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# Matter as the New Wilderness: Cognitive Obstacles, Radium, and Radioactivity in British and American Popular Fiction from the 1910s

**Abstract**: At the beginning of the 20th century, the radical paradigm shift in atomic physics and chemistry attracted attention from non-scientific culture, and provided a new set of imagery in literary representation of matter, particularly in popular fiction. The article presents a number of texts whose themes and plots were rooted in a peculiar manner of writing, featuring a radical and consistent projection of emotions and desires onto literary representation of matter. The theoretical background has been derived from recent discussion of cultural materialism, and from Gaston Bachelard's psychoanalysis of the scientific mind. The selection of literary texts covers popular novels and short stories published in Britain and the United States between 1880 and 1918. The conclusions present a somewhat surprising link between the new developments in atomic theory, and the tradition of frontier settings in the American adventure romance.

**Keywords**: cognitive obstacle, cultural materialism, radium, radioactivity, popular science

## 1. General Outline: The American Frontier and the Frontier of Science

The discovery of radioactivity, and the consequent development of new models of the atom, have brought on a strong cultural response, which amounted to a craze in the first two decades of the 20th century. There was a similarly strong response in fiction, especially in popular fiction, ranging from thematic interest in new rays and elements, to the mood of anxiety and enthusiasm engendered by the scientific revelations that matter is somehow linked to radiation and electricity, and that

matter was unstable, susceptible to explosive disintegration. Matter, in many of the literary texts discussed here, could no longer be taken for granted, as it was becoming less solid and more dangerous. Representation of matter in such terms can be described as a distinct mode of realism, the realism focused on matter, which is characterized by a specific choice of sensational themes and plots. The realism focused on matter can be defined in terms proposed by Gaston Bachelard in his psychoanalytical discussion of pre-scientific thinking. Most generally, as observed in the conclusions, this mode of realism focused on images that blurred the distinction between mind and matter, and presented them in sensational plots and images of violence, physical strain, dynamic movement, and bodily suffering.

## 2. Theoretical Background: Gaston Bachelard, Jane Bennett, and the Myth and Symbol School of American Studies

The present study is a historical survey of the figuration of radioactivity in English and American popular fiction from the 1890s and the 1910s; this mixture is justified because many of the texts and authors seem to have functioned in both countries simultaneously. Theoretically, the discussion is based on Gaston Bachelard's notion of the cognitive obstacle, which he presented in *The Formation of the Scientific Mind* (1938). The literary texts under discussion are treated as reflections, echoes, if not explicit thematic representations, of an epistemological crisis which challenged earlier ideas about matter among scientists and, more importantly, among members of the general audience. The dramatic effects of radioactivity challenged common sense, utilitarian views of matter, popular perception of materialism and idealism, religious opinions about science. Most importantly, the crisis was discernible on a practical level of direct, everyday experience represented in fiction: the representation of a character's body and soul, of material objects, was affected by confusing news from the world of science. The challenge will be discussed in Bachelard's terms, as challenge to epistemological obstacles.

In science, an epistemological obstacle is a way of thinking "badly" (Bachelard 2002 [1938], 25), that is in a scientifically unproductive way. Bachelard identifies everyday life as the source of epistemological obstacles, which is perhaps similar to the contemporary notion of cognitive metaphor, in that an epistemological obstacle is often a metaphor derived from everyday experience, such as the absorbing sponge (2002 [1938], 72) or the digesting stomach (2002 [1938], 172). It is possible to understand sponge-soaking and digestion scientifically, and both are complex bio-chemical systems. An epistemological obstacle occurs, however, when someone thinks of sponges and stomachs as simple phenomena, which can be used as simplifying metaphors (e.g. in teaching or in popular science writing) for explanation of physical processes and chemical reactions, for instance by saying that a liquid absorbs gas like a sponge, or that an electric circuit is 'fed' electricity from a power source.

Bachelard claims that such metaphors are doing more harm than good in science, particularly in teaching of science, and he dismisses their use in general "opinion" (general discourse) as irrelevant. In fiction, however, cognitive obstacles can become central premises, themes, and patterns of imagery used in representation of settings and characters, or even as patterns of plots. In other words, the present discussion is based on the idea that material world in fiction is largely made of cognitive obstacles. When cognitive obstacles were radically challenged by new scientific developments, when many of them became untenable and useless in science, there was hypothetically at least some corresponding upheaval in fictional worlds, in fictional representation of matter. The following interpretative passages will focus on representation of materiality in terms of cognitive obstacles. It is assumed that writers could explicitly identify and mention some "old" cognitive obstacles, but at the same time, while dealing with new, confusing scientific evidence, they also implicitly met "new" cognitive obstacles, falling back on easy, generally accepted metaphors and ways of thinking, to create stable and understandable material settings. As the texts suggest, in the 1910s, this process was occurring with a great intensity, displaying an interesting variety of images, metaphors, and themes.

What seems to be the crux of Bachelard's writings is the confrontation that brings about the cognitive obstacles, the confrontation between realistic imagination of objects and an active experimental search for relations:

> Both science and poetry create a "presence" of possibilities, the one mathematically conceived, the other verbally imagined, before any link to physical reality is established. As Bachelard sees it, both science and poetry can be said to project a particular reality rather than merely to reflect it. […] Bachelard examines this projective quality of science in light of the matter–radiation, wave–particle, determinism–indeterminism contrasts of contemporary science. [...] The constructed phenomena of science, such as electron spin, have no meaning in isolation. One may imagine the spin of an isolated electron, for example, but one does not think it. Thinking, in the science of second approximation, depends on mathematical relations. Without these relations the phenomena of science cannot meaningfully be said to exist. (Smith 2016, 28)

Consequently, the imaginary construction of matter results from attempts to translate mathematical relations into words and images: commonly used phrases, metaphors and images can form cognitive obstacles, instead of explaining mathematical relations. Bachelard discusses this process psychoanalytically, as projection of confusing images or verbal concepts onto an active work of scientific imagination: many of his examples suggest that matter is mainly a manner of speaking, a set of widespread metaphors and turns of phrase. Smith, in his monograph on Bachelard, wrote about "seduction of words and the images they evoke" (36), and the variety and intensity of those images, as they formed the world in which

whole nations lived, was recorded in Bachelard's best known works. He wrote about visual and substantialist images used in everyday speech: cognitive obstacles emerge when visual images of objects dominate human understanding of empiricist observation, for instance when matter is conceived as porous sponge, as bunch ravenous animals, or (perhaps most commonly) as a clod of microscopic marbles that stick together. This is how atoms often work in everyday language: various material phenomena (colours, opaqueness or transparency, firmness or softness, temperature, specific heat etc.) are explained as underlying qualities of atoms, which have the function of internal "caskets" in which qualities are stored and hidden; matter's qualities can be hidden in the "caskets" because the caskets are invisible by virtue of their small size. Bachelard describes this semi-logical reasoning as substantive obstacle: "explaining a phenomenon by reference to a supposed underlying substance" (2002 [1938], 107). More generally, the substantialist obstacle of is an "obstacle of immediacy," an outcome of what Bachelard calls the "Harpagon complex" (2002 [1938], 54), a forced preservation of imaginary substance at the cost of ignoring empirical evidence: in semi-scientific versions of matter, what is at stake is the preservation of its materiality, that is creating an image of atoms endowed with qualities of matter known from everyday experience (as rigid, hard, "material" marbles). This habit of thought is perhaps the most widespread and persistent one of all Bachelard's epistemological obstacles, constituting much of the life of the scientific mind in everyday language and in many popular-science texts or in fiction.

It would seem that the semi-scientific interest in materiality, observable in the literary texts analyzed here, would be best visible in science fiction, and indeed most texts under discussion belong to this genre, and were written in a period that is seen as a crucial early stage of its development (Moskowitz 1968; Stableford 2003). However, there is no intrinsic reason to exclude other genres from the analysis; it would seem that any material setting will do. Perhaps all of realist fiction was, to some extent, affected by changing and confused views of materiality at the beginning of the 1910s. Thus, some of the examples do not belong to science fiction, but other popular genres (detective fiction, melodrama, Western fiction).

Other than Bachelard, the present study is theoretically related to more recent discussions of materialism in cultural criticism, as exemplified by the essays collected in Anna Malinowska and Karolina Lebek's *Materiality and Popular Culture: The Popular Life of Things* (2017). In a representative essay from Malinowska's collection, "The Secret Life of Things: Speculative Realism and the Autonomous Subject" (Czemiel 2017), Grzegorz Czemiel discusses the "de-anthropocentric tendency" of cultural materialism, which leads to "overturning the absolute monarchy of humankind in culture" (42). The reference to speculative realism springs from the idea that matter can be endowed with something that amounts to agency and rights, that matter takes part in a debate: matter strikes back, surprises people, undermines human assumptions. A similar conclusion is reached in John Storey's

article from the same collection, on the relationship between the popular and material culture: in spite of the attempted total commodification of matter, it invariably regains its independence from commercialized popular culture, when it turns into garbage or raw material for bricolage, and becomes a wilderness or a common, a freely available, unregulated resource (20–23).

Earlier, these ideas have been comprehensively proposed, as a philosophical project, by Jane Bennett in *Vibrant Matter: A Political Ecology of Things* (2009). Referring to Henry David Thoreau, and his treatment of the American mythology of the wilderness, Bennett observes on the multiple aspects of the "thing-power":

> The idea of thing-power bears a family resemblance to Spinoza's conatus, as well as to what Henry David Thoreau called the Wild or that uncanny presence that met him in the Concord woods and atop Mount Ktaadn and also resided in/as that monster called the railroad and that alien called his Genius. Wildness was a not-quite-human force that addled and altered human and other bodies. It named an irreducibly strange dimension of matter, an out-side. (2–3)

While the wild thing-power influences people, there is also an opposite process at play: the taming of the Wild is comparable to scientific endeavour, understood as a struggle between human agency and non-human agency: the "not-quite-human force" is forcing human thought to change, redefine, but then, human thought is also trying to redefine and demarcate matter, civilize it, utilize it, and appropriate it on the fundamental, microscopic level, by claiming and owning (rights to) newly defined (discovered) elements, particles, reactions. In particular, human agents try to neutralize matter by reducing its "vitality" to a "dead and thoroughly instrumentalized" status (Bennett, ix) of a natural resource. This, conversely, strikes back at human self-definition, causing anxieties about the non-existence of the soul, non-agency of human beings, and reduction of humanity to the status of "human resource" (with the word "human" added by employers by way of a superficial, but legally non-binding courtesy). There is also a religious angle about it, as many Christian denominations attach negative meanings to the word materialism. Thus, to save human agency, even as it tries to seize control over matter by defining and understanding it, some sort of material agency and independence must be recognized, which Bennett describes as vitality. This mutual definition, a dialectic struggle that seems quite unpredictable and very interesting, is often thematized, implicitly, in the texts discussed here.

Returning to Bachelard, who never makes this claim explicitly, a challenge to cognitive obstacles can be seen as a sort of action by matter performed on people, i.e. on human ideas; matter is forcing people to change their views. In literary fiction, this is a very interesting possibility, because it corresponds to the process of character development, and to various structural and thematic elements commonly met in literature, such as tragic recognition, passage from innocence to experience,

or, in the American context, the frontier experience. The interaction between matter and cognitive obstacle is analogous, or at least similar, to the interaction between the character and the setting and the background, in that the setting and the background can be represented as factors (agents) that force the character to change, evolve, reorient, humble down or shape up.

In American fiction, the interaction between the character and the setting was often thematically linked to the historical experience of the American frontier. In particular, the frontier adventure was important for author of the American romance in the first half of the 19th century, exemplified by James Fenimore Cooper, Robert Montgomery Bird, and William Gilmore Simms. Closer to the texts discussed here, there is of course the early phase of Western fiction, exemplified by Owen Wister and Zane Grey. By extension, Western settings in well-known mainstream fiction by Bret Harte, Ambrose Bierce, and Jack London, also features the natural frontier setting as an important factor in character development. Below, in the discussions of literary texts about materiality, some notable similarities will be noted, particularly in American texts, between adventures in the Western frontier and adventures on the frontiers of science. Arguably, this similarity is related to Richard Slotkin's claim that the frontier experience was "the structuring metaphor of the American experience" (1974, 5). Slotkin, in *Regeneration through Violence* (1974), describes the metaphor as an extended one, a skeleton plot used and reused by many authors, which includes images of solitude, solitary communion with wild nature, violent struggle against adversaries, and eventual experience of physical regeneration and spiritual rebirth. At the end of the 19th century, this structuring metaphor was recognized as the source of American national identity, and was often combined with references to racial and social Darwinism. This is the traditionally accepted critical view which goes back to Frederick Jackson Turner's seminal formulation of the frontier thesis in 1897, and has been developed in American studies, beginning with seminal work by Henry Nash Smith (1950, 240), subsequently developed by Burton (1962; 1965), Cronon (1987), or the recent essays in Jada Ach and Gary Reger's collection (2020), and by Stephen J. Mexal's *The Conservative Aesthetic: Theodore Roosevelt, Popular Darwinism, and the American Literary West* (2020). When this structuring metaphor is applied to a scientific theme or image in fiction, it appears to operate in a manner similar to Bachelard's cognitive obstacles, and the similarity will be discussed with reference to specific texts.

## 3. Cultural Reaction to the Discovery of Radioactivity: Existing Research in History of Ideas and Literary History

The cultural context of the cultural formation of matter was discussed in Spencer R. Weart's studies on nuclear fear (2012, 22–32; 1988, 3–54), and most specifically by Andrea Candella in "The Radium Terrors: Science Fiction and Radioactivity

before the Bomb" (2015). Candella lists a number of thematically related popular science texts and fiction from the first three decades of the 20th century, most importantly H.G. Wells's *The World Set Free* (1914) and a number of popular-science publications by the physician Frederick Soddy, an Italian novel by Emilio Salgari (1907), *Le meraviglia del Duemilla* [The Wonders of the Year 2000], and Albert Dorrington's *The Radium Terrors*. The texts discussed by Candella include speculations about political and historical change brought on by radium as weapon and inexhaustible source of energy. Candella provides an extensive discussion of Dorrington's novel, commenting on the variety of imagery used to describe radium, "inspired by religion, mysticism, and spiritualism" (2015, 336), and on international popularity of the novel (337). Candella also discusses texts from the 1920s and 1930s, such as an Austrian 1936 novel by Rudolf Brunngraber,[1] and better known novels by Karel Čapek, *The Absolute at Large* (1922), and *Krakatit* (1922), as well as Soviet pop novels by Alexey Nokolayevich Tolstoy, published in the 1920s. The common denominator of these works, as Candella observes, was the general interest and anxiety caused by the fact that "[r]adioactivity appeared to exist in opposition to every known natural phenomenon and even to the basic laws of physics" (342). Importantly, Candella observes that the texts (often the same texts in translation) were published in various countries almost simultaneously, which amounted to a sort of international craze, spanning across political borders and cultural differences. The present inquiry, in comparison with Candella's astute article, will cover a similar number of texts and perhaps a greater thematic variety of responses, but the selection will be limited to texts published in the United States in the 1900s, and focusing on new speculations about matter, and on what was, arguably, an emerging new kind of realistic imagery.

The democratization and commercialization of the atomic theory of matter in popular science was discussed by Matthew Lavine in *The First Atomic Age* (2013), about American cultural responses to radium and X-rays in the first half of the 20th century. In particular, Lavine comments on the intriguing speculations that new rays were opening the doors to spiritualist mysteries, enabling telepathy or communications with the dead (130–135), seeing this as part of "vulgarization of radiation" (140) and the general commodification and democratization of imagery related to the new rays:

> By the end of the 1920s, the wholesale commodification of x-rays and radium had made them ubiquitous. Nonscientist Americans could and did interact with them physically, intellectually, and rhetorically. Some were indifferent, and many had retained through those first few decades the vague dread or acute fear that had been part of the spectrum of reactions from the start. (144)

Thus, it seems that the new rays were perhaps among the more sensational and attractive themes in popular science, possibly because of the newness and tentative

quality of quality. The new rays, because they were new and unpredictable, became frequently used symbols of free play of imagination, and served, symbolically, as fertile new grounds for easy speculation, unmitigated by the prosaic and the unremarkable. This quality was recognized by contemporary commentators already, as observed by Lavine: "Benjamin Gruenberg, a textbook author and social commentator, argued in 1935 that such speculation in science popularizations was a 'rich source of aesthetic satisfaction' precisely because 'the pursuit of the not-yet-known […] also meets a human need quite as truly as do other forms of play' in ways that already realized technologies might not" (122). Consequently, reactions to new rays had a wider cultural meaning as controversy over playful use of imagination: some negative reactions "might also be due to a wounded sense of Victorian propriety, a reaction against a new physics that seemed daily more metaphysical, or a manifestation of the broader antimodern sentiment that had not only Soddy in its sights but also Joyce, Stravinsky, and Picasso" (145). Lavine also observes that the general interest in radioactivity and new elements was a brief phenomenon, which waned in the 1920s, only to be renewed in 1945, with the advent of nuclear weapons and power plants (123).

Apart from the general interest in new rays, there was a limited but growing awareness of the change in the atomic theory of matter. At the time of popularity of stories about radium and new rays, scientific descriptions of atom were transitioning from the "plum pudding model" by J.J. Thomson to the "planetary" model developed by Ernest Rutherford (and other physicists) in the first two decades of the 20th century. The "ten original papers" which presented new models of the atom were compiled by Lakhtakia, and three of them (by Thomson, Rutherford, and Niels Bohr) are particularly important as the distant background for the literary texts discussed here (1996, 233–308). The importance of Thompson's and Rutherford's models was that they presented the atom as a composite object and a site of violent movements and forces in a state of dynamic equilibrium; they theoretically divided the atom into parts to account for various physical observations, whose dramatic nature attracted popular attention. The spectacular effects included the emission of electrons from a metallic surface in a Crookes tube, the X-ray images of skeletons and internal organs, radioactivity and damage it caused to the human body, the discovery of previously unknown, radioactive elements, the tremendous amounts of energy produced by radioactivity (Lavine 12–47). In the first decade of the 20th century, there was a number of popular discussions of the rapid change in the atomic theory of matter; those discussions were related to the general interest in radioactivity at the same time. Among the general and accessible contemporary presentations of new developments there were Marion Erwin's *The Universe and the Atom* (1915), F.B. Venable's *The Study of the Atom* (1904), Ernest D. Wilson's *The Structure of the Atom* (1916), and above all the English translation of Jean Baptiste Perrin's *Les Atomes* (1916). Those were general presentations of the new image of matter created by Thomson, Rutherford, Moseley and Bohr. They all

presented a comprehensible picture of how the new atom models were influencing other sciences, chemistry in particular, and how they were changing the entire texture of scientific materialism. Although they were addressed to the general reader with some knowledge of physics, their impact seems to have been limited, with the exception of Perrin's book (the French chemist was presenting the research on Brownian movements, for which he would be awarded Nobel prize in 1926). Nevertheless, the literary texts discussed below were often based on the idea that the new nuclear physics was not only a study of new rays, but that it created a new concept of matter, a new imaginary texture of the world. As it will be demonstrated below, most texts presented this new texture as an unstable, unpredictable and dangerous one.

Nearly seventy novels and short stories about radium and radioactivity are listed in Everett F. Bleiler's monumental bibliography of early science fiction published before 1926. Many of the texts, because of their poor, amateurish quality as literature, are examples of the democratization and vulgarization mentioned by Lavine, as popular responses to new science, and as documents of a craze. The bibliography lists fewer texts on radioactivity than on radium, suggesting that the newly discovered phenomena of radioactivity, confusing for scientists as they opened new roads in atomic theory, were perhaps even more confusing for the general public, as they blurred the cultural boundaries between chemistry and physics, between matter and radiation, between the material and the immaterial. Radium, on the other hand, seems to have been more manageable as a theme and source of literary imagery. Thus, when Bleiler (910) breaks down radium-fiction into thematic subgroups, he lists fictions on radium "as healing substance," as "source of antigravity," and more: radium "erases personality," "in bloodstream produces X-ray vision," and in very numerous works it prevents aging. Notably, several short stories feature radium as currency. Radium was probably the last wonderful element that was perceived in terms of non-nuclear chemistry, as a sort of new gold, in the sense that popular culture could refer to radium without having to absorb the language of nuclear reactions. This seems to be important because nuclear physics would later bring on images of transformation of one element into another, something that had been previously described in terms of alchemical magic, a subversive procedure that could undermine the relative values of elements, make rare ones readily available, make the mysterious ones less mysterious, and the common ones less obvious. More notably, nuclear physics would blur the distinction between matter and radiation, matter and energy, demonstrating that rays can be described as pieces of matter, and (perhaps more disconcertingly) matter as waves, or as somehow frozen energy. Nuclear synthesis was obviously a hard bit of a paradigm shift, not only in physics, but in popular ideas about matter as well. The popular image of radium, however, was initially still anchored in chemistry, and its special qualities were only harbingers of the paradigm shift brought on by nuclear physics in the first half of the 20$^{th}$ century.

The texts discussed in the present inquiry suggest that the formation of matter in popular science, early in the 20th century, was an international phenomenon, occurring in parallel between Britain and the United States. This was partially because popular culture market was organized in this way; there was a lot of cooperation and opportunity for reprints or simultaneous publication on both sides of the Atlantic. Another important aspect was the international quality of science (and popular science) related to radium, x-rays, and the new models of the atom; Lavine mentions the popularity of American lecture tours by French, German, and British scientists, who were enjoying the status of minor celebrities among non-scientific audiences. Consequently the texts described here are both British and American, and were often published in both countries.

The popular response discussed here is paralleled (but not anticipated) in highbrow literature by "The Dynamo and the Virgin," the well-known 25th chapter from *Education of Henry Adams* (1918). In the chapter, Adams describes his meeting with Samuel Pierpont Langley at the World Exhibition in Paris in 1900. As they are both watching steam engines and dynamos, Adams is disturbed by the difference between combustion engines, which he can understand, and various electric machines, which he cannot. Langley, however, announces the advent of a more disturbing problems:

> Then he [Langley-PS] showed his scholar the great hall of dynamos, and explained how little he knew about electricity or force of any kind, even of his own special sun, which spouted heat in inconceivable volume, but which, as far as he knew, might spout less or more, at any time, for all the certainty he felt in it. To him, the dynamo itself was but an ingenious channel for conveying somewhere the heat latent in a few tons of poor coal hidden in a dirty engine-house carefully kept out of sight; but to Adams the dynamo became a symbol of infinity. […] No more relation could he discover between the steam and the electric current than between the Cross and the cathedral. The forces were interchangeable if not reversible, but he could see only an absolute fiat in electricity as in faith. Langley could not help him. Indeed, Langley seemed to be worried by the same trouble, for he constantly repeated that the new forces were anarchical, and especially that he was not responsible for the new rays, that were little short of parricidal in their wicked spirit towards science. His own rays, with which he had doubled the solar spectrum, were altogether harmless and beneficent; but Radium denied its God – or, what was to Langley the same thing, denied the truths of his Science. The force was wholly new. (380–381)

As it is known from history of science, and from commentators on Adams's text, Langley is referring to radioactivity and the enormous amount of energy emitted by the sun, two phenomena that had no explanations before the imminent advent of nuclear physics. Langley's "own" rays were electromagnetic ones, as he had done research in infrared rays, and won scientific and non-scientific fame as the

inventor of the bolometer, an extremely sensitive detector of thermal energy carried by electromagnetic waves. Langley's experiments, in which he could mysteriously detect the heat of a cow in a distant field, measure the temperature of the moon, or find an absorption line in an unknown and invisible part of electromagnetic spectrum, probably contributed to the popular imagination of wonderful invisible rays discussed below. Unlike popular imagination, contemporary scientific record solemnly assures that there was nothing very disturbing about those experiments to a physicist of the time (Walcott 1912, 249–251). In Adams's text, too, the new fields of physics are still assumed to be unbroken in 1900, still relatively isolated and localized in chemistry, as a problem of radium and the surprising amount of energy it emits. Langley, however, understands the subversive quality of radium (and radioactivity in general) and talks about anarchy, parricide, denial of God, and denial of science. This anxiety was also present in popular fiction of the time, in stories about radium and mysterious rays, often relating them to spiritual phenomena, electricity, and in one case to the energy of the sun.

## 4. Psychoanalysis of Realism in Selected Works of Fiction about Radium

Among the popular novels and stories listed by Bleiler, most feature radium as a secondary device, or a functional prop that can be replaced by an equivalent one (a means of transportation, or a coveted treasure). Those are often imitative repetitions of well-known formulas, such as lost-race novels styled on the originals by H. Rider Haggard and Edward Bulwer-Lytton, or invasion novels (popular speculations about future war), or various imitations of H.G. Wells's work. The texts seem to be evenly distributed between British and American publishing markets, either as book or magazine publications. As suggested by Canella's discovery of Italian translations, some of the texts could have been republished in translations in European magazines, so it would seem that radioactivity was an international theme, perhaps reflecting the internationalization of stock themes in popular fiction. Thus, radium is often a weapon, a treasure, a means of transportation, or a source of power, which testifies for the popularity of radium as a cultural phenomenon late in the 19th century, and which can be interpreted in terms of the psychological mechanisms discussed by Bachelard.

For example, as already mentioned with reference to Bachelard, the substantialist and animalist obstacles makes it possible to infuse matter with hidden content, such as desire for agency in vivid images of explosions (2002 [1938], 44–47), or desire for possession and control in images of treasures hidden in matter (2002 [1938], 136), which Bachelard describes as valorisation of matter: "any trace of valorisation is a bad sign in knowledge that is aiming at objectivity. A value here is a mark of an unconscious preference" (2002 [1938], 72–73). Frontier settings are usually valorised in terms of civilization and wilderness, light and darkness,

rationality and madness, or peacefulness and violence. Some of the most striking examples of valorisation in frontier setting are the negative ones, such as Robert Montgomery Bird's *Nick of the Woods* (1836), William Gilmore Simms's *The Yemassee* (1835), and later, the Gothic Western stories, such as Ambrose Bierce's "The Stranger" (1893) and "The Damned Thing" (1893). In these texts, the valorisation is negative, construing the frontier as the site of madness and death (Winston 1984; Bryant 1966). Bird's and Simms's romances were polemical imitations of Cooper's successful frontier romances, such as *The Last of the Mohicans* (1826), whose protagonist (Natty Bumppo) would occasionally utter triumphant comments about the regenerative and purifying power of his solitary, nomadic life in the frontier wilderness. Bird and Simms both changed the valorisation, but preserved the plot structure: protagonists immerse themselves in the wilderness, go through a series of bloody episodes, and re-emerge as changed people in the civilized world.

This pattern of valorisation would be recycled in later Western fiction as a formulaic plot (Cawelti 194–215), in Owen Wister's or Zane Grey's fiction, with the same valorisation and symbolic treatment of the setting. As Cawelti observes, a Western author "each in his own way develops and elaborates the same quasi-allegorical landscape of town, desert, and mountains and the same social and historical background" (233–234) which all contribute to the image of "the West as challenge and regeneration" (237). For Wister, in *The Virginian* (1902), the frontier was a forging ground of a new American aristocracy, whereas for Grey, whose novels fall just off the chronological range of the present study, the frontier was often the scene of a melodramatic plot, a personal fulfilment through release of romantic passion, understood to be a natural force whose intensity would not be possible in the civilized territory (Cawelti, 236, 238). In any case, as in the earlier frontier romances, a civilized outsider visits the frontier and after an initial shock, is transformed by the regenerative force of its rough, wild nature.

The structure of the American wilderness setting in earlier frontier romance was analysed, among others, by Daniel Peck, who concluded that Cooper's adventure episodes were interlaced with numerous references to the ideal of pastoral harmony (1977). Donald A. Ringe wrote a general, synthetic treatment of the setting in "the pictorial mode" in works by James Cullen Bryant, Washington Irving, and Cooper (1971). Edgar Allan Poe, too, could be included in this list, with occasional landscape pieces such as "Landor's Cottage" (1849), "The Domain of Arnheim" (1846), "Morning on the Wissahiccon" (1844), and the unfinished Western novel, *The Journal of Julius Rodman* (1840); these works were discussed by Gerhard Hoffman's article on Poe's symbolic space (1979). More general, ideological background for the combination of beautiful landscapes with violent episodes was described by representatives of the myth-and-symbol school of American studies, especially by Henry Nash Smith (1950), Leo Marx (1968), and Richard Slotkin (1973). Recently, the ideological combination of landscape art with Western expansion was discussed, among many other critics, by Fresonke

(2003) and Mexal (2021). The texts discussed below suggest that the pervasive and ubiquitous Western mythology served as source of imagery for the construction of cognitive obstacles in fiction about radium, or more generally in fiction influenced by the new scientific ideas about matter.

With an added reference to a radium treasure, the valorisation of the frontier can become closely related to valorisation of matter, as in John Brisben Walker's "A Modern 'Swiss Family Robinson'" (1905), the polemical imitation of Wyss's novel, whose theme is the distribution of wealth in a social utopia set up by a representative group of castaways. Walker, the distinguished early editor of *The Cosmopolitan*, was advocating a more efficient system of economic distribution, a sort of committee-based technocracy, in the long novella that combined scientific speculation about matter with the theme of frontier settlement and adventure. Radium is one of the treasures found on the desert island, but the treasure is guarded by local "savages" led by a Japanese engineer, and presented in a peculiar, subterranean setting. The radium ores are found in "an extraordinary cave" (450), into which a protagonist has to creep through narrow passages which "lead indefinitely beyond" (451) and, in the deepest chamber of the cave, finds an abode and laboratory run by a solitary Japanese scientist who accumulated a scientific treasure of "considerable piles of ores" (452), which include radium, a mineral "more valuable than gold – that has marvellous properties – that will revolutionize the mechanical world in many ways" (451). The cave is illuminated by radium, whose "mysterious" light is subject to much amazement and long description. The Japanese scientist intends to keep his discovery "a secret that I do not intend any living man, except these natives, shall possess" (451). Bachelard's idea of "Harpagon's complex," whereby matter is treated as a cache full of hidden value, is visualized in the image of a cave, filled with the glowing deposit of radium, and controlled by the Japanese enemy, who, however, quickly surrenders. The discovery and surrender mark the turning points in Walker's story, because the castaway community begins to thrive on the radium. "From day to day new riches were discovered, until it became a standing joke that if you did not see just what you wished, you had only to look carefully to discover it" (560).

This sudden wealth leads to revival of frontier way of life, which was apparently still in living memory of the collective hero: "There was also revived the ancient custom of Americans who first went into the backwoods; that is, the log-raising bee" (560). The discovery of radium ore, and the chemical isolation of the pure metal, is thus incorporated into the general prospector activity, settlement, and struggle against the natives, who could not understand and exploit the hidden wealth of their land. What makes the imagery remarkable, more than a mere example of the hidden-treasure story, is the underground laboratory where radium is not simply extracted, but purified and researched. Psychoanalytically, in Bachelard's terms, this is an example of what he calls the realist imagery of matter:

> [R]ealism can rightly be called - and this is not in our view a recommendation – the only innate philosophy there is. To see this properly, we need to go beyond the intellectual level and understand that the substance of an object is generally accepted as being a personal possession. People take mental possession of it in the same way that they take possession of some obvious advantage. Hear how realists argue: they have an immediate advantage over adversaries because, they believe, they have a hold on reality and possess the riches of reality while their adversaries, the mind's prodigal sons, chase empty dreams. In its naive, affective form, the certainty realists feel has its origin in a miser's joy. (2002 [1938], 136)

As Bachelard observed, commenting on the animist cognitive obstacle (FSM 44–50), the object of realist desire is not limited to material treasures, but can take more powerful and elaborate forms, such as explosions, immortality, or mind control; Bachelard interprets this as an unconscious desire for direct control, by sheer willing, over matter and people.

For example, an elaborate system of fantasies about powers and treasures hidden in matter can be found in Clifford Smyth's *The Gilded Man: A Romance of the Andes* (1918), a lost-race novel by a distinguished magazine editor. The novel is mostly set in an underground pre-Columbian empire, with radium performing similar functions as Bulwer-Lytton's "vril": an enormous lump of radium provides heat and light, as a sort of underground sun, and radium-related research has led to wonderful discoveries and inventions, clairvoyance, remote control of mind and matter, and healing. At the end of a convoluted plot, the decision is made to unveil those discoveries to the outside world, and the queen of the underground empire decides to leap into the burning lump of radium in an act of self-sacrifice that is barely explainable, other than as an imitation of the ending of Haggard's *She*. In Bachelard's terms, the wonderful usefulness of radium, its placement in a hidden underground empire, and its ultimate destructive power in the conclusion of the novel, are all examples of introjection of subconscious content into matter:

> Our present task is not however to study the psychology of the self but rather to follow thought as it wanders in search of an object: we need to follow reverie as it attributes inwardness to objects. Although the aims are different, the processes are homologous because psychologists of inwardness and naive realists are beguiled by the same seductive charm. This homology is so clear that characteristics could be exchanged: realism refers essentially to inwardness just as the psychology of inwardness refers to reality. (2002 [1938], 105)

In adventure narratives, this kind of thinking corresponds to the imagery of hidden treasures and palaces in isolated, distant settings, as in lost-race narratives, hidden either underground or in secluded valleys. Traveling to those locations is often the central premise of a work of fiction, and the characters who reach the hidden place

are usually rewarded with a supreme boon. Of course, such imagery is related to mythic quest narratives, but in the Western frontier context the imagery assumes the role of a geographical curiosity, a place to be discovered, a place where the treasure of the West is stored. This was often a secondary theme in frontier romance fiction, visible for example in the settings of James Fenimore Cooper's *The Pioneers* (1821) and *The Prairie* (1827), where characters speculate about treasures hidden in caves and mounds (Clark 1986; Walker 1984). The substantialist treasure can be small enough to be hidden without the need for an unusual geographical setting, whereas the animist treasure is attainable through a quest, by moving about. The effects of the operation of both obstacles, however, can be combined in the same text.

In Smyth's novel, the initial chapters involve scientific research into ghosts, which are assumed to be something like stray thoughts, and which can be "captured and measured by electric apparatus" (30–31). This is where the inwardness of realism, as discussed by Bachelard, leads to a curious combination of psychoanalysis and ghost story with a quest adventure in exotic settings, and finally to fantasies about hidden properties of matter. As one of the protagonists claims, both physical factors, such as food, and mental factors, such as thoughts and ghosts, cause electric "mental ripples" (32) which can be detected by the apparatus. During the examination, the subjects (David and Una, who will be the protagonist in the following chapters) play the game of free associations, when suddenly a ghost makes a "mental ripple" in David's mind, and sends in a number of clues about an Eldorado in the Andes. David and Una decide to go, and after many chapters of adventure it turns out that the clues were broadcast, like mental waves, into David's mind by means of radium hidden in a radiant cave, where a lost-race society occasionally invites adventurers from the outside to visit.

This comparison between thoughts, food, radium, secret caves, all united as "mental ripples," suggests some of the concepts proposed by Bennett, notably the "geoaffect of material vitality" (61) invoked by Bennett, when she discusses assemblages of human agency, human body, food, and external physical objects: the philosopher compares "[h]uman intentionality" and food "as a self-altering, dissipative materiality" which is "also a player" as "[i]t is one of the many agencies operative in the moods, cognitive dispositions, and moral sensibilities" (51). Of course, in Smyth's novel the operation of the material agency is fantasized by means of the strange apparatus and the dialogue about ghosts, but it is, nevertheless, explicitly a material operation, not a supernatural one.

Inspired by the experiment, David and Una go to South America to follow the clues and find the Eldorado. Thus, David and Una's enquiry into mind-matter interface is transformed (or extended, as continuation) into a dangerous and daring expedition into the Andes. The protagonists (there are more of them than David and Una) find out that the way to Eldorado leads into a deep, uncharted system of caves and corridors. At this moment, the novel becomes symptomatic of Bachelard's idea

that non-scientific, "realist" understanding of matter is based on images of concealed, solid, valuable objects, as with treasures in cellars and caves. The first object "of untold value" found in the cave is the "Black Magnet" (192) which attracts only gold. But more than money value, the protagonists discover the valuable "brilliance" and "atmospheric vitality" (239) in the cave, the force of rejuvenating and invigorating rays projecting from the ceiling of an enormous cavern, the abode of a lost race.

As in Walker's novella, valorisation of matter is visualized by means of a mysteriously illuminated cave: the source of light is described as "ceaseless energy similar to that of a gigantic dynamo whose emanations are produced by a concentration of power as yet unattempted by man" (281). Soon, it turns out that the underground sun is made of radium, and some members of the expedition immediately estimate its price, as the most expensive thing on Earth (329). But its value is even greater: the radium-sun is the "life giver" not just for the cave, but for the entire Earth (332), and also the source of supreme knowledge. "It is really the eye of the cave – and sometimes the arm. […] It can carry an electric force, an irresistible current, without using wire" (333), and thus it can control organic life and human thoughts in the cave, and all around the world as well. Again, Bachelard's psychoanalysis of materialism becomes useful here, because the fantastic properties of radium are, in his terms, extensions and magnifications of human willing: Smith's novel is a fantasy of wish fulfilment, visualized as something possible through discovery of a mysterious property of matter. For Bachelard, an important image of this kind was an explosion, whereas in Smith's novel the imagery is more complicated, as the radium-sun can create new, fantastic forms of life (flowers, edible plants), can move objects about and propel fantastic machines (described as marvels of crystalline beauty), can read human minds and control human behaviour. In the conclusion, there is also a big explosion, as the radium-sun is used by Sajipona, the queen of the underground nation, to destroy herself, the cave and the lost race in it.

Other examples include narratives about the influence of radium on health, aging, and mortality, on sources of mechanical power, and as weapon. For instance, in Richard Dehan's[2] scurrilous short story, "Lady Clanbevan's Baby" (1915), the protagonist has her son rejuvenated with radium, so he remains forever a baby. Her purpose is to keep the fortune that the son would control after coming of age. In the closing lines it turns out that the baby has a moustache. Similarly, radium is a convenient device in "The Current Locker" (1910) by William Harold Durham, a story of a wronged inventor, who uses a mysterious radium box to stop electricity and thus force US government into redressing his wrongs. In George Glendon's *The Emperor of the Air* (1910), a master-of-the-world novel, radium only provides heating and power for the emperor's base on the North Pole, but in similar stories and novels it was sometimes used as a device that gave an individual, or a small group, the upper hand in a struggle to establish a better world-order. As those works

were imitations of Jules Verne's novels about Nemo and Robur, improved airplanes or submarines were the usual device. This is related to a crossover device, that is airships improved with radium, e.g. in J.U. Giesy's *All for His Country* (1915), where an inventor helps win a future war against Mexico and Japan.

Returning to the theme of rejuvenation and health, in Edgar Mayhew Bacon's "Itself" (a competent commercial work published in *Black Cat* magazine in 1907) is a simple invention story about a devotional painting that heals persons with various ailments; the rational explanation is provided, that the painting was impregnated with radium. Thus, the story is another example of understanding radium in terms of divine power: where Langley saw radium as something that defies God, Bacon's story presents it as a rational, material equivalent of the will of God; in both cases, radioactivity is seen as a divine power, as opposed to the qualities of ordinary elements, which are presumably more natural. From the chemical point of view, this is an important quality of radium as a cultural phenomenon: with radium it was possible to attribute divine qualities and powers to the materiality of the setting; radium was a visible material *fiat*, or a sort of chemical pathetic fallacy. In more interesting texts, the divine agency of radium is represented in terms of mystery and enchanting quality of matter as such, a sort of exhilaration caused by the bare existence of nature, known from the opening of Emerson's *Nature*. as The animist introjection of human desire for freedom and rapid movement is evident in Frederick L. Keates's "The Man in the Air" (1906), a sort of compressed backyard version of Wells's *First Men in the Moon* (1901): an inventor defies gravity with radium, decides to try flying in this way, and the story revels in physical descriptions of flying shoes and belts: "Now observe; as I gradually turn the rods the covers slip over the platinum, and the less platinum there is exposed, the lower I sink, and *helas!* I am standing upon the floor. […] This is perfection!" (461–462). In the end, the inventor is launched out into the sky and lost when the element proves uncontrollable. The narrator and other characters watch him, a tiny speck in the vast skies, until he disappears. Radium, an extremely rare metal, was used as an imaginary currency too, but infrequently, perhaps most notably in W.W. Cook's series of *Tales of Twenty Hundred* published in *Argosy* in 1906 and 1907; those are, however, thriller tales set in future world, with numerous themes and subplots, international intrigue, crime, and air war. Finally, a sole example of biological emanation of the force of radium (through mutations) can be found in "The Ultimate Inheritors" (1914), a competently written story about fight against gigantic man-eating spiders.

The most interesting texts focus on spiritual or psychic effects of radium, that is on the psycho-physiological problem; in several texts radium or radioactivity is represented as the material substance of spirit. Consequently, representation oscillates between the exhilarating description of spiritualized matter, and a soothing description of materialized spirit. In Vincent Harper's *The Mortgage of the Brain* (1914), personalities and memories are made of a "fleeting element" that can be erased and manipulated by radium, which characters find very exciting. This text is

perhaps related to Edward Bellamy's *Dr. Heidenhoff's Process* (1880), an excellent earlier novel about materiality of the mind, where mechanical removal of memories (by electric apparatus) is described as a failed remedy for social and personal problems. Bellamy's novel, where the fantastic device turns out to be a dream, is a psychological and philosophical one, and its treatment of materiality of memory seems to fall under the category of philosophical speculation: suffering is described as diseased brain tissue, which Dr. Heidenhoff destroys with electricity. Similarly, in Gelett Burgess's "The Ghost Extinguisher" (1905), the spiritual realm is fully identified with chemistry: ghosts can be made semi-material, can be extinguished by gentlemen ghostbusters, stored in bottles and resold, or restored back into the immaterial dimension, all with the help of radium:

> It was not until radium was discovered that I approached the solution of my great problem, and even then months of indefatigable labor were necessary before the process was perfected. It has now been well demonstrated that the emanations of radiant energy sent forth by this surprising element defy our former scientific conceptions of the constitution of matter. It was for me to prove that the vibratory activity of radium, whose amplitudes and intensity are undoubtedly four-dimensional effects a sort of allotropic modification in the particles of that imponderable other which seems to lie half-way between matter and pure spirit. This is as far as I need to go in my explanation, for a full discussion involves the use of quaternions and the method of least squares. It will be sufficient for the layman to know that my preserved fantoms, rendered radio-active, would, upon contact with the air, resume their spectral shape. (694)

Burgess's witty story points out precisely to the qualities of radium that made it interesting as a cultural phenomenon; literary (and scientific) texts formulated the idea that rays could be represented as a spiritual fact, and radium as a sort of gateway into scientific examination of a spiritual-material medium, the substance of the universe, the single coin of which matter and spirit were but two faces.

Albert Dorrington's[3] *Radium Terrors* (1912) adds a political dimension to the disquieting qualities of radium. The novel was initially serialized in Frank A. Munsey's magazines in 1910 and 1911. The novel is a piece of medicalized yellow-peril fiction, but Dorrington includes long descriptions of visual suffering induced by radium, placing chemistry at the psycho-physiological borderline, as if the Japanese criminals could operate in human heads, manipulating people's perceptions. It is in this novel that Langley's comment on denial of God by radium is paralleled by the opening line: "I've been hunting for a little god that escaped from some pitchblende, Tony," to which the answer is: "I should say that your god will hate you like poison when you have found him" (3). The god somehow refers to radium, so that chemically, Dorrington's radium combines god and poison; it still denies God as substance, not as a paradigm-shifting new vision of matter. This, however, is just the beginning: the detective Renwick, who utters the opening line,

is lured into the house of the Japanese doctor Tsarka, leader of "a gang of medical fiends" who stole radium from the neighbouring house, where an English scientist experimented with radium to discover a cancer cure. It is a trap; the Japanese fiends overpower the detective and smear radium solution over his eyes, so that he begins to see terrible flashes of violent colour. There follows a long monologue by the Japanese doctor, who can cure the detective, and other victims, but only at a price.

One of the most unusual passages in Dorrington's novel is the description of a Japanese-trained rat in the drains and sewers filled with chemical washings from the British doctor's laboratory; this is how the radium was stolen (45–49), and as it goes underground (or down the drain), it clearly is described as a sort of hidden force of subversion, before it gets into a victim's head: "Renwick was conscious of a numbing pressure of the eyes as though a silver-rimmed ophtalmoscope were searching the cells of his brain. His nerves flinched under the strain. A needle of light seemed to probe and illumine the depths of his retina" (75). More victims are affected by radium, as the gang organizes a series of viewings of Japanese art, where viewers use stereoscopes permeated by traces of radium solution, and thus receive "a baptism of radium molecules" (338). After a series of chases, the fraudulent Japanese doctor and his henchman are arrested, the detective regains his sight, and the radium is restored to its rightful owner. Like many yellow-peril novels, *The Radium Terrors* features a device that gives Asians a temporary advantage (a superexplosive, a sabotage plan, or death ray), but Dorrington's use of radium capitalizes on the fact that the radioactive element could be detected in very small quantities, traces, even when absorbed into a chemical compound with other elements; this quality is presented as an alarming one, because radium never goes, never fully dissolves, and remains dangerous, as a Japanese weapon, in smallest quantities, as a trace on a container, or as a thin solution in sewers, in human bodies, on eyerests of stereoscopes, in paintings, in the air.

Bachelard, in *Psychoanalysis of Fire*, provides an interesting observation on the substantialist cognitive obstacle, as a mechanism of imagination, which can be triggered by anxiety about hidden, inexplicable material interaction, and which leads to development of a paranoid fantasy about matter, possibly transposed into a political or criminal conspiracy theory. Commenting on pseudo-scientific theories about combustion, Bachelard notices that 18th-century theorists could (in their imagination) infuse matter with various attributes, giving it a hidden, energetic life:

> The muffled life force is really a dispersed heat. It is this vital fire which forms the basis for the idea of hidden fire, of invisible fire, of fire without flame. When this idea becomes common, then scientific reveries can be given free rein. Now that the igneous principle has been deprived of its perceptible quality, now that fire is no longer the yellow flame, the red coal, now that it has become invisible, it can take the most varied properties, the most diverse qualificatives. If we take the aqua fortis for example, we see that it consumes bronze and iron. Its hidden fire, its fire without heat, burns the

> metal without leaving any trace, like a well-planned crime. […] Thus this simple but hidden action, laden with unconscious reveries, will be covered over with adjectives in accordance with the rule of the unconscious: the less we know about something the more names we give it. (1964, 78)

In popular culture, this overwhelming "covering over with adjectives" is recognizable today in apocalyptic narratives about radioactive contamination and fallout, but in 1912 it led to the development of a chemical conspiracy theory, a cross between chemistry and politics, which was an example of a mechanism based on the animist cognitive obstacle: because the destructive power was hidden in matter, it was subject to rapid work of attribution and name-calling. Consequently, it could be a fertile ground for construction of a plot based on the racist conspiracy theory. The criminal plot, and the urban setting, distinguish Dorrington's novel from the American frontier settings: radium is no longer a treasure hidden in the frontier, but a deadly poison dispersed in the bodies of the English upper class. The operation of substantialist cognitive obstacle, however, is observable in this novel too, in the images related to the search for residues of radium, dispersed in human bodies and spilled in London sewers.

## 5. Conclusion

The disturbing qualities of radium and radioactivity were most intensely represented as an illness, or other disruption of ordinary experience of the body or of biology in general. Most often, such representations can be found in texts about mysterious rays affecting a body, deforming or decomposing it. When such rays were described with a reference to chemistry, as something material, the text falls into the category of realist imagination, based on Bachelard's idea of realism. As it has been mentioned, literary interest with rays in the 1890s is not only attributed to the discovery of radioactivity, but also to Roentgen's X-rays, and Langley's research in infrared rays. It was probably in the wake of those two events, and their representation in the press, when it occurred to the general public that there is something new and disturbing about relations between rays, electricity, and matter.[4] Examples of literary representation of these relations include various early science-fiction texts about mysterious rays and the texts that Bleiler's bibliography lists under "atomic categories," that is texts about a fantastic discovery of the atomic nature of personality, emotions, energy, youth, health etc. Similarly to fictions about radium, most texts were about military rays, employed as background devices in fantastic descriptions of future wars. Interestingly, Bleiler lists relatively few texts about rays and atoms in general; as most texts were specifically about radium. Given the comprehensive quality of his bibliography, it is a good indication of radium's cultural importance as the

central chemical theme that provoked a reflection on matter in popular culture from the 1890s to the 1910s.

In terms of Bachelard's cognitive obstacles, while scientists were at a sort of blind spot, experimenting and looking for a new theory of matter, the general public was in a free and creative space of fantasy, where imagery, rooted in cognitive obstacles, could grow unchecked by experimental results. As it has been demonstrated with reference to more recent science fiction (Cogell 1978), scientific imagery was often related to the imagery of the American romance, in particular to the American mythology of the wilderness and of pastoral landscape. The same relation is suggested by the sensational plots of the stories discussed here. For a brief time, the atom could be incorporated into the American wilderness myth as a setting: the atom was a new imaginary frontier, an uncharted territory of free adventure, power play, and opportunity. Two American texts, which are not discussed here because there is no radium in them, take this tendency to its extreme but logical conclusion, and simply use the atom as setting of an adventure plot: in Fitz-James O'Brien's "The Diamond Lens" (1856) the protagonist can peek into an atom with a fantastic microscope, and in Ray Cummings's *The Girl in the Golden Atom* (1923), the protagonist shrinks and enters an atom.

In terms of realistic imagery, the texts discussed in this article are set in a world where matter, because it has new and surprising qualities, becomes unstable and unpredictable, because it is under an imaginary control of the human willing, projected inwardly into matter, through the operation of the animist and substantialist cognitive obstacles. As a setting, the world based on speculations about new rays was perhaps corresponding to fantasies about frontier spirit and freedom in the wilderness: radioactivity was still 'wild,' and so was the atomic world in general. Visible phenomena were signals from a wilderness, and so they presented opportunities for free play of imagination, perhaps best reflected by the adventures described in "A Modern 'Swiss-Family Robinson,'" in *The Gilded Man*, and in "Man in the Air." Characteristically, in all of those stories, human desires are fulfilled by inquiries into microscopic properties of matter, combined with macroscopic exploration of exotic (frontier) settings: in accordance with Bachelard's theory, radium and frontier perform the same function as the containers for objects of materialist desire. When valorisation becomes negative, as in the combination of racist and chemical imagery in *The Radium Terrors* and in "A Modern 'Swiss-Family Robinson,'" the animist and substantialist cognitive obstacles fed imagery into racial and political anxieties, contributing to images of racist-stereotypical enemies using the new and unknown qualities of matter to threaten the established social order in Britain and the United States (in Walker's novella the Japanese engineer makes only a half-hearted attempt to be an enemy). Thus, the time of scientific confusion and uncertainty was culturally reflected as a new world of adventure and opportunity, built of a matter that was believed to be more responsive to human dreams, prejudices, obsessions and aspirations.

## Notes

1. The present inquiry tries to link the American frontier theme with imagery related to speculations about the structure of matter in American fiction of the 1910s. As an interesting digression, there is an analysis which somewhat similarly compares scientific inquiry into radium with colonial expansion in Brunngraber's novel, in terms of "synthetic colonialism" in Nazi Germany (Wagner 2022). In absence of opportunities for ordinary colonial expansion in the 1930s, German matter-related fiction, that is popular fiction about technology, focused on "synthetic" exploitation of new, previously unknown, "territories" in the microscopic world of chemical reactions, new elements, synthetic fuels and materials, etc.
2. Pseudonym of Clotilde Graves, a distinguished Irish playwright (1863–1932), who pursued a successful second career in England and America as author of competently written, melodramatic novels and short stories.
3. Dorrington (1874–1953) was an Australian author active in Britain, where he published serious fiction with Australian themes. In America, he was moderately successful in pulp-fiction magazines. Dorrington and Clotilde Graves are among many authors discussed here, who were not Americans, but had trans-Atlantic careers in the sense that their fiction was published in both British and American magazines; books would often be published simultaneously in both countries, and the authors were probably not perceived as foreigners in any. It seems that perhaps much of pulp fiction was a trans-Atlantic phenomenon, and only the most successful authors, such as H.G. Wells, were recognized as foreigners, or had a recognizable nationality at all.
4. There was, more or less at the same time, an anxiety about the age of the Earth and the estimated amount of energy emitted by the sun (the age of the Earth could be estimated by means of radioactive decay in fossils, the age of the sun could not be reliably estimated at all). It was not clear how the sun, over the estimated age of the Earth, could have produced and emitted so much energy. Here again, new rays and other newly unknown properties of matter, led to conclusions that could not be understood without the creation of a new branch of physics.

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