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Functions of Science in French Fiction

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FUNCTIONS OF SCIENCE IN FRENCH FICTION

In the animated children's film titled *The Phantom Tollbooth*, a young man journeys to a once-wondrous land called the Kingdom of Wisdom. Unfortunately, the ailing monarch of this country has recently died and his two quarreling sons, one devoted to Words and the other to Numbers, have split the kingdom into two warring states (whose capitals are Dictionopolis and Digitopolis respectively). Even worse, the twin princesses of Rhyme and Reason have been banished to the faraway Castle in the Air because, when asked to decide which of the two realms was more important, they replied that both Words and Numbers were of equal value and that, together, they made up the "warp and the woof" of the fabric that unified the Kingdom of Wisdom. The boy's quest: to rescue and bring back both Rhyme and Reason to this divided land now in danger of invasion by the Demons of the nearby Mountains of Ignorance.

This simple parable seems a fitting epigraph to recent scholarly investigations into the interrelations of Science and Literature where, instead of being viewed as intrinstically conflictual (i.e., the "Two Cultures" debate), these two domains are increasingly being considered as part of a common and culturally embedded network of human perception and rhetoric.[1]

But such has not always been the case.

Throughout most the 19th and 20th centuries, and perhaps more acutely in France than elsewhere, "scientific" and literary matters have been perceived as diametrical opposites, mutually exclusive modes of thought requiring vastly different discursive vehicles for their expression. As Michel Foucault has pointed out, for example, the ideal of a "pure" scientific discourse grew to be an important *épistémè* of the 19th century—an historical period that witnessed dramatic changes in the basic premises of scientific methodology. The desire for a cognitively "objective" outlook, deemed to be a prerequisite to valid scientific inquiry, became increasingly extended into the realm of language itself, substantially altering what had traditionally been a more "holistic" relationship between language and knowledge.[2]

Viewed semiotically, the structural characteristics of this (hypotheti-

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[1] V. the continuing studies sponsored by the Society for Literature and Science whose 1987 conference, for example, was devoted to "Literature and Science as Modes of Expression."

[2] Michel Foucault, *Les Mots et les Choses* (Paris: Gallimard, 1966). p. 309.

cally) "pure" scientific language provide a useful rhetorical starting point for the following essay—to the extent that they permit some insight into how these late 19th century texts were constructed as scientifico-literary narrative. For this reason, a brief summary of a few of the theoretical assumptions implicit in this linguistic polarization of scientific and/from literary discourse seems warranted. For example:

Literary discourse is principally distinguishable from scientific discourse by the former's self-referentiality, wherein the emphasis is less on language as instrumentality than language aimed at *itself* (i.e., "style"). As such, it seeks to generate a very different kind of "meaning" (connotative vs. denotative, esthetic vs. analytic, polysemic vs. definitional, and so on).[3] Scientific discourse, in seeking objectively to explain the exterior world, endeavors only to be true or false—determinable by experimentation and observation. Hence, it limits its interpretive possibilities to questions of right vs. wrong, correct vs. incorrect, and provable vs. unprovable. Its primary goal is intelligible coherence and empirical noncontradiction. Unlike literary discourse, its value as an effective didactic tool seems proportionate to the extent to which it can "depersonify" the language process itself. For example, by eliminating the narrator as a mediating presence between the reader and the text, it strives to maintain a single, autonomous, authoritative, and machine-like narrative voice whose sole function is to communicate factual information. In so doing, it seeks systematically to reduce the paradigmatic to its simplest form in an attempt to communicate more effectively the "pure" referent. Finally, as institutionalized linguistic phenomena, literary and scientific discourse require two very different kinds of reading skills. The former presupposes an awareness of and sensitivity to certain recurrent topoi, tropes, and other various literary/cultural conventions for a maximum recuperation of meaning. The latter presupposes familiarity with a very different set of codes that are more axiomatic, mathematically derived, and syllogistic in nature—codes that are purposefully geared to an accumulative, inductive explanation of physical phenomena (as opposed to a "poetic" portrayal of the human condition).

But, despite these seemingly concise theoretical distinctions, the modern scholar confronts at least three fundamental difficulties in seeking to define and compare scientific and literary discourse. The first has to do with the relatively limited number of typological studies of the former as an encoded signifying system—particularly when compared to the vast amount of critical attention given the latter during the 20th century. As one contemporary critic has described it: "Narrative analysis has been

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[3] V. Roland Barthes, *Leçon* (Paris: Seuil, 1978), p. 20.

created to describe the functioning of *figurative* speech. And this fact has influenced the nature of the theory itself—both via the categories that it selects and the definitions that it offers . . . Whether it be the result of inattention and/or of censure, scientific or technological texts have not at all been described scientifically . . ."[4]

The second difficulty concerns scientists' traditional reliance on literary rhetoric in their prose. Whether it be due to the lack of a more fully developed empirical language for communicating their findings, the intrinsic ambiguity of the findings themselves, or the need to conform their discourse to certain socially accepted polemical and/or epistemological formats, scientists' writings seem to have historically tended to oscillate "between the library and the laboratory."[5]

The third—which I wish to investigate in this essay—involves the somewhat oxymoronic presence of identifiably scientific discourse within literary discourse, given their capacity for "reciprocal repulsion," as Thomas De Quincey once phrased it.[6] Being (theoretically at least) mutually exclusive by nature, their textual juxtaposition should produce a tension-filled linguistic configuration that one would think to be quite rare in French prose. But, surveying a number of French narratives from the 17th to the 20th centuries, one discovers a large number of such hybrid forms, each with its own specific fictional recipe for mixing science with literary narrative. I shall classify them into three major taxonomic groups according to the diegetic function of the scientific discourse and its textual "dominance" over the literary discourse (most to least)—a schematic that, further, closely parallels the "purity" of the former within the latter. I label these three categories as pedagogical, satiric, and narratological. In the first, the literature "accommodates" itself (often via framing) to the science. In the second, the literature seeks to repel (often via parody) the science. And in the third, the literature attempts to transform and/or manipulate the science, creating a metaphoric bridge between them for the purpose of enhancing the narrative process. In the first two groups, the science is palpably "foregrounded"[7] in the text—positively, then negatively—whereas, in the third, it is more intricately interwoven into (and masked by) the literary

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[4] François Rastier, *Essais de sémiotique discursive* (Paris: Mame, 1973), pp. 175, 179.

[5] V. Wilda C. Anderson's *Between the Library and the Laboratory*. Baltimore: Johns Hopkins Press, 1984.

[6] Thomas De Quincey, "The Poetry of Pope," *The Collected Writings of Thomas De Quincey* ed. David Masson (Edinburgh: Adam and Charles Black, 1889—90), XI, pp. 54-55. This 1848 essay is often referred to as the "Essay on the Literature of Knowledge and the Literature of Power."

[7] Erich Auerbach, *Mimesis* (Princeton: Princeton University Press, 1953), pp. 7-13.

rhetoric. But, in all cases, it is important to remember that these textual manifestations of science in literature are by no means mutually exclusive; the same literary work may (and often does) utilize several of these narrative recipes to satisfy its vary novelistic needs.

PEDAGOGICAL

Not surprisingly perhaps, both the most dominant and the "purest" manifestations of (pre-modern) scientific discourse seem to occur in those literary texts which are intentionally *didactic*; i.e., narratives that attempt, through fiction, to teach the principles of scientific knowledge. In French literature, such works of "popularization" include (among others) Fontenelle's *Entretiens sur la pluralité des mondes* (1686), Diderot's *Rêve de d'Alembert* (1769), Camille Flammarion's *Les Récits de l'infini* (1862), *Uranie* (1889), and *Stella* (1897), as well as most of those *romans scientifiques* in Jules Verne's *Voyages Extraordinaires* (1862-1919).

Since pedagogy is the vehicle by which science is introduced into these fictions, certain narrational formats seem preferred. The scientifically didactic "lessons" therein are usually expressed in one of two ways narratologically: either via direct *unmediated* exposition or via indirect *mediated* exposition.

In the first, the scientific pedagogy is spliced directly into the text without any attempt to dilute its nature or to otherwise "harmonize" its presence. The syntagmatic flow of the narration abruptly halts, a complete change of register takes place, and the text (communicating in what might be described as one-to-one address) apprises the reader of pertinent scientific information and/or documentation about the subject-matter in question. There is no endeavor to channel the scientific voice through the fictional characters in *porte-parole* fashion; the narrator/speaker is autonomous and unknown; there is no "subjectification" of any sort (unless, of course, the passage itself is a quotation from the work of an authoritative scientist and due reference is provided). Variants of this procedure include, for example, what might be called *en bloc* insertions of differing lengths such as the 14-page lesson on basic astronomy (complete with graphs) intercalated into the early chapter of Jules Verne's *De la Terre à la Lune*,[8] or the following (less prolix) historical and scientific "aside" that occurs during the gunpowder deliberations of Barbicane's Gun-Club in the same novel:

> There remained for consideration the question of powders. The

[8] Jules Verne, *De la Terre à la Lune* (Paris: Livre de poche, 1966), pp. 52-66.

public awaited this final decision with great interest. The size of the projectile and the length of the cannon having been settled, what would be the quantity of powder necessary to produce sufficient impulsion? This powerful compound, mastered by Man, was to be called upon to play a role of unusually large proportions in this project.

It is generally believed that gunpowder was invented in the 14th century by a monk named Schwartz who lost his life as a result of his discovery. But, nowadays, it has been more or less proven that this story should be ranked among other such legends handed down from the Middle Ages. Gunpowder was not invented by anyone; it derives from Greek fire which, like itself, is composed of sulphur and saltpeter.

If most educated persons are aware of this erroneous history of gunpowder, few among them are familiar with the mechanical force of gunpowder. Now this is precisely what needs to be understood in order to comprehend the importance of the question submitted to the Gun-Club committee.

A litre of gunpowder weighs about 2 pounds (900 grams). It produces during combustion 400 litres of gas. This gas, acted upon by a temperature raised to 2400 degrees, occupies a space of 4000 litres. Consequently, the ratio of the powder to the gas produced is 1:4000. One might imagine, therefore, the tremendous pressure of this gas when compressed into a space 4000 times too small for it.

All of this was, of course, well known to the members of the committee when they convened the following day . . . .[9]

Another variant of such unmediated pedagogy, but somewhat more closely integrated into the narrative structure of the text—i.e., where it occupies less textual "space" and where the change of discursive register is momentary instead of prolonged—might be called an *en passant* brand of insertion. These generally take the form of brief supplements to the text (added via apposition, footnotes, or parenthetically) in order to clarify a technicism or a foreign term, to convert a numerical reference to local usage (e.g., pounds into kilograms), or to reformulate into lay language as otherwise puzzling lexical item:

At six o'clock in the morning, the thermometer reading was 26 degrees (-3 Centigrade) . . . .[10]

Thus, as the orator's words were spoken that evening, they were simultaneously broadcast via telegraph to the entire United States at

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[9] *De la Terre à la Lune*, pp. 107—8.

[10] Jules Verne, *Voyages et aventures du capitaine Hatteras* (Paris: Hachette, 1978), p. 102.

a speed of 248,447 miles (2) per second.
(2) One hundred leagues. This is the speed of electricity.[11]

Finally, one last didactic strategy utilizing unmediated exposition in these texts merits special attention: *technicized tropes*. They might be considered a border-line case (i.e., semi-unmediated) because their narrative voice is not totally automonous; the reader immediately senses that, lurking "behind" them, is a very style-conscious narrator. Such hybrid rhetorical devices (curious as they are) aptly illustrate one method of how one might go about grafting scientific references onto literary topoi, thereby providing them with a pedagogical thrust. Consider, for example, the following periphrastic double simile taken from Verne's *Les Enfants du capitaine Grant*:

> The day star, like a metal disk gilded by the Ruolz process, emerged from the Ocean as if from an immense voltaic bath.[12]

Or, remaining within the same time-honored topos of sunrises, witness the following specimen from *Le Rayon vert*:

> However, the perimeter of the sea grew brighter along the eastern horizon. It gradually unfolded the full gamut of colors contained in the solar spectrum. The faint red of the early mists at sea-level progressively transmuted into violet at the zenith. Second by second, the colors took on more intensity. The pink became red, the red became fiery. Daybreak occurred, at the point of intersection between the diurnal arc and the circumference of the sea.[13]

Passages such as these clearly demonstrate how Verne's scientific pedagogy operates on a variety of different discursive levels. In addition to periodically embedding *mise-en-abŷme* mini-lessons of scientific fact into his fiction and translating scientific precepts and idioms into common "lay" references and terminology, Verne also occasionally infuses scientific nomenclature directly into his literary rhetoric—substituting technical terms for the traditional poetic ones anticipated by the reader. Such a strategy, although perhaps useful pedagogically and very striking narratologically, does nevertheless have its drawbacks. This practice can lead to serious problems because the reader, while normally very accepting of semantic reductions, frequently reacts very poorly to its opposite—excessive "jargonization." And the line is extremely fine between what the reader will tolerate in this regard (for educative purposes or

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[11] *De la Terre à la Lune*, p. 38
[12] Jules Verne, *Les Enfants du capitaine Grant* (Paris: Livre de poche, 1966), p. 48.
[13] Jules Verne, *Le Rayon vert* (Paris: Livre de poche, 1968), pp. 185—86.

otherwise) and what will be rejected out of hand as gratuitous affectation on the author's part. At its worst, overly technicized tropes can even temporarily short-circuit the pedagogical seriousness of the passage itself, triggering an unintended sense of parody. To cleverly sidestep this danger, Verne most often adds a touch of *entre-nous* humor to such excessively jargonized formulations—underscoring his obviously tongue-in-cheek intentions and inviting the reader to share in the playfulness. Consider, for example, such "scientific" comparisons and metaphors as the one describing a jovial fellow whose "zygomatic muscles, necessary for the action of laughter, were never in repose"[14] or that of a crowd whose terrified flight is described in Newtonian fashion as "Their courage was inversely proportional to the square of their velocity . . . in running away"[15] or the formulaic definition of a woman's amourous penchant for overweight scientists expressed as "she felt herself attracted to him in proportion to his mass and inversely to the square of the distance between them. And, accordingly, J.-T. Maston was of sufficient corpulence to exert upon her an irresistable pull."[16] In all of these instances, the reader immediately senses the comical incongruity of scientific terminology being used to describe perfectly mundane matters. But, so long as such jargonized rhetoric is purposefully humorous, of short duration, and infrequent in the text, the average reader of Verne's *romans scientifiques* tends to play along with (or overlook) such self-conscious stylistic oddities in the author's prose.

So, in the final analysis, what are the built-in advantages and disadvantages of mixing scientific with literary discourse through unmediated narratological structures such as these? On the one hand, they enhance the mechanical "objectivity" of the text's scientific voice: it remains depersonified, abstract, and blatantly non-fictional (i.e., more "real"). Further, those reading processes necessary for the assimilation of such discourse can be more easily attuned to the analytical procedures intrinsic to scientific methodology itself—not only as regards the importance of documentation, quantification, and empirical consistency but also, and more basically, for the development of certain cognitive habits such as the use of extrapolative analogy and induction.

On the other hand, there are a number of distinct disadvantages to this approach. In its most elemental modes (*en bloc* and *en passant* insertions), the abrupt change of discursive register into and out of such scientific passages continually impedes the syntagmatic flow of the

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[14] Jules Verne, *Une Ville flottante* (Paris: Livre de poche, 1970), p. 21.

[15] Jules Verne, "Un Drame dans les airs" in *Le Docteur Ox* (Paris: Livre de poche, 1966), p. 180.

[16] Jules Verne, *San dessus dessous* (Paris: Ed. Glénat, 1976), pp. 46-47.

text—making it excessively fragmented, choppy, and difficult to read. Also, these discursive schisms (coupled with the unique semantics of the passages themselves) clearly demarcate such insertions within the fictional narrative, setting them apart from the plot and inviting the reader to simply skip over them and continue with the story. Even in its most integrated format (*technicized tropes*), the reader is required to simultaneously decipher two very different discursive codes that, juxtaposed, are imitating and/or masking each other—a quite cumbersome decoding task whose outcome, as mentioned, is potentially subversive to the text's didactic purpose. But perhaps the most serious (and unavoidable) disadvantage of all to using such direct unmediated exposition in this way is neither linguistic nor cognitive in nature: it is emotional. It is the average lay reader's lack of empathetic involvement with such recurring doses of pure scientific data. In this regard, more effective phatic contact with the reader can be achieved through the use of *mediated* exposition.

In *mediated* exposition, the scientific lesson is more fully incorporated into the narrative structure of the text by using, as a discursive stepping-stone, the various conversations among the fictional protagonists themselves. The reader witnesses secondhand the scientific didacticism woven into such dialogues and assimilates it as part of the plot situation at that moment. This often takes the form of a learned protagonist teaching his apprentice and/or peers the discoveries and theories of modern science—in most instances to demystify a puzzling enigma that they have encountered during their journey. Consider, for example, the baffling case of the red snow observed during the Hatteras expedition to the North Pole in Verne's *Voyages et aventures du capitaine Hatteras*:

> Imagine the group's surprise, their gasps, and even their first stirrings of fear as they confronted this crimson snowbank. Doctor Clawbonny hastened to reassure and instruct his companions. He had heard of this strange red snow and of the chemical analyses done upon it by Wollaston, de Candolle, and Bauer. He explained that this snow was found not only in the Artic, but also in Switzerland in the middle of the Alps. De Saussure collected a sizeable quantity of it on Le Breven in 1760, and, since that time, Captains Ross, Sabine, and other navigators have reported it during their northern expeditions.
>
> Altamont asked the Doctor about the nature of this extraordinary substance. The latter explained that the coloration was due to the presence of microrganisms. For a long time, scientists wondered if these microrganisms were animal or vegetable. But they finally decided that they belonged to a species of microscopic mushrooms of

the genus "Uredo" which Bauer proposed to call "Uredo nivalis."[17]

Or it can follow a more explicitly first-person and dialogic format, as in the following where Prof. Aronnax of *Vingt mille lieues sous les mers* gives an explanation of pearls:

> Ned and Conseil sat down on the couch and the Canadian said to me:
>
> "Monsieur, what exactly is a pearl?"
>
> "My dear Ned," I answered "for the poet, a pearl is a tear of the sea; for the Orientals, it is a drop of hardened dew; for women, it is an oblong jewel with a glassy sheen which they wear on their finger, around their neck, or on their ear; for the chemist, it is a mixture of calcium phosphate and calcium carbonate with a bit of gelatin; and, finally, for the naturalist, is is merely an abnormal secretion from the same organ which produces mother-of-pearl in certain bivalves."
>
> "Subphyllum of mollusks, class of Acephala, order of Testacea." added Conseil.
>
> "Exactly, my knowledgeable Conseil. Now among these Testacea the abalones, turbos, tridacnae, and pinnae marinae—in other words all those which secrete mother-of-pearl, that blue, violet, or white substance which coats the inside of their valves—are capable of producing pearls."
>
> "Mussels too?" asked the Canadian.
>
> "Yes, the mussels of certain rivers in Scotland, Wales, Ireland, Saxony, Bohemia, and France sometimes produce pearls."
>
> "Well! I guess I'll have to be more careful from now on!" answered the Canadian.[18]

Passages of scientifically pedagogical dialogue such as these usually involve the same basic *modus operandi*: a "novum" is encountered by the fictional protagonists, its clarification is requested of the resident expert by a *vox populi* character, the information is conveyed through a friendly give-and-take discussion (as opposed to a lengthy lecture), and it is punctuated with bits of humor to offset the serious educational tone. The latter component is often the product of the interlocutor's reduction of the lesson to his own frame of reference (Conseil's penchant for taxonomies), his naïve incredulousness (Ned Land's interjections), or his idiosyncratic applications of what he sees to be the lesson's overall message ("Well! I'll have to be more careful from now on!").

Where the dialogue occurs between two scientists, however, the format is quite different. The *vox populi* humor is all but absent; replacing it as

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[17] *Voyages et aventures du capitaine Hatteras*, p. 400.

[18] Jules Verne, *Vingt mille lieues sous les mers* (Paris: Livre de poche, 1966), 310-11.

the animating phatic device in the narrative is an element of confrontation and competition—what might be called a "contest" dialectic. Notice, for example, the intellectual sparring of Prof. Aronnax and Captain Nemo in the following pedagogical passage taken from the same novel:

> "That's all very well, Captain, but now we come to the real problem. I understand how you can cruise just beneath the ocean's surface. But when you go deeper, won't your submarine encounter a pressure that will push it upward, a force equal to one atmosphere for every 32 feet of water, or almost 15 pounds per square inch?"
>
> "That's true, Monsieur."
>
> "Then, unless you fill the *Nautilus* completely, I don't see how you can make it dive deep into the ocean's depths."
>
> "Professor," replied Captain Nemo, "you must not confuse static and dynamic, otherwise you risk making errors. It requires very little effort to reach the great depths of the ocean because an object develops a "sinking" tendency. Please follow my reasoning."
>
> "I'm listening, Captain."
>
> "When I wanted to calculate the increase in weight I had to give to the *Nautilus* in order to dive, I only had to concern myself with the greater density of water at increasingly lower depths."
>
> "That's obvious." I answered.
>
> "Now, even though water is not absolutely incompressible, it is at least compressible only to a very small degree. As a matter of fact, according to the latest calculations, this reduction in volume amounts to no more than a proportion of 436 ten-millionths per atmosphere, or for each 32 feet of depth. So if I wish to go down to a depth of 3200 feet, I take into account the reduction in volume at a pressure equivalent to that of a column of water 3200 feet high, or, in other words, a pressure of a 100 atmospheres. The reduction in volume would therefore be 436 hundred-thousandths. Hence I would have to increase the weight of the vessel from 1507.2 tons to 1513.77 tons. The increase would therefore be only 6.57 tons."
>
> "That's all?"
>
> "That's all, Monsieur Aronnax. And the calculation is easy to verify. But I have supplementary tanks capable of taking on 100 tons. I can therefore dive to considerable depths. When I wish to resurface, I need only to get rid of this water and empty all the tanks. The *Nautilus* will lose one-tenth of its weight and rise."
>
> I could not argue with his reasoning, based as it was on solid mathematics.[19]

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[19] *Vingt mille lieues sous les mers*, pp. 129-31. For further analysis of Verne's "didactic discourse," as well as a more detailed treatment of the ideological underpinnings of the *Voyages extraordinaires*, see my book entitled *Jules Verne Rediscovered: Didacticism and the Scientific Novel* (Westport, CT: Greenwood Press, 1988). Portions of the preceding

The primary characteristic of such dialogue is its quantitative argumentation and its deductive rationalism (as opposed to the naming and localizing procedure used earlier). The pedagogy is couched in a contest format, the winner of which is decided by *force de raison* and demonstrable mathematics. This party-and-thrust approach is an effective didactic strategy in a variety of ways: it enlivens the otherwise dry theoretical discussion in question, it humanizes Aronnax as a scientist who does not have all the answers (facilitating continued reader-identification with him), and it encourages emulation of those analytical capabilities—i.e., "scientific method"—that enabled Captain Nemo to win such a confrontation.

Thus, through the narrative strategy of fully mediated exposition, the scientifically didactic discourse is "empathized" in two important ways: via reader-involvement in the plot itself and via reader-identification with the conversations among the various protagonists as reported by the first-person narrator. The pedagogical "novum" to be explained and then absorbed by the reader—red snow, the origin of pearls, sea pressure and buoyancy and so on—is first dealienated through the reader's shared immediacy with it, as experienced through the narrator. And it is then valorized by its evident capacity not only to solve specific (and potentially life-threatening) problems, but also to influence inter-personal relationships: i.e., to win debates, to elicit humor, to earn respect, and so forth. Hence, it is shown to be an eminently *useful* acquisition on many different levels—intellectually, emotionally, and socially. Narratologically, such scientific discourse (though arguably less "pure") is better integrated into the syntagmatic flow of the text. It is event-specific (albeit fictional), easier to animate with humor and melodrama, and less likely to be glossed or entirely skipped over by the reader. The main disadvantage to this procedure, of course, is the questionable verisimilitude of the fictional pedagogue himself: i.e., is the human encyclopedia of scientific facts and figures truly believable? But this is a problem of literary technique—effectively mimetic characterization, for example—and therefore tangential to our immediate subject at hand.

SATIRIC

Let us now consider the flip-side of the pedagogical coin: those fictional texts that utilize either real or artificially "cloned" scientific discourse for purposes of deliberate satire and/or parody. In these variants, the scientific discourse is still structurally dominant, but now it functions

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discussions are drawn from this publication.

in a manner that is negatively (rather than positively) self-referential. Such satiric works, in the tradition of Rabelais' *Pantagruel* (1532), Jonathan Swift's *Gulliver's Travels* (1726), and Voltaire's *Micromégas* (1751), most often target one of three subjects for ridicule: the vanity of scientists, the scientific gullibility of the public, or the fallacy of scientific "truths."

When speaking of scientific-in-literary discourse used in this way, the much-studied novels of Gustave Flaubert immediately come to mind. The pretentious pharmacist Homais of *Madame Bovary* (1857) and the "encyclopedia in farce" of *Bouvard et Pécuchet*[20] (posthumous, 1881) are classic examples of what Flaubert regarded as positivistic examples of *la sottise humaine*. In the latter (unfinished) novel, for example, two comically inept office clerks attempt to learn and then put into practice what they call the "wisdom of Science"—gleaned from their reading of various scientific brochures and encylopedias on agriculture, geology, chemistry, archeology, etc.—with invariably catastrophic results. A slapstick journal of incompetence and naïveté that parodies the catechisms of Scientism, *Bovard et Pécuchet* sought to underscore the potential dangers of one's blind veneration of Baconian scientific philosophy. But, when viewed in retrospect from our post-Newtonian vantage-point of the 20th century, certain passages of this novel seem particularly prophetic. Consider the following excerpt:

> Then, as in former days, they went to drink their coffee and brandy on the hillside.
>
> The harvest had just finished, and the stacks in the middle of the fields rose in dark heaps against the soft blue of the night sky. The farms were quiet. Even the crickets could not longer be heard. The entire countryside was wrapped in sleep.
>
> The pair digested their meal while they inhaled the breeze which blew refreshingly against their cheeks.
>
> Far above, the sky was covered with stars. Some shone in clusters, others in a row, or some alone at certain distances from each other. A zone of luminous dust, extending from north to south, bifurcated above their heads. Amid these shining splendors, there were vast and empty spaces; the firmament seemed a sea of azure with archipelagoes and islets.
>
> "So many!" exclaimed Bouvard.
>
> "We do not see them all," replied Pécuchet. "Behind the Milky Way are the nebulae, and behind the nebulae, more stars. The most distant is separated from us by three million myriametres."

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[20] Gustave Flaubert, *Bouvard et Pécuchet* in *Oeuvres complètes*, Paris: Gallimard, "Pléiade," 1952.

He had often looked into the telescope of the Place Vendôme, and recalled the figures.

"The Sun is a million times bigger than the Earth; Sirius is twelve times the size of the Sun; comets measure thirty-four million leagues across."

"It's enough to make one crazy!" said Bouvard.

He lamented his ignorance and regretted that, as a youth, he had not been able to go to the Polytechnic Institute.

Then Pécuchet, turning him in the direction of the Great Bear, showed him the Polar Star; then Cassiopeia, whose constellation forms a "Y"; Vega, scintillating in the Lyra constellation; and, at the lower edge of the horizon, red Aldebaran.

Bouvard, with his head thrown back, followed with great difficulty the triangles, quadrilaterals, and pentagons that one must imagine in order to make oneself at home in the sky.

Pécuchet went on: "The swiftness of light is 80,000 leagues a second. One ray from the Milky Way takes 6 centuries to reach us. Thus any star, at the moment that we observe it, may have disappeared. Several are intermittent; others never come back; and, moreover, they change position. They are all in motion; every one of them is moving."

"But surely our Sun is immobile!"

"Formerly it was thought to be so. But today men of science tell us that it is rushing towards the constellation of Hercules!"

This upset the thoughts of Bouvard. After a minute of reflection, he observed:

"Science is constructed according to data furnished by only one corner of space. Perhaps it doesn't fit in with the remainder that we are unaware of and cannot discover."

They talked thus, standing on the hillside in the starlight, their conversation often interrupted by long moments of silence.[21]

This mildly mocking Flaubertian commentary begins as a poetic *locus amoenus*: the two protagonists are on a country hillside, staring at the night sky, and musing on things eternal. In true Carl Sagan pedagogical fashion, Bouvard's expressions of wonder systematically alternate with Pécuchet's astronomical anecdotes. As always, the "lesson" is sprinkled with bits of humor (using the same abstract/mundane "incongruity" procedures noted earlier) as Bouvard mentally grapples with the geometric shapes "that one must imagine in order to make oneself at home in the sky." But the text soon after metamorphoses into a (deceivingly) serious and quite profound statement on the nature of reality itself and Man's incapacity to define it—totally *subverting* the supposedly authori-

[21] *Bouvard et Pécuchet*, pp. 778-79.

tative scientific data immediately preceding! And the jarring significance of this revelation has the effect of reducing the two protagonists' ensuing discourse to "long moments of silence."

The irony of Flaubert's *Bouvard et Pécuchet* extends well beyond the socio-historical time-frame in which it was written. This novel, conceived as a piece of anti-science literature, unknowingly foreshadows important developments in scientific theory of the 20th century. That is to say, long before the quest for unified field models, long before the advent of quantum mechanics, long before Einstein's relativity theories, Gödel's theorems of mathematical ambiguity, or Heisenberg's uncertainty principle, Flaubert was already positing the fundamental "thought-upset" premise that subsumes these new paradigms of modern scientific methodology: "Science is constructed according to data furnished by only one corner of space. Perhaps it doesn't fit in with the remainder that we are unaware of and cannot discover." In Flaubert's neo-Newtonian age of Positivism—an age of Saint-Simons, Comtes, and Cuviers; an age of museums, encyclopedias, and moral *progrès*—such a statement, suggesting the anthropocentric arbitrariness of all scientific inquiry, no doubt appeared ludicrous. But in today's philosophy of science, as outlined by Thomas Kuhn (among others),[22] such an alternate "mind-set" is seen not only as desirable but also as a necessary prerequisite to all major scientific breakthroughs.

The often hilarious works of Alfred Jarry present an excellent example of "cloned" scientific discourse used for purposes of narrative satire. His *Gestes et opinions du Docteur Faustroll, Pataphysicien* (1911)[23] is a scientifico-philosophical fantasy (subtitled "neo-scientific novel") which recounts the curious adventures and theorems of a certain Faustroll, Doctor of Pataphysics. What is the science of Pataphysics? This wholly invented (and remarkably inventive) science governs a conceptual domain that Faustroll defines in the following terms:

> Pataphysics . . . is the science of that which is superinduced upon metaphysics, whether within or beyond the latter's limitation, extending as far beyond metaphysics as the latter extends beyond physics. . . . Pataphysics will examine the laws governing exceptions and will explain the universe supplementary to this one; or, less ambitiously, will describe a universe that can be—and perhaps should

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[22] Thomas Kuhn, *Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1962.

[23] Alfred Jarry, *Le Surmâle, suivi de Gestes et opinions du Docteur Faustroll, Pataphysicien* Paris: Les Humanoides Associés, 1979. The quotations used are from the following English translation: Roger Shattuck and Simon Tayler, eds., *Selected Works of Alfred Jarry* New York: Grove Press, 1965.

be—envisaged in the place of the traditional one, since the laws that are supposed to have been discovered in the traditional universe are also correlations of exceptions, albeit more frequent ones, but in any case accidental data which, reduced to the status of unexceptional exceptions, possess no longer even the virtue of originality.

DEFINITION: Pataphysics is the science of imaginary solutions, which symbolically attributes the properties of objects, described by their virtuality, to their lineaments.

Contemporary science is founded upon the principle of induction: most people have seen a certain phenomenon precede or follow some other phenomenon most often and conclude therefrom that it will ever be thus. Apart from other considerations, this is true only in the majority of cases, depends upon the point of view, and is codified only for convenience—if that! Instead of formulating the law of the fall of a body toward a center, how far more apposite would be the law of the ascension of a vacuum toward a periphery, a vacuum being considered a unit of non-density, a hypothesis far less arbitrary than the choice of a concrete unit of positive density such as *water*?

For even this body is a postulate and an average man's point of view, and in order that its qualities, if not its nature, should remain fairly constant, it would be necessary to postulate that the height of human beings should remain more or less constant and mutually equivalent. Universal assent is already a quite miraculous and incomprehensible prejudice. Why should anyone claim that a watch is round—a manifestly false proposition—since it appears in profile as a narrow rectangular construction, elliptic on three sides; and why the devil should one have noticed its shape only at the moment of looking at the time?[24]

Whereas Flaubert's brand of parody succeeded in sabotaging the apparent validity of scientific knowledge by using the latter's own empirical data to demonstrate its arbitrariness, Jarry's satire—more tongue-in-cheek but also more overtly critical—goes one step further. Defined in pseudo-Kantian terms, Jarry's surrealistic science of Pataphysics seeks to liberate "scientific" inquiry from its narrow cognitive confines by formulating the "laws governing exceptions" through the use of "imaginary solutions." Included among the good Doctor's many ingenious applications of Pataphysical science is a unique boat fashioned in the form of a sieve, utilizing the principles of "capillarity . . . weightless membranes . . . equilateral hyperbolae . . . surfaces without curvature . . . [and] the elastic skin which is water's epidermis" to remain afloat (inspired from an 1890 essay on the surface tension of liquids by the English physicist C. V. Boys, to whom Jarry formally dedicates these fanciful extrap-

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[24] *Selected Works of Alfred Jarry*, pp. 192-93.

olations). Another occurs in Book VII, entitled "Ethernity" (ether + eternity), where a recently-deceased but ever-loquacious Faustroll communicates his posthumous findings via telepathy to the English physicist Lord Kelvin. One such observation concerns "The Sun as a Cool Solid": "The sun is a cool, solid, and homogeneous globe. Its surface is divided into squares of one meter, which are the bases of long, inverted pyramids, thread-cut, 696,999 kilometers long, their points one kilometer from the center . . ." (parodying Lord Kelvin's *Popular Lectures and Addresses, vol. I: Constitution of Matter* of 1891). In another telepathic treatise—one which might be viewed as a modern variant of the medieval conundrum "how many angels can sit on the head of a pin"—Faustroll offers an elaborate mathematical measurement of God, complete with postulates, corollaries, square roots, Pythagorean theorem, x's, y's, and infinity signs. The final QED's of this complex theogeometrological "proof" are two: "GOD IS THE TANGENTIAL POINT BETWEEN ZERO AND INFINITY" and an exultant "Pataphysics is *the* science"—each statement deliciously rivaling the other in hyperbolic definitional opacity.

NARRATOLOGICAL

The third narrative strategy whereby scientific discourse is inserted into literary discourse in these 19th century texts serves ends that are neither pedagogical nor deprecatory. They are, rather, narratological. Accordingly, the literary discourse within such texts tends to dominate, either explicitly or implicitly, the scientific discourse therein. Most often, science (or, sometimes, pseudo-science) is summoned up as a kind of textual "magic-wand" to enhance verisimilitude, to create exotic effects, to expand the thematic possibilities of the plot, or to provide a fictional platform for social commentary. In the sometimes utopian-derived tradition of Cyrano de Bergerac's *Etats et empires de la Lune* (1649), Louis-Sebastien Mercier's *L'An* 2440 (1770), Restif de la Bretonne's *Les Postumes* (1802), and Balzac's *La Recherche de l'Absolu* (1834), the discursive configuration of these texts does not foreground science for its own sake but, rather, uses it as a kind of "enabling device" to allow for developments in the narrative that might not otherwise have been possible. This phenomenon—where the role of science is changed from being the textual subject into a contextual object or narrational "tool"—is very palpable, for example, in such novels as Villiers de l'Isle-Adam's *L'Eve future* (1886)[25] and Gustave Le Rouge's *Le Prisonnier de la planète*

[25] Auguste Villiers de l'Isle-Adam, *L'Eve Future*. Paris: José Corti, 1977. The quota-

Mars (1908).[26]

In Villiers de l'Isle-Adam's scientific romance, a fictional Thomas Alva Edison invents a remarkably-true-to-life female android (named Hadaly) as a gift for his lovelorn British friend Lord Ewald. The novel's plot is constructed around a narrative nucleus of approximately 50 pages in length detailing the mechanico-anatomical components of the cyborg's life systems. The overtly didactic nature of Edison's technical expositions in this section recalls in some ways the pedagogical discourse noted earlier in the works of Jules Verne. The following excerpt from Edison's commentary is representative:

> "The Android, even in her first beginnings, offers none of the disagreeable impressions that one gets from watching the *vital processes* of our own organisms. In her, everything is rich, ingenious, mysterious. Look here."
>
> And he applied his scalpel to the central apparatus fastened at the level of the cervical vertebrae of the Android.
>
> "This is the point at which the life of man has its focus," he said, continuing his lecture. "Its the place in the spinal column from which springs the marvelous tree of the nervous system. . . . You see that in this matter I have respected the example set by Nature; those two inductors, isolated at this very point, control the activity of the golden lungs of the Android. . . . It is by means of an intricate code recorded on these metal discs and automatically read off them, that warmth, motion, and energy are diffused through the body of Hadaly, through an interlaced network of complex wires, exact imitations of our nerves, arteries, and veins. . . . This the basic electromagnetic motor, which I have miniaturized while at the same time multiplying its power; *all* the various inductors of the mechanisms are connected with it.
>
> This particular electric spark (it's on loan from Prometheus) has been trained to circle this magic ring, and thereby to produce respiration, by acting on this magnet, placed vertically between the two lungs where it can influence this nickel strip leading to a stainless steel sponge, which moves and then returns to its original position under the regular influence of the isolator here. I have even thought of those profound sighs that sorrow draws from the depths of the heart; Hadaly, being of a gentle and taciturn disposition, is no stranger to them or to their special charm. . . .
>
> Here are the two golden phonographs, placed at an angle toward the center of the breast; they are the two lungs of Hadaly. They

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tions used are from the following English translation: *Tomorrow's Eve*, trans. Robert Martin Adams, Chicago: University of Illinois Press, 1982.

[26] Gustave Le Rouge, *Le Prisonnier de la planète Mars*. Paris: 10/18, 1976.

exchange between one another tapes of those harmonious—or I should say, *celestial*—conversations: the process is rather like that by which printing presses pass from one roller to another the sheets to be printed. A single tape may contain up to seven hours of language. The words are those invented by the greatest poets, the most subtle metaphysicians, the most profound novelists of this century-geniuses to whom I applied, and who granted me, at extravagant cost, these hitherto unpublished marvels of their thought.

This is why I say that Hadaly replaces *an* intelligence with Intelligence itself. . . .

Now the two lungs and the sympathetic nervous center of Hadaly are linked together by a single unique movement of which the fluid is the origin. Some twenty hours of recorded conversations, complex and captivating, are inscribed on her central tapes and, thanks to the technique of galvanoplastics, they cannot be erased. Their *expressive correspondences* are likewise inscribed on the points of her Cylinder, micrometrically exact. . . .

You understand that the ensemble of these different programs is regulated in every scene with split-second precision. No question but that it's much harder, mechanically speaking, than to record a melody with its accompaniments and complex harmonies on a single cylinder; but our instruments, as I've told you, have become so subtle and exact nowadays (especially with the help of fixed lenses) that with a little bit of patience and some use of differential calculus one can work out the whole procedure pretty exactly."[27]

The didactic intent of this lengthy exposé of Hadaly's mechanics appears, at least on the surface, quite evident. In reality, the reverse is true. These purposely "complex" descriptions of Hadaly's anatomy do not (nor were ever intended to) serve pedagogical ends. They function, rather, as a verisimilitude-building device—a narrative strategy textually "embodying" the limitless power of modern technology—that enables Villiers to communicate his true message: the quasi-identical roles played by the artificial and the real in the contemporary world. The majority of the science portrayed in *L'Eve future* is either pure fantasy or obscurantism, continually shrouded in mystery, myth, and a kind of *merveilleux mécanique*. As Edison himself sums it up: "In her, everything is rich, ingenious, mysterious."

The extent to which the scientific discourse is subservient to the literary in this text can be demonstrated not only by the novel's Pygmalion-like macrostructure but also by the actual mechanics of the narration itself. Notice, for instance, how the syntagmatic flow of each explanation follows the same basic lexical and semantic pattern: the technical invari-

[27] Villiers de l'Isle-Adam, *Tomorrow's Eve*, pp. 130-32.

ably gives way to the non-technical, the concrete is replaced by the vague, and the objective register of the discourse is always superseded by the subjective. Note also how Edison continually infuses his quasi-scientific terminology with various forms of literary rhetoric: e.g., unsubstantiated hyperbole ("the greatest poets, the most subtle metaphysicians, the most profound novelists"), metaphor and simile ("the marvelous tree of the nervous system," "like that by which printing presses pass from one roller to another the sheets to be printed"), references from classical mythology ("it's on loan from Prometheus"), and, of course, extensive personification ("Hadaly, being of a gentle and taciturn disposition, is no stranger to their special charm").

Throughout *L'Eve future*, it is the Faustian theme, so common in fantastic literature, that dominates the overall plot structure; it is transcendentalism and the occult, so common in symbolist and gothic literature, that permeates the novel's underlying ideology. And, as we have seen, despite the pseudo-technicized illusions conjured up by this "Magician of Menlo Park," Edison's scientific discourse resembles Hadaly herself insofar as both are entirely synthetic. The eventual procurement of a "soul" by the android as well as the *deus ex machina* intervention at the end, where she is destroyed by fire, exemplify perhaps best of all the true concerns of this text: *meta*physics rather than physics. A strange but often profound composite of mechanics, metamorphosis, and mysticism, *L'Eve future* raises a great many more questions than it answers—itself a clear indication that the ultimate *raison d'être* of the "scientific" discourse in this novel is primarily (if not purely) narratological.

Around the turn of the century, the French reading public witnessed a massive influx of pseudo-scientific adventure novels into the publishing marketplace. Some, labeled as belonging to the "Verne school," utilized the same more or less didactic format as that of Verne's very successful *Voyages Extraordinaires*. But most followed the discursive model of Villiers de l'Isle-Adam to the extent that the scientific references therein tended to grow progressively more impressionistic and much more oriented towards narrative melodrama than scientific pedagogy and/or satire.

The scientific fantasies of Gustave Le Rouge are one example of these *fin-de-siècle* publications and clearly exemplify this fictional shift in the portrayal of science from cognitive object to "special effects." Consider, for instance, his novel titled *Le Prisonnier de la planète Mars* (1908) where a young inventor-scientist named Robert Darvel journeys to a Tiebetan monastery and is persuaded by the evil Ardavena to construct a complex "energy condenser." This machine, by concentrating the combined mental energies of dozens of monks into one person, would not only make feasible communication with distant planets but would also

bestow upon its recipient human powers undreamed of (whence Ardavena's scheming interest in this technology). Robert explains his blueprints to Ardavena:

> "It is a huge black room. But, unlike an ordinary darkroom, it will be round and the interior will be layered with a special phosphorous gelatin (for which I have worked out the formula) that reproduces certain properties of brain tissue. It's this gelatinous material, very costly to produce, that accumlates human willpower like a battery accumulates electrical energy. A glass cylinder of massive dimensions, filled with the same substance that has been energized even more by an electrical bath, will act as a kind of reservoir for all of the energy channeled into the eyepiece of the machine . . . ."
>
> "I understand perfectly. But, once you have stored this willpower in the cells of your 'artificial brain', how can you make use of it and transmit it over distance?"
>
> "I'll show you. At the rear of the machine is located a chair, the arms of which terminate in two metal spheres that are perforated with an infinity of small holes like the heads of two watering cans. Through these perforations run the strands of the electro-magnetic web of my machine, all of which then connects to the center of the gelatinous mass. Once charged, to activate the Condenser all you need do is place your hands on the spheres. In a few seconds, you will be the recipient of all the energy stored in the machine. Your faculties of willpower and creativity will be increased by that of all those who contributed to the energizing of the Condenser. The power of your brain will thus be expanded almost to infinity . . . ."
>
> Robert Darvel started to work feverishly. In a few days, the outer shell of the "Energy Condenser" was completed . . . .
>
> The fabrication of the electrified phosphorous gelatin, which seemed to have a kind of life of its own, was more difficult and had to be restarted several times. Finally, with patience and hard work, everything began to go as planned.[28]

Similar to Villiers de l'Isle-Adam, Le Rouge adopts the vernian prototype of ostensibly pedagogical scientific discourse in order to advance his story-line and bolster the authoritative verisimilitude of his fictional hero. Here, many of the same narrative elements used to facilitate such didacticism are present: e.g., the dialogue format, the incredulous interlocutor serving as intermediary for reader identification, the systematic and logical presentation itself constructed around linear cause-effect "scientific" principles, the *de rigueur* valorization of the travail and patience required to bring the project to fruition, and so on.

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[28] Le Rouge, *Le Prisonnier de la planète Mars*, pp. 108-11.

But note also the degree of vagueness and obscurity that mask the details of this apparently complex contrivance, reminiscent of *L'Eve future*'s "intricate codes," "unique movement," and "expressive correspondences." Amorphous terms such as "huge," "massive," and "an infinity of" are measurements that are consistently qualitative rather than quantitative—forcing the reader to fill in the blanks on his own. And consider the unspecified composition of the materials used in the construction of this machine: "a special phosphorous gelatin," "certain properties" "a kind of life of its own," and so forth. Their textual function is undoubtedly to evoke exoticism, mysteriousness, and the arcane. But the nebulous character of such nomenclature immediately identifies it as wholly non-scientific.

And, finally, witness the other deliberately distancing devices used in this description, such as the mysterious "formula" that is "very costly to produce" (like Hadaly's tapes purchased by Edison "at extravagant cost")—a topos that eventually becomes a well-worn cliché in this brand of fiction. Why? Because such references amplify the uniqueness of the fictional inventor as a person, investing him with both wisdom and finances well beyond that of normal people. In Le Rouge's text, these words are not spoken by an historically real and recognizable scientist such as Thomas Alva Edison, i.e., by an intrinsically credible narrator. Nor are they coupled with an impressive display of "real" scientific prowess such as the encyclopedic regurgitation of facts and figures by Verne's pedagogue-scientists. It is, rather, via Robert Darvel's association with *secret* scientific knowledge that his expertise is defined—in the mythical tradition of alchemists, wizards, and sorcerers, and/or in the literary tradition of Mary Shelley's Dr. Frankenstein and Stevenson's Dr. Jekyll. Such knowledge, while structurally necessary for fictional verisimilitude, is never fully revealed: it is dismissed as morally "forbidden" in those texts modeled on the Faustian variant, extolled but quickly backgrounded in others. In all cases, such textual references, while pretending to be instructive, are operating in a consistently *anti*-pedagogical manner in these fictions—addressing the reader's intuitive imagination rather than his reasoning intellect.

Thus, the linguistic integrity of "real" scientific discourse in these texts is deliberately sacrificed for the sake of enhanced literary effect. But, proportionate to the extent that authors like Villiers de l'Isle-Adam and Le Rouge attempt to "bridge the gap" between scientific and literary discourse by blurring the former's referentiality and channeling it toward narratological ends, they are also adding a new and innovative dimension to the reading process itself. In the above fictions, the reader is only sporadically challenged by the various non-mimetic referents,

empty signifiers, and "absent paradigms"[29] that can result from such discursive cross-pollenizing. But this hybrid semiotic recipe will soon prove to be the trademark of an increasing number of early 20th century French works by authors such as J.-H. Rosny Aîné, Maurice Renard, and Jacques Spitz—ultimately coalescing into one variant of a new scientifico-literary genre that literary historians (rightly or wrongly) have come to call "SF."

In this essay I have attempted to illustrate a few of the methods by which some late 19th and early 20th century authors managed to incorporate scientific discourse into their literary prose and the effects that this mixing produced. Although their efforts may be judged in retrospect as historically and/or culturally determined—given the on-going social dichotomization of Science and Literature during this period—I nevertheless feel that their experiments in this realm can also teach us a great deal about the evolution of narrative forms.[30] Viewed as specific case-studies of the many possible intersections between literary and scientific rhetoric, I believe that their detailed study can contribute much to bringing back the twin princesses of Rhyme and Reason to the cities of Dictionopolis and Digitopolis and, hopefully, once more unify the Kingdom of Wisdom.

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[29] See Marc Angenot's "The Absent Paradigm: An Introduction to the Semiotics of Science Fiction," *Science-Fiction Studies* VI:17 (1979); 9-19.

[30] See my article entitled "SF versus Scientific Fiction in France: From Jules Verne to J.-H. Rosny Aîné," *Science-Fiction Studies* 44 XV:1 (March 1988); 1-11.