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The Astronomer at the End of the World

Authority, Speculation, and Communication in Camille Flammarion's 'La Fin du monde'

Abstract: During the *fin de siècle,* a Romantic trend in apocalyptic fiction coincided with a boom in popular science writing and spectacles. Astronomer and science popularizer Camille Flammarion made his career at this confluence, establishing a vision of science as fundamentally imaginative and necessarily in communication with the public, rather than a strictly empirical enterprise limited to specialists. This essay will take Flammarion's use of apocalyptic themes and imagery as a window onto the turbulent negotiations over scientific authority around the turn of the century. In his novel *La Fin du monde,* and related writings, speculative plots about the end of the world are used to deliver scientific knowledge to the public, while at the same time demonstrating the potential dangers of bad communication and irresponsible speculation. For Flammarion, the end of the world was an especially fruitful site for these debates because it was both impossible and unavoidable: impossible because the universe was supposedly infinite, and unavoidable because entropy pointed in only one direction. This apparently unresolvable dilemma provided an ideal setting for Flammarion's vision of an open science as authoritative over unseen events and mediating through troublesome processes of transmission and distortion.

Keywords: fin de siècle, science fiction, popularization, astronomy, entropy.

By the close of the nineteenth century, the end of the world had become a topic of scientific debate. Even as imperial mapping projects approached the apparent limits of the globe, new developments in thermodynamics rattled the perceived stability of the cosmos. In 1852, the physicist William Thomson declared that "within a finite period of time past the earth must have been, and within a finite period of time to come the earth must again be, unfit for the habitation of man" (Thomson 1857, 142). This view echoed and rephrased a then-flourishing Romantic trend in literary apocalypse that extended from the 1805 publication of Jean-Baptiste Cousin de Grainville's *Le dernier homme* through Mary Shelley's pandemic novel, *The Last Man* (1831), building, by the end of the century, into a steady flow of extinctions, ruined cities, and planetary finales.[1] Framed thus by the geographical ends of the globe and the temporal end of the universe, this *fin de siècle* anxiety over the apparent limits of humanity dovetailed in the 1890s with a vivid popular fixation on the *fin du monde* itself.

In 1894, the astronomer and popular author Camille Flammarion published his own take on the form with his novel *La Fin du monde,* in which he reprised the doomed lovers of De Grainville's poem alongside a parade of familiar themes. Indeed, the book combined so many recognizable tropes that it threatened to burst the generic mold: the plot even stretched to include two separate apocalyptic events, as well as an expository chapter that considered many other possible endings. This surfeit of doomsdays indicated a tension over the nature of scientific authority at the end of the nineteenth century; after all, whoever could be trusted to predict the end of the world must perforce be a reliable source of information about the state of the universe in the meantime.

Scholars of Victorian science and literature describe the period as one of enormous social and scientific upheaval, though also one in which new disciplinary norms were beginning to constellate around formal methods and specialist training.[2] Even as positivist thinkers insisted on the empirical limits of scientific knowledge, new developments in geology, natural history, physics, and astronomy disturbed existing models at every scale.[3] Contra the empiricists, the promoters of these newer frameworks encouraged a view in which scientific prediction was no longer a matter of, say, observing the position of celestial bodies and calculating their trajectories. Henceforth, the makeup, origins, and evolution of such distant and difficult-to-sense objects were all valid targets of investigation, via new technologies of chemical analysis, photography, and telegraphy (Becker 2011). These new realms of science also introduced new forms of communication with the broader public, through novel imageries and imaginaries (Secord 2014; Morus 2010; Lightman 2009).

1 For an exploration of Grainville's poem, see Wagar (2003); Ransom (2014). On Shelley, Bailes (2015). Many more examples of this literary trend may be found in the catalogue of English-language science fiction from 1644 to 1968 found in Clarke (1972). For more on the trope of the last man specifically, see Stafford (1994). While my study will focus on the final decades of the 19th century, these trends continue into the 1900s and the formal foundation of science fiction; as explored by Whitworth (2001).

2 One example of disciplinary development at this time is the case of "psychophysics," which was developing between mechanics and sensory studies at this time; see Staley (2018).

3 For a general overview of the scale and range of these transformations, see Williams (2006, 457–70).

By the second half of the nineteenth century, the French bourgeoisie exercised a remarkable appetite for popular and participatory science (Chouillet et al. 1992). This was reflected in the preponderance of new mass-produced journals, crowded lecture series, and market demand for personal scientific instruments such as telescopes (Béguet 1990). Flammarion was the youngest of a cohort of *vulgarisateurs* that included François Moigno, Victor Meunier, and Louis Figuier, all of whom modeled themselves to some degree after polymath heroes such as François Arago and Alexander von Humboldt. Abroad, analogous figures included the English astronomer Richard Proctor and the astrophysicist J. Norman Lockyer (Lightman 2009, 295–352; Bigg 2010, 305–24). Lecturers, writers, publishers, and social critics: these popularizers constructed extensive cultural structures outside the traditional bastions of scientific authority, institutions which were increasingly being bulwarked behind elaborate entry requirements like the *baccalauréat* and the *licence* (Fox 2012, 285–90).

Camille Flammarion's willingness to speak critically of that establishment contributed to his enormous popularity (and profitability) as a public speaker and writer. His works were widely translated into English and favorably reviewed in foreign newspapers. Throughout his career, he was immersed in debates about science and the public in France and abroad, through syndicated newspaper columns, books in translation, and scientific lectures and exhibits. Despite this notoriety, Flammarion's role as a public communicator of science has only been lightly treated in English-language scholarship.

This essay will take Flammarion's use of apocalyptic themes and imagery as a window onto the turbulent negotiations over scientific authority at the turn of the century. *La Fin du monde*, along with its English translation *Omega*, is exemplary of Flammarion's heterodox approach to popular science, in which speculative plots deliver specialist knowledge to the public while at the same time demonstrating the potential dangers of bad communication and irresponsible speculation. While his contemporaries sometimes maligned such public exchange and conjecture as a corruption of science's authoritative empiricism, Flammarion insisted on their necessity. In so doing, the astronomer presented and defended a view of scientific authority as fundamentally a process, and product, of communication across seemingly impermeable barriers: between scientific institutions and the public, as well as between the known and the unknowable. By speculating about the end(s) of the world, Flammarion had an ideal subject through which to enact this vision of an open science, authoritative over unseen events and mediating through troublesome processes of transmission and distortion.

Speculation & Spectacle: Scientists in Public in the 19th Century

Speculating Science

Astronomy's rise as a social authority might be explained through a series of celestial events spread over centuries, during which time scientific observations and predictions became increasingly precise and the rhetoric of astronomical prediction increasingly powerful. The ability to forecast the movements of heavenly bodies was fundamental to establishing the role of the scientist in society; this was particularly true of comets (Yeomans 1991; Schaffer 1988). But by the mid-1800s, the power of established protocols of prediction and calculation was shifting in relation to more tentative approaches and newer theories in multiple domains, where strict traditions of observation were unsettled in favor of more open-ended explorations. Scholars have shown how prominent articulations of thermodynamics by Sadi Carnot, William Thomson, and Rudolph Clausius between the 1830s and 1860s, along with new instruments of spectroscopy and photography, contributed to a view of the cosmos as a complex, chemical system tending to disorder, rather than the perfect mechanism of a clockwork universe (Brantlinger 1989; Clarke 2001; Anger 2014). On Earth, evolutionary theory and geological catastrophism gave shape to the idea that the planet's apparently stable systems could shift dramatically (Rudwick 1997). Emphasis of the critical role of the imagination in this view of science can be traced to earlier Romantic figures such as Alexander von Humboldt and François Arago (Dassow Walls 2009; Holmes 2009; Tresch 2012). By the late nineteenth century, these diverse speculations were linked by common concerns and influences; critically, debates over science were fraught with anxiety about the unconscious will of the individual corrupting the supposed objectivity of scientific work (Galison and Daston 2007). Nevertheless, uncertainty—whether about the history and future of the Earth, the nature of its inhabitants, or the larger fate of the universe—created a space of possibility into which charismatic individuals could venture without relinquishing claims to objectivity and authority.

In astronomy, this shift developed in fits and starts as tension built between institutional discipline and the more improvisatory approaches of popular science. As late as 1854, François Arago's authoritative and accessible *Astronomie populaire* countered popular speculations about the disappearance of Saturn or the immolation of Jupiter with an appeal to the Laplacean stability of the solar system (Merleau-Ponty 1983, 39–40).

Within a decade, however, science popularizers were putting new emphasis on narratives of possibility and probability over the familiar plot of calculability. Flammarion, styling himself as a successor to Arago with his own *Astronomie populaire* (1880), nevertheless turned away from stability and predictability. Instead, he touted astronomy's ability to puzzle out "celestial hieroglyphics": that is, to 'read' a story in the stars, as though parsing linguistic nuance rather than making purely mathematical derivations (Flammarion 1880, 399). This emphasis pervaded his career from his first published work, *La Pluralité des mondes habités* (1862), in which the scientist imagined the possibilities of alien civilizations. This publication found echoes in Richard Proctor's 1870 *Other Worlds Than Ours* and in works by American astronomers such as Percival Lowell and Bartholomew Burges, who postulated Martian civilizations and comet-bound aliens travelling around the solar system (Crowe 2008; Nall 2019; Fraser 2021). Yet, these imaginative extrapolations were grounded in logical arguments about scale and reach of the universe, particularly relative to the limited nature of observations: If space is infinite, and life is present in one place, how could it not exist elsewhere?[4] Reasoning along such lines, Flammarion concluded that "modern astronomy" had placed "the doctrine of human existence on other planets on a solid and imperishable basis" (Flammarion 1887, 160).

By the 1870s, the young Flammarion had given up institutional posts at the Paris Observatory and the Bureau of Longitude and was on his way to becoming one of the most popular—and one of the most prolific—writers in France. Between the publication of *Pluralité* and his death in 1925, Flammarion authored more than 70 volumes, ranging from scientific descriptions of the atmosphere and cosmos to first-person travelogues and philosophical speculations on psychic energy and the nature of life in the universe. Accordingly, much scholarship of Flammarion focuses on his role within new media forms that allowed scientists to speak directly to the public: primarily the burgeoning popular press and the scientific lectures and spectacles then undergoing a century-long boom in popularity (Bensaude-Vincent 1989). Another prominent approach has addressed Flammarion's unconventional interest in psychic and occult phenomena (Bensaude-Vincent and Blondel 2004; Finn 2007; Brower 2010; Lachapelle 2011) although these research areas were not self-evidently outside the mainstream at this time (Noakes 2019). Both strands of scholarship are important to understanding Flammarion's emphatically public and openly speculative approach to scientific practice.

Scientist-popularizers like Flammarion, characterized by a "qualitative, literary, and aesthetic approach rather than a quantitative, mathematical

4 This argument for the existence of extraterrestrial civilizations was also taken up by various utopian and socialist thinkers, and used as an incitement to consider the possibility of other life-ways on Earth, e.g. Louis-Auguste Blanqui (2009). For more background on alien utopias, see Crowe (2001, 218–24).

approach," favored the general and the popular over the specialist and the institutional (Bigg 2010, 308). The astronomer Maria Mitchell, who in 1847 made her name as the first American to discover a new comet, explicitly criticised the limited view of astronomy demonstrated by almanacs and ephemeris. In her view, astronomers could be predictive (calculating positions), observational (forming hypotheses), or prophetic; the latter involved "[looking] up at the stars with a sense of speculative possibility" and was, in Mitchell's opinion, regrettably practiced little among her fellow astronomers (Fraser 2021, 126). Flammarion, reflecting on his time at the Paris Observatory, made a similar point about his colleagues, writing that all were "careful calculators" and that none "was interested in celestial contemplation, none asked himself what the other worlds were, none travelled with his imagination in the infinite spaces of the sky" (Flammarion 1912, 154).

The practice of "travelling" by imaginative power was core to Flammarion's science, and evocative of other kinds of imaginative exploration in science and popular narratives. Emulating Humboldt and Arago, Flammarion refuted the positivist belief that scientific inquiry should, as Auguste Comte insisted, remain "local" to our own solar system and to topics relevant to "our real needs" (Merleau-Ponty 1983, 170). Flammarion commuted Mitchell's idealization of an astronomical third way into an imperative, writing that the "mission of astronomy was not to stop at the measurement of the *positions* of stars, but to rise to the study of their *nature*" (Flammarion 1912, 156). To rise (*s'élever*) also carried connotations of leaving the Earth's surface, just as one would in a balloon. Although eighteenth-century mania for hot air ballooning had eased slightly, the scientific observer aloft in a balloon remained a popular figure in scientific and literary writings (Brant 2017; Doherty 2017). The aerial vista—which Flammarion had experienced on several occasions including during his honeymoon (Finn 2007, 46)—suggested the exciting possibility of leaving behind the limitations of Earth-based observation to achieve a cosmic perspective, even if only through imaginary means (McCormack 2018; Henchman 2014).

This speculative vision was closely tied to new techniques of spectroscopy and photography that let scientists chemically 'sample' the stars at the ends of their telescopes, as well as related innovations of representation and communication (Bigg 2010, 305–24). Though Arago had initiated experiments in spectroscopy during his tenure as Observatory director, by the middle of the century, the methods of "celestial chemistry" mostly took place in ad hoc laboratories outside the formal centers of astronomy (Tresch 2012, 107–109). For Flammarion, spectral analysis evoked the act

of reaching toward the stars as though "to touch with our hands" (Flammarion 1887, 160).

Notably, this tactile approach to astronomy was also linked to nineteenth century explorations of the human soul; this is especially clear in French, where 'analyse spectral' evokes the same 'spectre' that a medium might summon at a séance. This ghostly pun enforced Flammarion's insistence on the physical reality of immaterial phenomena, be they electromagnetic or ethereal, or some combination of the two. At the time, research in the luminiferous ether (Navarro 2018) resonated with demonstrations of "action at a distance" carried out by psychic mediums (Finn 2007). Religious and spiritist doctrines freely combined these sorts of speculations, as in Balfour Stewart and P. G. Tait's *The Unseen Universe* (1875) and Louis Figuier's *Le Lendemain de la mort* (1871). These phenomena equally required 'natural' explanation under Flammarion's scientific approach. "Our souls are not pure spirit," Flammarion wrote, but "fluidic substances. They move and communicate between each other by material means, but of a material subtle, invisible, and imponderable" (Flammarion 1897, 60–61). Thus, the composition of distant stars and the material of the human soul were interrelated in Flammarion's cosmology, in which spectral analysis could uncover physical and psychical connections between our bodies and the distant universe.

Communicating Authority

Thus a newly tactile, exploratory, and spiritist science seemed to throw open the doors of the universe to questions of the unseen, the infinite, and the incalculable. This speculative science was also characterized by its thorough entanglement with acts of public communication, in which novel technologies of observation and analysis became tools of presentation and entertainment. That is, not only could stars be sampled through photography and projection; they could also be shown to the public, in newspaper reproductions and darkened lecture theatres. While science and its communication are always entangled (Secord 2004), the late Victorian period saw a particular emphasis on the interchange between making and communicating knowledge (Morus 2006; 2010). In this view, Flammarion's engagement with the press was not incidental but a deliberate tactic and central tenet of his work.

Alongside the expansion of astronomical practices, new modes of engagement began to emerge. New journals such as *Cosmos* and *L'Astronomie* furnished an appetite for fresh imagery and speculation;

in turn, these drew together new communities of scientists who could organise themselves outside of established institutions (Lightman 2009; Baldwin 2015). As the Second Empire extended its ambitions over state science, institutions such as the Paris Observatory came to embody a rigid and limited scientific culture, where previously the revolutionary, republican science of Arago had held sway. Arago's successor as Observatory director, Urbain Le Verrier, exemplified this shift (Aubin 2003; Fox 2012). In a repudiation of Arago's emphasis of enthusiasm and curiosity in science, Le Verrier insisted on militant discipline and absolute precision among his employees.[5] Alternative structures cropped up in response, including the Société astronomique de France, which Flammarion founded in 1887 as a gathering place for non-academic scientists and enthusiasts. Within these communities, Flammarion and others had the freedom to mingle scientific practice and popular communication. This was a broader, more inclusive vision of science, perhaps, but also one in which questions of authority and conflict would have to be carefully negotiated.

A central site for this negotiation was the popular press. Illustrated magazines and broadsheet newspapers experienced enormous growth during the late nineteenth century, powered by technological change and newly populist forms of journalism (Tattersdill 2016). These new publications were notorious for favoring profit over strict accuracy; as H.G. Wells commented, "The normal newspaper is a sheet of advertisements, with articles written to attract, amuse and interest customers, provided they do nothing to detract from the primary purpose of putting goods over to the reader" (Wells cited in James 2012, 44). And yet these were unquestionably powerful forms. During this intense period of popularization, the gravity of new journalism drew many scientists into its pages. This was epitomized by the 'Mars craze' beginning around the 1880s and continuing into the first decade of the 1900s, when even scientists tending to mistrust of the press felt compelled to comment in its debates (Lane 2006; Nall 2019). During this time, Mars exercised a powerful attractive force on the scientific imagination, serving as a dark analogue for evolutionary and entropic concerns about Earth (Markley 2005). In these and other controversies, Flammarion was an enthusiastic commentator, with columns syndicated in French, British, and American papers throughout the latter half of the century; especially via the Paris edition of the *New York Herald* (Nall 2019, 18–19; 94–97). He published opinions on meteorological forecasts, tidal waves, sunspots, and solar eclipses: all topics which were at the center of immense public interest, and often controversy.[6] Among these disparate prognostications, Flammarion also predicted, from time to time, the end of the world. Indeed, by the 1890s, it seems to have become one

5 It is difficult to overstate the differences between Flammarion and Le Verrier, who is frequently described as a near-caricature of the precise and blinkered empiricist that Flammarion (and Arago) reacted against. The supposed boredom of positional astronomy was indeed a key part of its claim to authoritative status (Donnelly 2014). Le Verrier was, however, responsible for opening the Observatory to the public through the founding of the Association francaise (Aubin 2003).

6 Demonstrative titles include: 'Is the Climate of Europe Changing?' (*New York Herald,* March 1891) 'Past and Coming Crops and Seasons,' (*NYH*, Oct 1893), and 'Flammarion on Sun Spots,' (*NYH*, June 1891).

of his favorite topics for comment, whether he was forecasting a fatal planetary cooling on geologic timescales or debating the possibility of an imminent run-in with a comet.[7] (Fig 1).

THE SUNDAY HERALD, BOSTON, MAY 15, 1910—MAGAZINE SECTION. 5

FLAMMARION'S TALE OF THE COLLISION WITH HALLEY'S COMET

SO FRIGHTFUL WAS THIS SUDDEN BRILLIANCE THAT ALL ESCAPED WITHOUT EXCEPTION .... RUSHED FOR THE FIRST DOOR THEY COULD REACH ....

Eminent French Astronomer Pictures the Ghastly Horrors That Befell Mankind in 2400 A.D., When the Heavens Rained Fire and Gases.

BY EDMUND NOBLE.

Figure 1. Flammarion's tale of a collision with Halley's comet. (*The Sunday Herald*, Boston, Mass. 15 May 1910)

In treating apocalyptic themes, Flammarion submitted to a contemporary interest in utopian thinking, characterized in France by the philosophical writings of Henri de Saint-Simon and Charles Fourier (Manuel 1962). Abroad, this genealogy was mirrored by socialist-leaning fictions like Edward Bellamy's *Looking Backward* (1887) and William Morris's *News from Nowhere* (1890). These writers shared a tendency to depict the future as a stable endpoint from which to survey various contemporary schemes of social improvement. Together with *La Fin du monde*, these texts illustrate how a century of industrialization and mechanization had transformed 'the end of the world' into a secular fable by which to digest the moral, political, social, and scientific ideologies their authors held dear.

These apocalyptic and utopian speculations were continuous with fictional concerns, and sometimes blurred into the norms of professional science. Adelene Buckland has explored the ways in which 19th century

7 For example, an article, appearing in September 1893, on the return of Halley's comet was titled 'End of the World - Flammarion Says It's Sure to Come' (*Kalamazoo Gazette*, Sept 1893). Other similar stories linked the cometary return to planetary heat and climate.

geologists used narrative and drama to tell stories about the past; in this case, being a good scientist meant telling a good (and convincing) story (Buckland 2013). Other Romantic and Victorian scientists used literature and poetry to think through (or satirise) concepts in math, physics, natural history, and chemistry (Brown 2013). Flammarion also borrowed liberally from popular media and culture to illuminate his scientific passions; meanwhile, popular culture was borrowing right back. Characters such as Mary Shelley's Frankenstein (1818), Robert Louis Stevenson's Jekyll (1886), and H. G. Wells' Moreau (1896) enshrined a popular view of the scientist as a deeply ambiguous moral figure.[8] In French, the writer most associated with the "scientific romance" was Jules Verne, whose staggering output began with *Cinq semaines au ballon* (Verne 1863) and continued to an eventual 60 installments of the *Voyages imaginaires* series. Variations of the Vernian scientist-explorer archetype can be found in Flammarion's writings, especially his philosophical explorations in *Recits de l'infini* (1873), which he later adapted into the novel *Lumen* (1887).[9] These literary works at the confluence of popular science writing and Victorian gothic literature demonstrated a growing interest in—and uneasiness over—the role of science in society.

The convergence of the melodramatic and the scientific can also be seen in the visual vocabulary of science popularization, which commonly saw sensational images and dramatic scenes deployed alongside texts. When these hyperbolic and stylized illustrations accompanied a technical argument, they might be interleaved with scientific charts or diagrams displaying a cooler rationality (Lightman 2012). These apparently separate registers were in fact complexly interconnected throughout the 19th century (Marshall 2021). Flammarion's work is exemplary of this iconographic jumble, in which illustrations were deployed in chaotic and seemingly incoherent relations that saw technical illustrations and figures mingled with romantic scenes and reproductions of historical imagery (Béguet 1990, 162–67; Keshavjee 2013). Literary scholar Elsa Courant characterizes Flammarion's more technical illustrations as lending "scientific justification" to his fantastical claims, thus separating his work from similar "scientific romances" while enacting a persistent confusion over, and convergence of, generic expectations (Courant 2016, 7). Arguing from the other direction, Bruce Clarke has suggested that the more asynchronous images declare a kind of intentional obsolescence in their deployment of medieval, renaissance, and baroque iconography (Clarke 2001, 35–36). Certainly, these archaic-seeming images serve to historicize Flammarion's narrative, grounding arguments about future conditions in a partially constructed and reimagined past.

8 Shelley and Stevenson are prominent members of this canon but the most notorious of all is H.G. Wells, who would come to be credited as the founder of science fiction; see James (2012); Shackleton (2017).

9 The influence almost certainly worked in the other direction, too: In 1865, soon after the "instant sensation" (Fox 2012, 197) of Flammarion's *Pluralité*, Verne published his own story of extraterrestrial travel, *De la terre à la lune* (1865). Interestingly, Verne also authored an earlier dystopian/apocalyptic novel, titled *Paris au XXe siècle*, the manuscript of which was only discovered and published in 1994. For more on the dynamics between Verne and Flammarion, see Finn (2007).

Photography had a decisive role in the visualization of science in this period. Beginning with the daguerreotype, invented by Louis Daguerre in 1839 and championed by Arago, photography had revolutionized mid-century science, in general, and astronomy in particular (Tresch 2012, 89–122). Alongside these changes came transformations of mass media and visual culture more broadly (Belknap 2016; Natale and Leonardi 2021). The photographic process held out the possibility of reproducing a "true" copy of reality (Galison and Daston 2007) while simultaneously introducing new complications to the boundaries between truth and artifice (Lightman 2020; Dawson et al. 2020). In science, photographs offered a powerful channel for collecting and communicating findings, perhaps most notably through images of solar eclipses and solar transits (Canales 2002; Bigg 2010). During the Mars debates, too, photographs were used to claim credibility, though their meaning was often unclear or unstable (Lane 2006, 204–5). Though photographic reproduction was cost-prohibitive until the late 1890s, photographs were sometimes copied manually by an engraver in order to import some of their alleged authority into print (Belknap 2021).

Although much of the historiography of scientific photography emphasizes its mechanical objectivity, for Flammarion, photography and cinematography enabled fluent movement between speculation and science, illusion and reality, particularly when deployed selectively in the public lectures and entertainments that were a fixture of late nineteenth-century Parisian society. As Laurie Garrison has shown, public spectacles were often highly ambiguous, open to multiple and conflicting interpretations (Garrison 2012). In his lectures, Flammarion borrowed from popular illusionists and 'fantasmagoriciens' such as Robert Houdin and Étienne-Gaspard Robertson when he juxtaposed realistic images of stars and nebula (Fig 2) with the sudden, startling image of a skeleton, thus blending the specialist "telescopic" views with popular phantasmagoria (Barber 1989). These projected apparitions, confusing technology and magic, science and wonder, trick and truth, were exemplary of Flammarion's spectacular and speculative communication.

Narrating the End of the World

These themes of speculation and communication—and their translations between science, literature, technology, and society—are central to the inner workings of Flammarion's apocalyptic novel. In *La Fin du monde,* the relationship between scientists and the media plays out in an uneasy series of co-dependent encounters, as the territory of 'the end of the

Figure 2. 'Les plus belles nébuleuses du ciel' from *Atlas céleste* (Flammarion 1877) (credit: Bibliothèque nationale de France)

world' is staked out as both a scientific opportunity and a media event (Flammarion 1894, henceforth *LFDM*).

Long before the fictional comet makes contact with Earth, but after its position has been calculated, Flammarion's 25th century Paris is already in disarray, as "the entire population, worried, troubled, terrified, every social class mixed together, as though hanging on the decision of an oracle as they waited feverishly for the results of the calculation that a famous astronomer would publicize that Monday, at three o'clock, at the meeting of the Académie des sciences" (*LFDM*, 2). The suspense over a scientific meeting recalls the 1773 publication of Jérôme Lalande's *Reflexions sur les comètes qui peuvent approcher de la Terre,* which was a carefully calculated catalogue of potentially dangerous comets. Though Lalande made no actual predictions of cometary collisions, the incomplete communication of his findings was widely taken to signify that such a collision must be imminent. The resulting months-long panic was so extreme it caused "stillbirths and public disorder" across France (Schaffer 1988, 56–58). Flammarion also writes a direct account of this episode later in the book to evince the power—and danger—of the interplay between scientific and public imaginations (*LFDM*, 197–199). It is this dynamic which forms the true center of Flammarion's novel.

From Position to Composition

Flammarion's interest in both the authority of traditional astronomy and the imaginative possibilities of newer practices drew him into mediation between strict positional astronomy and the speculative science of the composition and nature of celestial bodies and the universe. Accordingly, the interplay of calculation and speculation weaves through *La Fin du monde*. In the first half of the book, calculation has an uneasy, partial triumph as the astronomers successfully predict the path of the incoming comet but bungle its public communication; in the second part, the possibilities of speculation open a wider vista on the future, raising new questions about the role of science in parsing distant and uncertain possibilities.

At its outset, *La Fin du monde* seems to be a straightforward fable of scientific authority. From the moment the new comet appears in the sky, its significance for humans on Earth is understood through traditional astronomical observation and calculation: "No one would have suspected, from this inoffensive glimpse, the tragic role that this new star was going to play in the history of humanity. Only calculation indicated its march

toward the Earth" (*LFDM*, 30). Flammarion's own career in astronomy began with an appreciation for the predictive powers of the science, after he witnessed a partial eclipse that, he wrote, "impressed me the more forcibly at the time because it had been foretold to a minute by the learned men of Paris, and had taken place exactly as predicted by them" (Flammarion 1890, 101). By contrast, on this same occasion he recalled that "the good old countrywomen of the place said that the end of the world was at hand" (1890, 101). The disparity between the credulous women and the knowledgeable astronomers is framed starkly in this formative brush with prediction.

The theme of astronomy as a replacement or antidote to superstition is developed more fully in a chapter of *La Fin du monde* devoted to the 'History of belief in the end of the world across the ages.' Leaving his plot to the side, Flammarion uses this chapter to detour through the history of apocalyptic predictions by religious prophets and courtly astrologers, mapping the emergence of astronomy as a predictive authority over centuries (*LFDM*, 171–215). Arriving at the point in this story that encompasses his present day, Flammarion demonstrates the unfinished business of this progressive depiction of history, in which "prophets of evil, more or less sincere," have announced the end of the world as many as 25 times over the course of the nineteenth century (*LFDM*, 215). These misguided prophets base their methods in "cabalistic calculations that rest on no serious principle" and Flammarion concludes that "similar predictions will return as long as humanity survives" (*LFDM*, 215). This rather extraordinary sentence both invalidates attempts to predict the end of the world, while itself positing the eventual end of humanity, thus calling into question the possibility of prediction altogether.

The limited nature of calculation-based prophecy is likewise on display as Flammarion's comet approaches Paris. While its position, velocity, and mass are precisely known, the makeup and meaning of the celestial object remain deeply uncertain. The scientists who assemble to debate the implications of the comet focus on the ways in which the specific arrangement of materials that make up the comet may interact with planetary systems; it is not, after all, a uniform Newtonian mass, but an agglomeration of gases and irregular solids. Spectroscopic analysis had revealed the comet to be composed primarily of 'oxide of carbon,' and it is this fact that moves the conversation away from astronomical authority and into a realm accessible to other (and, to Flammarion, less trustworthy) experts. In this new epistemic register, Flammarion suggests, the uneasy balance between calculation and speculation breaks down. This is exemplified by the personage of the President of the Academy of Medicine, a skeletal fig-

ure described as an undertaker presiding over a corpse, rather than a doctor who might be "animated by the hope of curing illnesses" (*LFDM*, 60). He gives a speech full of vivid, technical description of the effects of carbon monoxide: "The circulation of the blood will stop. The venous blood will fill the arteries and veins alike…the base of the tongue, the throat, the carotid artery, the lungs will redden with blood, and soon the entire corpse will show a violet coloration characteristic of this suspension of hemoglobin" (*LFDM*, 63). This exotic portrayal in fact represents the ordinary effects of death by suffocation, rendered extraordinary through irresponsible use of the doctor's authority and imagination. Furthermore, this act of communication has an immediate and palpable effect on the audience, who turn various colors as they listen, from green to scarlet red, as if fulfilling the doctor's predictions in real time.

This, then, is Flammarion's idea of the dangers of over-speculation, in which the values of dispassionate calculation and probability are abandoned in favor of imaginative productions. Nevertheless, the chapter finishes midway through the scientific debate, leaving the audience—both the scientists at the meeting and the readers of the book—waiting to find out "whether the end of our world must truly come from the mysterious menace suspended above our heads at that moment, or whether its arrival might occur by other calculable causes" (*LFDM*, 86). This phrasing of "other calculable causes" reveals a fundamental problem with calculation as a predictive tool, despite its historical successes. While the future may be *able* to be calculated, that is no guarantee that it will be calculated correctly.

Speculations in the News

If scientists are sometimes irresponsible communicators, then Flammarion suggests that their misdeeds pale in comparison to the role of the press in creating crisis and fomenting panic. Satirising the controversy-fueled journalism of the 1890s, Flammarion writes:

> For a long time, all the newspapers in the world, without exception, had become simple mercenary businesses. The press, which had in other times provided services to free human thought, was for sale to governments and to base capitalists, demeaned by financial compromises of every sort. All newspapers were commercial operations. The only question for them was how to sell the greatest number of broadsheets pos-

> sible every day, and how to make their headlines pay dividends…'business is business,' that was everything.
>
> They invented false news that they calmly denied the next day, undermined at every chance the stability of the State, travestied the truth, put into the experts' mouths things that they never said, slandered blatantly, dishonored men and women, sowed scandals, lied with impunity…[they] put their own readers in peril and betrayed every social class at the same time, with the only goal to excite general curiosity to the point of paroxysm and to "sell the numbers" (*LFDM*, 12–13).

The fictional journal in which Flammarion concentrates this vision of mercenary, amoral media is *The XXVth Century*.[10] Its owner is an anti-semitic caricature of an 'American Israelite' who spends the first half of the novel playing the stock market and manipulating a tentacular global media enterprise from an underground bunker in Chicago. Yet the relationship between the media mogul and the scientific authorities is not a straightforward one of truth and falsehood, or supply and demand, but rather a complex, two-way process of distortion. For instance, the Director of the Observatory—a "venerable elder" who serves as a double for Arago—prefaces his comments before the Académie by saying that if he had the "misfortune" (*LFDM*, 52) to be business-minded, he would invest while the market is depressed by news of the cataclysm. On cue, the American businessman races from the room to turn this "purely scientific reflection" into financial action (54–55). Bruce Clarke identifies this character as Flammarion's "daemonic double," a grotesque stereotype who seems to exert a compulsive attraction over his author (Clarke 2001, 57). Indeed, there are uncanny parallels in the ways both figures mediate their authority toward the public: the player of markets speculates financially while the author speculates in fiction, both selectively telling a story about the end of the world to achieve their goals. Indeed, while the American is an obvious villain of the story, he is notably one of the few characters to respond rationally to the astronomers' scientific predictions, drawing on the "new calculations" in order to make his financial speculations (*LFDM*, 89).

Despite the worst malfeasances of the press, Flammarion emphasizes that there is no possibility for scientific authority divorced from its means of communication. Experts who seek to distance themselves from popular debates risk becoming so detached from human affairs that their knowledge becomes obsolete. The astronomers who first study the comet, for example, judge it to be the exclusive interest of fellow specialists; only "a calculation to be verified" (*LFDM*, 16). Not "overly worried" about the

10 The name echoes *Le XIXe siècle*, founded in 1871, but it is more likely a satire of American "yellow journalism" papers, such as the *Herald* and Joseph Pulitzer's *New York World*.

collision insofar as "consequences on the level of humanity," they publish their results in special astronomical reviews, "the only [journals] that still had some authority" (16). These journals do not seem to have many readers, however, as several days pass before the news is picked up by general interest publications. Even when the astronomers are drawn into public debate, "submitting" (16) to interviews as though to unwelcome surgical procedures, they insist on the boundaries of public and professional interests. The Observatory Director, whose "voice was listened to everywhere," uses his platform to issue a statement that "all conjectures were premature until one heard the authorized technical discussions that would take place at the Institute" (*LFDM*, 20). In other words, the astronomer insists that scientific authority cannot, or should not, be separated from its proper setting.

This proves to be a futile tactic. Helped along by the opportunistic reporting of *The XXVth Century*, the public falls into a panic while the American mogul, "our indefatigable speculator," profits from the experts' predictions (*LFDM*, 34). After the scientific meeting, people wander the streets, their faces "livid and pale, eyes sunken, hair in disarray…marked by the most dreadful anguish that ever weighed on the destiny of man"—despite the fact that, notably, "the day passed without astronomical incident" (*LFDM*, 221–224). The contrast between extreme human despair and mundane reality suggests that, at this point, the stars of human fate are not so much celestial as they are serial.

Projecting the Ends of the World

Mediation and perspective are key to understanding how to approach the end of the world. In *La Fin du monde*, the Observatory Director points out to his audience at the Academy of Sciences that by "the end" we indicate an apocalypse in earthly terms only: the end of *this* world. If we allow our vision to travel beyond the familiar and the known, however, we might see a different pattern, one in which an ending might look a lot more like a beginning.

This attention to mediation turns us, next, to the public toward whom these mediated messages might be directed. Throughout Flammarion's career, he addressed his audiences not just as readers but as spectators. Images were central to transmitting the astronomer's speculative, spiritist vision of science. In the blending of the technical and the abstract, as well as the scientific and the miraculous, Flammarion explored the technology and the trickery of spectacle with the same intent with which he

employed the fantastical plots of his books; both approaches were means of projection, whether via light or the imagination, into realms beyond the limits of direct observation.

In this space of spectacle, the world's end provided a fertile ground for representation. Apocalyptic images played through Flammarion's rhetorical repertoire long before *La Fin du monde*, often in allegorical and melodramatic depictions. In the 1880 *Astronomie populaire*, for example, a section on 'the death of worlds' (Flammarion 1880,101–3) is accompanied by an image of the "last human family" imagined as a gothic huddle of skeletons attended by the ossified remains of a loyal dog (Fig 3). Another exemplary image has been the subject of much previous study and popular fascination since it first appeared in Flammarion's *L'Atmosphère* (1888). Often referred to simply as 'the Flammarion engraving,' the image appears to be a medieval woodcut, but closer inspection has shown it was engraved with a burin—a tool not used before the eighteenth century—possibly by Flammarion himself, who was apprenticed to an engraver in his youth. In the ornately carved image, a figure identified as a missionary lifts the edge of the celestial dome to peer into the cosmos beyond (Fig 4). Whatever its origin, the anachronistic effect grounds Flammarion's account of the triumphs of modern science in a history in which false beliefs (the flat Earth; the testimony of religious authorities) had been transcended by more critical, curious exploration. The power of the iconography has since assimilated other meanings, eventually coming to stand as a mythic metaphor for the heterodox, revelatory science that popularizers like Flammarion promoted. The missionary even lifts one hand toward the sky, as though enacting Flammarion's tactile spectroscopy.

In fact, this engraving also presents an 'end' of the world, albeit the physical one of a flat Earth. The visual rhyme is more than a coincidence, however, as both kinds of endings present a fundamental challenge to representation and Flammarion's interest in such images demonstrates the tension in his cosmology between observation and the invisible. Both the last human family and the missionary are pictured from seemingly impossible perspectives: in the former case, we know that there is no one left to witness the scene, so that it appears to come from beyond the grave; in the latter, there is ostensibly nowhere an observer could stand to see both the inside and the outside of the 'dome' of the sky, so that we seem to be standing outside the Universe itself looking in. By constructing these kinds of impossible images, Flammarion demonstrates how one might envision the invisible: there is no point from which these events can be observed, and yet we observe them. These are all, therefore, meta-images of how speculation works to construct plausible scenes of

Surpris par le froid, la dernière famille humaine a été touchée du doigt de la Mort, et bientôt ses ossements seront ensevelis sous le suaire des glaces éternelles...

Figure 3. 'La dernière famille humaine' from *Astronomie populaire* (Flammarion 1880)

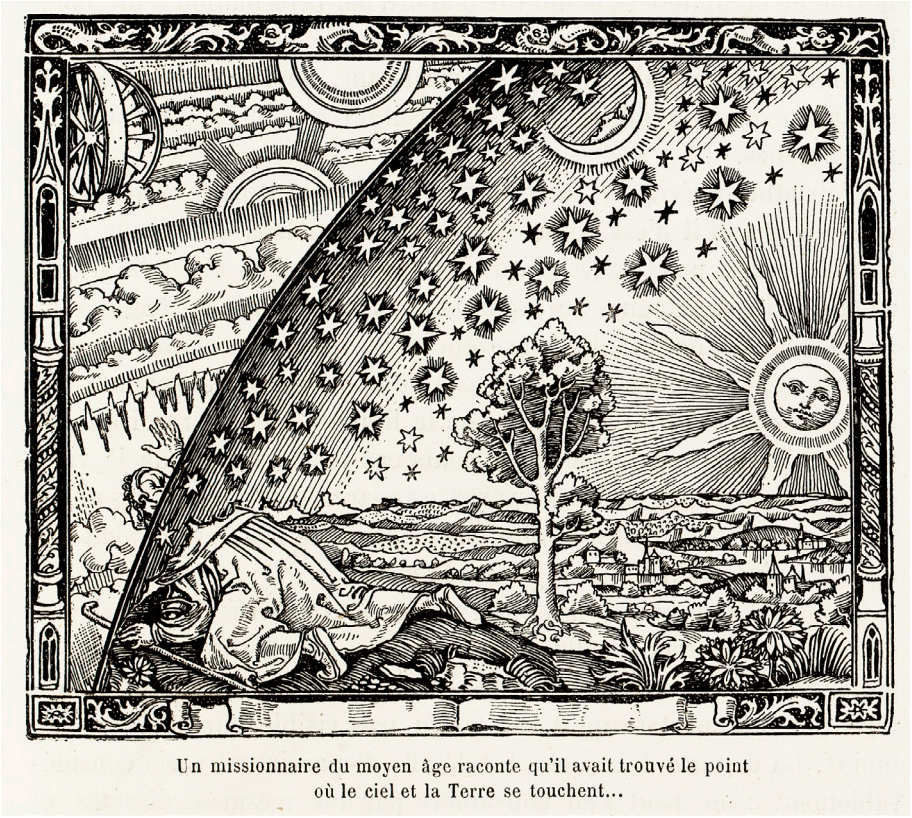

Figure 4. The 'Flammarion engraving' from *L'atmosphère* (Flammarion 1888) (credit: Bibliothèque nationale de France)

impossible content. The seemingly incongruous iconography of *La Fin du monde* functions in this same way, restaging the story in a parallel, mythical register.

This bears an important similarity to another of Flammarion's speculative novels, *Lumen,* in which an astronomer discovers his disembodied spirit can travel through space faster than the speed of light. These frictionless, effortless movements grant Lumen the extraordinary visionary capacity to 'rewind' time and watch the history of the Earth as though it were a moving picture. Throughout the book, the camera furnishes the chief cosmic metaphor, as the light that 'contains' Earth's history is projected infinitely into the universe like a moving picture into a darkened theatre: "These successive and endless projections into space of the history of all accomplished facts on each one of the worlds, carried out in the heart of the Eternal Being, of whom ubiquity thus holds each thing in eternal permanence" (Flammarion 1887, 143). The spectator for this universal cinematography again occupies an impossible subject position: the

"Eternal Being" who can observe the entire universe in space and time must be present everywhere at once and yet take up no space, must be looking in every direction and at every scale, at every moment. Lumen's superhuman travels can only approximate this imagined state of complete omniscience in the same way that a speculative image approximates an otherwise inaccessible idea.

Speculation is necessarily fraught with dangers of perception. Among the optical illusions that Lumen experiences is one in which the astronomer seems to observe the Earth's death as the planet begins to heat and expand, finally merging with the sun into a giant, amorphous nebula. "To witness the end of a world is a rare privilege," Lumen remarks as he is seized by "a feeling of vanity" and calls out in despair over the fate of "innumerable inhabited worlds" (Flammarion 1887, 85–87). Yet this vision turns out to be another apparition—a trick—that reveals a truth. A disembodied godlike voice corrects Lumen's interpretation: "Not *the end* … *but the beginning"* (87). The message and its meaning have been reversed through mediation, and that what Lumen took to be the end of the world is in fact a reversed view of the nebular hypothesis of planetary formation. In this vision, the future of humanity, in fact, still lies ahead. But this reversibility demonstrates an important tenet of Flammarion's philosophy: The end of the world only exists within a mediated human framework. Just as the solar system reignites at the end of *La Fin du monde*, when "there could be neither end nor beginning" (418), here we see the meaninglessness of space and time when the subject position of the observer is removed. Without a witness to establish a pattern—that is, to identify an 'end' or 'beginning'—there is only ceaseless change and endless, ubiquitous light.

Conclusion

In 1921, Berlin journalist Alexander Moszkowski published his *Conversations with Einstein*, over the protestations of its subject.[11] In a chapter on 'Other Worlds,' Moszkowski reports a conversation in which he brought up "the fantastic figure" (Moszkowski 1921, 112) of Flammarion's Lumen, to which Einstein is immediately dismissive. Moszkowski records Einstein's reaction: "The whole story is mere humbug, absurd, and based on false premises…[i]t is not an imaginary experiment: It is a farce, or, to express it more bluntly, a mere swindle!" (116).

Much of Flammarion's career may be seen as preliminary to developments in science and literature in the twentieth century. One oft-cited

11 First published as *Einstein the Searcher*; see Brown (2014); Redington (2014).

passage of *Lumen* even seems to anticipate Einstein's physics, as Lumen rebukes Quaerens that "as you are disposed to regard your ideas respecting time and space as *absolute*, while they are only *relative*, your understandings are closed to the truths which reside outside your sphere" (Flammarion 1887, 66). Henri Poincaré, whose 1902 *Science et Hypothèse* influenced the young Einstein, was a correspondent and collaborator of Flammarion's in the early years of the twentieth century—he even delivered a speech at a 1912 'scientific jubilee' celebrating the astronomer as "a savant who is at the same time a poet, and a poet who is also a savant."[12] Most evocative of all is Einstein's own account of the origins of the theory of relativity, which the physicist traces to a formative daydream of travelling alongside a light beam, seemingly reprising the central premise of *Lumen* and enacting Flammarion's ideal of travelling "with [the] imagination in the infinite spaces of the sky" (Flammarion 1912, 154). Looking back in 1955 at this "juvenile thought experiment," Einstein concluded that "invention is not the product of logical thought, even though the final product is tied to a logical structure" (Pais and Penrose 2005, 131).

Yet, even if Moszkowski's testimony is taken as trustworthy, Einstein's dismissal of Lumen suggests he did not acknowledge the similarities between his approach to scientific imagination and that of the French astronomer. As he reportedly complained, the premise of Lumen "projects us right out of the world of reality into a pure fiction of thought, which, if followed to its conclusion, leads to the most degenerate form of imagination" (Moszkowski 1921, 118). For Einstein, Flammarion's projecting imagination overshot the boundaries that twentieth-century physics and astronomy would come to delineate and fortify around the discipline. The French astronomer's attempts to marry science's calculating authority and speculative scope did not usher in a new era of scientific psychospiritism. Indeed, by the 1920s, psychical research was increasingly separated from mainstream physics, and figures like Flammarion were seen by other scientists as credulous and superstitious, not unlike credulous countrywomen predicting the end of the world.

But Flammarion's extraordinary communicative force did shape the world that would come after the end of the century. New norms of science fiction, as formally described by Hugo Gernsback in the 1926 inaugural issue of American monthly magazine *Amazing Stories,* brought together science and speculation (Tattersdill 2016). H.G. Wells, often credited as the 'father' of the genre, took many of his most memorable ideas from Flammarion's 1890s fiction and articles, not least the Martians with which he made his fame in *The War of the Worlds* in 1898. Wells' 1897 story *The Star* is a direct retelling of *La Fin du monde,* which Wells likely

12 'La Jubilee scientifique de M. Camille Flammarion' *Le Petit journal*, 1912.

read as *Omega* sometime after 1894. Later, Wells expanded this brief story into his novella, *In the Days of the Comet*, in which scientific authority over the heavens is undercut by the chemical uncertainty of the comet (as seen through spectral analysis) which ultimately has social ramifications that dwarf the limited concerns of astronomers.

For Flammarion, the end of the world was a fruitful theme because it was both impossible and unavoidable: entropy pointed toward it, and infinity pointed away from it. The things that made apocalypse a difficult scientific topic, inaccessible to ordinary inquiry, unavoidably drew on imagination and communication, both necessary tools for understanding—not merely calculating—the mechanics of the universe. Scientific authority in the world had real consequences, as the comet panics of the eighteenth and nineteenth centuries had shown; it also could produce real insight into distant stars and distant times through the emerging viewpoints of chemical analysis and theoretical physics. And yet the realm of the known expands at a rate proportional to the unknown. The unseen and the invisible continue, to this day, to exert their imponderable influence over the observable universe. Every new discovery at the turn of the century, including relativity, raised new questions even as it answered old ones. On this point, at least, Flammarion and Einstein agreed.

When MIT professor Norman Hugh Redington published chapters of Moszkowski's *Conversations* online in 2014, he chose a familiar image to head the chapter on discovery: the Flammarion engraving. In this ancient-seeming illustration, the missionary kneels to poke his head under the edge of the sky, looking out from the end of the world into a cosmos whose structure defies representation. In reality, the sky may have no edge and the world may not end, but the image nevertheless communicates, forcefully, the possibilities of seeing past what can be seen, and the compelling desire to reach out and touch what lies beyond.

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