way to future experimental science.

Conclusion: Verne's Way

In terms of later development of science fiction, the paths that lead from Wells and Verne bifurcate. The pivotal point is this question of sense of wonder. Wells uses the term in his later novel *The War of the Worlds* (1898), but the situation for his narrator is very different from that of Axel. The moment is the end of Chapter 7, as the narrator leaves the Artilleryman, and

proceeds on to experience “dead London”: “With that realization my dormant sense of wonder, my sense of the proportion of things, awoke again. I glanced... to Mars, red and clear, glowing high in the west, and then gazed long and earnestly at the darkness of Hampstead and Highgate.” (156) Wonder here is, as in *The Time Machine*, a sense of the *proportion of things*. Here he looks to Mars; he will wander the deserted streets of London, surveying the utter destruction superior Martian science inflicts on humanity. Later, however, he will see those streets again teem with men, after the Martians succumb utterly to Earth bacteria, against which they have no defense. The narrator’s “wonder” is a kind of cognitive estrangement that comes from having stood twice in the center of things, between cosmic hubris and human folly, and watched the empty streets fill once again with mankind at the median: “And strange, too, it is to stand on Primrose Hill... to see the people walking to and fro among the flower beds on the hill, to see the sightseers about the Martian machine that stands there still and to recall the time when I saw it all bright and clear cut, hard and silent, under the dawn of that last great day... ” (173) What dominates the extraordinary is the common vision of the people, for whom the flowers and the Martian tourist attraction are one and the same.

The return of Wells’s Narrator to London would seem, like that of Axel and Lidenbrock to Hamburg, to be a homecoming. In the case of Wells, we are tempted to quote T.S. Eliot’s famous lines: “We shall not cease from exploration/ And the end of all our exploring/ Will be to arrive where we started/ And know the place for the first time.” [34] But this applies only if we amend it to say “know *our place* for the first time.” To wonder in Wells is to sense that lonely middle ground, on one hand, between the scientific explorations of a Time Traveler, a Doctor Moreau, or even the “evolved” Martians, and on the other, the mass of humanity that lives like the mindless bacteria who outlast them. In contrary manner, the point of Axel’s homecoming, of the chain of wondrous moments and events that bring him back, is that he knows neither this place nor the places he has been. In the eyes of experimental science, we never know any place, for the first or for any time. But Axel and Lidenbrock, in their failed encounters with *res extensa*, have shown enough of the wonders of the unknown that the reader desires to continue the scientific journey.

Bridenne ultimately qualifies Wells’s work: “[I] est rapidement passé de l’anticipation scientifique à l’anticipation *ou plutôt à la prophétie sociologique*. (110) The word “prophesy” may not fit, but in a sense science, in Wells, remains a function of the human user in its social context. If for Claude Bernard, science is a passionate and continuous search to know the unknown, for Wells pursuit of the unknown leads the pursuer (and his narrator double) to realize the human limits of what can be known. Considered the more scientifically speculative of the two writers, Wells instead bequeaths to future science fiction a deep pessimism. The scientific adventure ends with mankind isolated within its cognitive structures, and the reader that accompanies the scientist on his journey being warned that knowledge of the other—the unknown outside self—is a solipsistic dream. This way leads to the skepticism of a Stanislaw Lem, who works with the epistemological a priori, that humans can never know anything outside themselves.

Verne’s way, especially as set forth in *Voyage au centre de la Terre*, traces a very different path in later SF. His subsequent, most famous, novels of scientific exploration all feature notable encounters with the unknown, where the scientific observer but slenderly grasps the phenomena at hand. An example is Arronax in the silence of his diving suit moving through an

Atlantis he can never touch (*Vingt mille lieues sous les mers*). Another is Barbicane, Nicholls and Michel Ardan flying by the dark side of the moon. Given a short glimpse of the terrain by a meteor flash, they are whisked away before they can see and examine it. (*Autour de la Lune*). Even in Verne's later novels, where he becomes more pessimistic about the moral reach of science, he still creates moments of wonder, as in *Le Sphinx des glaces* (1897) where solving one mystery (that of Arthur Gordon Pym) leads to fruitless encounter with the greater scientific unknown of the "Ice Sphinx" itself.

All these however are episodes. They all point back to the miraculous unity of *Voyage au centre de la Terre*, where Verne first develops a narrative and a rhetoric of wonder that transposes the open-ended science of Claude Bernard into a structure that fuses experiment and exploration, that makes science into the adventure of science, the unfurnished process that, constantly generating its a sense of wonder, urges us to continue the journey.

In the above sense, Verne's novel provided the model for a long and distinguished series of later SF novels. Heinlein seems to exploit the young Axel and his improbable and wondrous brushes with the unknown in his 1950s juvenile novels, most notably in the first-person narration of Kip in *Have Space Suit, Will Travel* (1958). Kip the young dreamer with an old space suit finds himself on a journey that leads to encounter with incomprehensible physical forces, which he does not understand, but from which he wrests a reprieve for himself, and only serendipitously for the rest of mankind. In a different vein, Arthur C. Clarke seems to recreate Verne's sense of wonder in juvenile novels like *Islands in the Sky*, also narrated in the first person. There are, as well, many third person narratives in both Heinlein and Clarke where sense of wonder is generated by incomplete encounters with the physical unknown. With the above authors, these third-person narratives are so narrowly focalized as to present the action from the single point of view of a protagonist. Notable examples in Heinlein are *Starman Jones* (1953), where we see the marvels of interstellar space from the sole perspective of a young farm boy who becomes a brilliant astrogator; and *Citizen of the Galaxy* (1957), where the narrative focus is that of a slave boy, Thorby. Clarke routinely focuses his encounters with the unknown through the tightly restricted perspective of protagonists who are ultimately overwhelmed by the ineffable. Examples are "A Meeting with Medusa," *Rendezvous with Rama*, and ultimately the entire *Space Odyssey* series.

Finally, we find Verne's techniques of wonder still functioning in Gregory Benford's novels of space-time exploration. A clear example is *Against Infinity* (1983), a third-person narrative, but again tightly focalized on the vision of the young protagonist, Manuel. In a sense here, Axel and Lidenbrock are reincarnated as Manuel and Old Matt, and the center of the earth is recast as the Aleph, an inscrutable entity that somehow contains all of physical existence, yet is located on not-too-distant Ganymede, a place (like the center of the earth) humans can and do explore. Manuel's final encounter with this entity is, in the best Vernean manner, a brush with the unknown, the inconclusive nature of which provides the sense of wonder that will drive the enterprise of human science forward, on a perhaps never-ending struggle with the brute mysteries of *res extensa*. If these works are central to what is commonly seen as science fiction, then we can at least speculate that Verne, in a single stroke in *Voyage au centre de la Terre*, and inspired by the vision of science of Claude Bernard, in fact created science fiction, as the literary form that defines itself as purveyor of scientific wonder.

NOTES

1. See John Clute and Peter Nicholls, *The Encyclopedia of Science Fiction* (New York: St.Martins-Griffin, 1995), p. 1083-85; and Cornel Robu, "A Key to Science Fiction: The Sublime," *Foundation* #42 [Spring, 1988], 128-136.
2. Letter to Louise Colet, April 6, 1853, in Gustave Flaubert, *Correspondance* II, editor Jean Bruneau, (Paris: Gallimard Bibliothèque de la Pléiade , 1980), 298.
3. Paul Valéry, "Sur la technique littéraire," in *The Art of Poetry*, Introduction by T.S. Eliot (New York: Vintage Books, 1958), p. 314. In this volume the concluding essay, Valéry's first published piece in 1889, is given in French.
4. Reino Virtanen, *Claude Bernard and His Place in the History of Ideas* (Lincoln: University of Nebraska Press, 1960), p. 13.
5. Claude Bernard, *Introduction à l'étude de la médecine expérimentale* (Paris: Garnier Flammarion, 1966), p. 307.
6. The edition of Claude Bernard's *Introduction à l'étude de la médecine expérimentale* we cite throughout is Garnier Flammarion (Paris, 1966).
7. Arthur B. Evans, *Jules Verne Rediscovered: Didacticism and the Scientific Novel* (New York: Greenwood Press, 1988), p. 25. Evans discusses the state of secondary science education primarily, where "science education was consistently viewed as a religious and ethical matter as much as an intellectual one." (13) Claude Bernard's remarks however give us a good idea of science education at the level of the university "faculties." Here the problem was more a question of inadequate scientific method (aprioristic positivism) than of religion or ethics. But insofar as young Axel is obviously a product of university science, and insofar as he demonstrates the various *défauts de méthode* Claude Bernard enumerates, one must assume that Hetzel was taking aim at higher science education as well.
8. Evans, pp. 18-19. Evans sees Verne discussing this new type of novel with Dumas *père* during the early 1850s: "But at this juncture the particulars of such a unique novel remained only a vague idea in Verne's mind." (19)
9. Non-dated letter from Hetzel to Jules Verne (end 1863-early 1864), in *Un éditeur et son siècle. Pierre-Jules Hetzel (1814-1886)* (San Sebastian: ACL Édition, 1988), pp. 118-119.
10. Michel is not the narrator. But Verne's third person narrator shows a visible disdain for the dominant Comtean categories and hierarchies that dominate this future world: "Nous ne pouvons citer la nomenclature infinie des Sciences qui s'apprenaient dans cette caserne de l'instruction: un palmarès du temps eût fort surpris les arrière-grands-pères de ces jeunes savants." [We are incapable of reciting the infinite nomenclature of the Sciences as it was taught in these military barracks of learning: A list of top awards today would have really startled the great-grandfathers of these young scientists" (our translation). (38)
11. An interesting connection exists between the fascination in German Romanticism with mines and underground "kingdoms" and Verne's late romantic journey. Ludwig Tieck's "Der Runenberg," (1802) for example, is a classic example. We have in this story a "rune mountain," a miner with connections to the "dark powers" of buried nature (Saknussem?), the fatal lure of the mineral kingdom, and its contrast with the world of organic life. Tieck was little known in France. However the most prominent German work in this vein is E.T.A. Hoffmann's "Die Bergwerke zu Falun"[The Mines of Falun] (1819), and Hoffmann, cited in *Voyage*, was, via the Loève-Veimars translations, a

major influence on 19th century French literature. Hoffmann's source for his tale was the famous treatise of G.H. Schubert, *Die Nachtseiten der Naturwissenschaften* [The Night Side of the Natural Sciences], which recounts the discovery, in a Swedish mine, of the perfectly preserved body of a young man. Hoffmann elaborates on this "scientific" account by returning to the idea of the lure of the mineral depths. It is tempting to see Axel's remark, when lost in the underground cavern, about the perplexity of future scientists when several hundred years hence they find his preserved body and the mystery of how it got there, as a playful reference to Hoffmann. But whereas Hoffmann "romanticizes" Schubert's factual account, Verne now reverses polarity, and sees Axel's plight, not as the lure of some mineral maiden, but as a genuine encounter, not with supernatural forces, but with the material unknown, with *res extensa*.

12. *Nova* in fact takes its clues from Verne. Doing science must become a narrative puzzle; seemingly loose ends, data often collected separately, or by accident, are dramatically linked, again often by chance, revealing a new phenomenon, but one that invariably points to greater scientific mystery. For example, a recent *Nova* episode on supervolcanoes "dramatized" doing science by presenting far-flung threads, scientists investigating various puzzles concerning sudden climate change as measured in different manners and domains. Through serendipitous connections, a pattern gradually emerges that points to the presence of supervolcanoes, capable of creating massive volcanic winters, literally right under our familiar lakes, and who knows where else. Under the earth remains a mysterious place. And in an obvious gesture toward Verne, the program ended with Neil deGrasse Tyson, in a short animated interlude, attired as an underground explorer, "falling" rapidly down a volcano, through the molten core, propelled, then slowed by surface gravity as he reaches the other side. (*Nova*, on KCET, Los Angeles, 09/12/2009).
13. On the Plutonist theory of James Hutton, that early displaced Davy's volcanic theory, see Dennis R. Dean, *James Hutton and the History of Geology* (Ithaca NY: Cornell UP, 1992). Also see the interesting book by Allen A. Debus, *Dinosaurs in Fantastic Fiction: A Thematic Survey* (Jefferson NC: McFarland Publishing, 2006), especially chapter 1 on Verne's subterranean "museum."
14. Translations from Verne's novel are from the William Butcher edition, *Journey to the Center of the Earth*, Oxford World Classics (Oxford: Oxford UP, 1992). The French text used is the 1867 edition, *Les Intégrales Jules Verne* (Paris: Hachette, 1978). Page numbers in text are to Butcher's translation.
15. See *Introduction*, p. 34-35: "Au premier abord... cette distinction entre l'activité de l'expérimenteur et la passivité de l'observateur paraît claire et semble devoir être facile à établir. Mais, dès qu'on descend dans la pratique expérimentale, on trouve que, dans beaucoup de cas, cette séparation est très difficile à faire. . Cela résulte, ce me semble, de ce que l'on a confondu l'art de l'investigation, qui recherche et constate les faits, avec l'art du raisonnement, qui les met en oeuvre logiquement pour la recherche de la vérité [At first glance, this distinction between the activity of the experimenter and the passivity of the observer seems obvious. But as soon as one gets involved in practical experiments, one finds that, in many cases, this distinction is difficult to make... The reason for this, it seems to me, is that one has confused the art of investigation, which seeks out and verifies facts, with the art of reasoning, which arranges these fact logically in the search for truth]."
16. Here we take issue with the Butcher translation. He flattens Axel's exclamation: "I had discovered how the code works." Discovering "la loi du chiffre" is a much more absolute claim, doubly absurd given the manner in which the solution to the code was found.
17. A note on the translation. Butcher translates "crâne" as "brain." The literal word is "skull," and this is significant in defining Axel's use of various forms of language. The word "skull" is starkly material and non-Cartesian. Axel is capable of outbursts of the most excessive Romantic language; he can shift in an instant to such neutral, "scientific" description. In other words, when pushed by circumstance, he proves capable of seeing through the veil of emotion and cultural illusion, of

grasping the physical object in itself. It is such “breakthroughs” (as when, lost in the underground cavern, he encounters the new darkness, and proves capable of measuring its unyielding physical nature) that bring Axel, and the reader, to the most intense experience of scientific wonder.

18. *Easy is the descent to Avernus.* (*Aeneid*, Book 6, line 126). Here already, facing the ominous reality of this descent, Axel’s Latin appears to be slipping: “Sate sanguine divom/Tros Anchisaide, *facilis descensus Averno*/Noctes atque dies patet atri ianua ditis/Sed revocare gradum superasque evadere ad auras/Hoc opus, hic labor est” [Easy is the descent to Avernus/For the door to the underworld lies open day and night/But to retrace your steps and return to the breezes above/That’s the task, that’s the toil]
19. A note on the text. The Butcher translation is accurate. No translation however can reproduce the particular late-Romantic prose of this effusion. One notices a stylistic effect that was already cliché by Verne’s time, the proliferation of illogical plurals. An example: “Je la passai à rêver de gouffres!” Or “Je tombais au fond d’insondables précipices.” The latter example even has a plural verb, the imperfect “was falling” which implies a number of falls. This excessive use of iterative discourse marks such late romantic, almost parodistic, works as Flaubert’s *Novembre*, (1842) or *Mémoires d’un fou* (1838). See Danièle Chatelain, *Perceiving and Telling: A Study of Iterative Discourse* (CSUSD University Press, 1998).
20. The style echoes that of Hugo’s poetry from *Les Rayons et les Ombres* (1840) and *Les Contemplations* (1856). Hetzel was Hugo’s publisher during this period. One of Hugo’s major themes during this period is the total indifference of the natural world (what we are calling *res extensa*) to human endeavor and suffering. An interesting possible link, via Vergil again, exists between the musing of Axel “perdu dans ce *labyrinthe* dont les sinuosités se croisaient en tous sens...” (202-203), that the discovery of his fossilized remains in this terrifying and indifferent place would “raise serious scientific questions,” and Hugo’s poem “*Oceano nox*” from *Les Rayons et les Ombres* (1840), where the poet reflects on an unnoticed death by drowning in an indifferent sea. The lines from Vergil to which the title refers: “Vertitur interea caelum, et ruit oceano nox, (*Aeneid*, II, l. 250) translates roughly as “meanwhile the sky revolves and night rushes from the ocean.” A further note on the translation. The phrase “cette prestigieuse extase” is translated as “high-blown extasy.” Insofar as the word “prestigieux” means something with “éclat,” and “shining extasy” is a barbarous rendering of the idea, we could suggest, in keeping with our theme, that Axel here means “wondrous ecstasy.”
21. A note on the translation: Having the French text before one’s eyes helps understand the nature of Axel’s discourse. In the passages translated in this paragraph, the Butcher translation flattens the archly late-romantic allusions and language of the narrator. When Axel says “je contemplais” he echoes Victor Hugo; none of this comes through with “reflected on.” Or “j’admirais... ses irradiations électriques,” which becomes “I was admiring... its electric illumination,” removes the romantic iterative. Finally, “I felt the granite vault above these clouds weighing down on me” does not render “je sentais par-dessus ces nuages une voûte de granit *qui m’écrasait de tout son poids*.” Echoes of Baudelaire, of Edgar Allan Poe, and beyond all literary models, the sheer physical feel of a massive weight of granite *crushing* Axel’s puny physical being.
22. See *Leçons de physiologie expérimentale, tome I, première leçon, 23 décembre 1854, p. 17*: “Les autres [découvertes] *imprévues* sont des découvertes qui surgissent inopinément dans l’experimentation, non plus comme corollaires de la théorie... mais toujours en dehors d’elle, et par conséquent lui étant contraires [The other *unexpected* discoveries are ones that arise unexpectedly as a result of experimentation, they are not simply corollary to a theory... but are always outside and other, and consequently opposed to a theory].” Claude Bernard presents these “découvertes imprévues” as having an almost cataclysmic effect on established knowledge, forcing a “collapse” [crouler] of existing theory, in effect a *tabula rasa* that demands that science reconstruct a new theory on new bases discovered in the wake of the new data.

23. *The Darwin Correspondence Project*, letter 4169. Falconer, George Busk, William Benjamin Carpenter, and Joseph Prestwich were the British members of the Anglo-French conference held at Paris and Abbeville to consider the authenticity of the flint tools and human jawbone discovered by the archaeologist Jacques Boucher de Perthes in the Moulin-Quignon gravel pit near Abbeville, France, in March 1863 (*Athenæum*, 23 May 1863, p. 682). See also letter from J. D. Hooker, [7 May 1863]
24. See William Butcher's "Introduction" to his Oxford UP translation, p. xvi-xvii: "The publishing history of the *Journey* indicates another concern, for this novel is unique among Verne's in undergoing significant changes after publication in book form. Most of chapters 37-39 were added in the first large-octavo edition (1867)."
25. See Andrew White's account in *A History of the Warfare of Science with Theology in Christendom*, 2 vols. 1898. White was first president of Cornell University. It is interesting to note that Charles Lyell's *Geological Evidence of the Antiquity of Man* appeared in 1863.
26. Butcher, p. 230. The Vergil misquote occurs in Victor Hugo, *Notre Dame de Paris* (1831), chapter 4, scene 3, entitled "Immanis pectoris custos; immanior ipse," referring of course to Quasimodo the hunchback. Butcher sees another classical allusion in Axel's description of the antediluvian herdsman, this time to Homer's *Odyssey*, Book 11, where Odysseus in Hades spies "a giant pursuing wild animals with a club in his hand." We wish he had given a precise reference for this. All we could find is 11, 285-293, concerning the cattle of "the mighty Iphiclus from Phylace," and Melempus, the only man who undertook to drive them, and ended up in chains "a prisoner of the savage herdsman" [*The Odyssey*, E.V. Rieu translation (London: Penguin Classics, 1991), pp. 167-68. If so, this is a pretty obscure passage.
27. *Voyage au centre de la Terre*, (Paris: Collection Hetzel, "Les mondes connus et inconnus," 1912), p. 169. The illustration is by Edouard Riou, (1833-1900), a pupil of Gustave Doré.
28. Hugo Gernsback serialized Verne's novel as *A Trip to the Center of the Earth*, in the May, June and July, 1926 issues of *Amazing Stories*. Gernsback comments in his "Introduction to Our Story" that "this particular "Voyage" has sometimes been declared the author's masterpiece." (100) *Dr. Ox's Experiment* was published in the August 1926 issue, and *The Purchase of the North Pole (Sans dessus dessous*, 1889) in the September and October 1926 issues. It is interesting that this series of Verne works are all, to some degree or another, works about scientific experiments. In fact, in Gernsback's editorial comment to *Dr. Ox*, he appears to respond to the kind of scientific wonder we are describing, in which failed experiment, an aborted encounter with unknown possibility, leads the reader to want to repeat the process, to do it better: "There is of course excellent science in this story, and if anyone should go to the trouble of repeating Dr. Ox's experiment on the vast scale shown here, the results would probably be just as depicted by our famous author." (421) Gernsback is even more categorical about *Voyage*: "There is nothing in all the daring visions of this tale which, even today our scientists would declare impossible. The interior of the earth is still unknown..." (100) In this work, Verne has successfully transferred the scientific vision of Claude Bernard to the birthplace of American SF.
29. There is an interesting connection here between Axel's response to the fire that should have physically consumed his party, and Gaston Bachelard's *La Psychanalyse du feu* (1938). Bachelard makes the distinction here between "le penseur"—the objective scientist—and l'homme pensif," the man who confronts physical reality as poet and dreamer. The case of fire interests Bachelard, for he states that, because of its fascinating nature, it has never been seen by science in a truly objective manner: "l'attitude objectif n'a jamais pu se réaliser [one has never been able to bring to term an objective approach]." The "homme pensif" on the other hand, like Axel, lets himself be taken up by the dream of fire.
30. The first major pronouncement by a major French establishment critic is Roland Barthes's essay "Nautilus et Bateau ivre," (*Mythologies*, Paris: Éditions du Seuil, 1957), pp. 80-82). Barthes sees

Verne's extraordinary voyages as juvenile power fantasies, "where the child-man reinvents the world, fills it, encloses it, closes itself within it, and crowns this *encyclopedic effort* by assuming the bourgeois attitude of appropriation—slippers, pipe, and fireside—while outside the storm, that is to say the infinite, rages uselessly." (80) Axel may recoil from the unknown, seek refuge in dreams, but the process of dreaming is an active one, that engages, however imperfectly, the unknown, leaving behind in the reader the sense of wonder that will inspire the desire for future encounters. The "storm that rages outside" is neither useless in the eyes of science, nor isolated from meaningful contact. What is interesting here is Barthes's comparison of Verne and Rimbaud's "Bateau ivre." One could argue that Axel's failure to engage the unknown with the models and systems his culture provides him, is the harbinger of Rimbaud's desire to cast off all such models as useless, in order to engage the "real" behind the veil of human theory. On the other hand, the "boat's" bold expedition, casting itself on unknown seas, reminds one of Lidenbrock's precipitous desire to rush to the center of the earth. Rimbaud's poetic visions, in fact, are full of references to Verne. The desire to contain Verne in the old Cartesian mind-matter duality continues in works like Michel Serres's *Jouvences sur Jules Verne* (Paris: Éditions de Minuit, 1974), and in works from inside the French SF community, such as Bernard Blanc's *Pourquoi j'ai tué Jules Verne* (Paris: Éditions Stock, 1978).

31. See Jean-Jacques Bridenne, "Jules Verne, père de la science-fiction, Part 11: "De Jules Verne à Wells," *Fiction* (7), June 1954, p. 109.
32. *The Definitive Time Machine: A Critical Edition of H.G. Wells's Scientific Romance*, with Introduction and Notes by Harry M. Geduld (Bloomington: Indiana University Press, 1987), p. 32.
33. See Frank Scafella, "The Rebirth of a Scientific Intelligence, or From "Traveller" to "Travailler" in *The Time Machine*," in *H.G. Wells's Perennial Time Machine*, edited by George Slusser, Patrick Parrinder, and Danièle Chatelain (Athens GA: Georgia University Press, 2001), 39-50.
34. T.S. Eliot, "The Four Quartets: Little Gidding," *T.S. Eliot: The Complete Poems and Plays, 1909-1950* (New York; Harcourt, Brace and Company, 1952) p. 145.

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