Mountaineer Undergraduate Research Review

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From Dr. Lisa DeFrank-Cole, Faculty Supervisor of MURR

Research is important not just because it helps our students pursue their passions and reach great heights, but because research can change the world. West Virginia University undergraduate researchers offer new studies in the sciences, close readings, and the distinctiveness of their respective experiences as students engaged in research. Who knows where these investigations and investigators may lead us?

The importance of research has been underscored for me in a unique way. As the director of the ASPIRE Office, I help students prepare and apply for graduate and professional school as well as prestigious scholarships; as you can imagine, undergraduate research is an important asset for many of the students I advise. As director of the Leadership Studies Program, I am interested in helping build intercultural connections and as part of that I will be conducting research in the Kingdom of Bahrain and the Royal University for Women this summer. It heartens me to see that WVU is emphasizing research as something with life-long implications for all those who are curious about their world and who believe they can change it.

Congratulations to all of our MURR contributors and many thanks to the editorial staff. This is truly a student-run endeavor and I am proud to be a part of it.

Lisa DeFrank-Cole, EdD
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Lea Bridi is graduating in May 2011 with a B.A. in English with minors in history and biology. She served as managing editor for the inaugural issue of MURR. Lea studies language variation in a socio-linguistics lab as part of the ongoing West Virginia Dialect Project, works as a technical writer for Administrative Technology Solutions, and volunteers at Milan Park Elementary School. In June 2010, Lea is traveling to Guanajuanto and Puerto Morelos, Mexico, for an Amizade service learning and study abroad trip. In Mexico, Lea will teach English as a second language and study Latin American history. In her spare time, Lea enjoys reading (especially the modernists), writing, watching movies, and running distances.

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Molly Simis will graduate in December 2010 with a B.S. in biology, a B.A. in environmental geoscience, and a minor in geography. As an undergraduate student at WVU, Molly worked in population genetics, and geography labs, served as the Community and Academic Ambassador of the Honors College, participated in club ultimate Frisbee, became a certified scuba diver, studied environmental issues from a geologic perspective in the American West, studied abroad in Bahrain, and somehow found time to create and serve as the chief editor of MURR, the University’s first undergraduate research journal. In her spare time Molly likes to explore the great outdoors and sharpen her Frisbee skills. Molly is passionate about scientific literacy and hopes to one day make its furtherance her career.
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HUMANITIES & SOCIAL SCIENCES
DAYS OF WAR, NIGHTS OF LOVE: LOVE & POLITICS IN THE TIME OF CHOLERA

Nicholas Fagundo

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Days of War, Nights of Love

Upon first reading, El amor en los tiempos del cólera may seem to be nothing more than a romantic story of unrequited love, drawing on the tropes of nineteenth century Romantic literature, realist fiction techniques and pastoral imagery. However, the thin, sentimental veneer of the novel masks an unsettling and contradictory message about the very ideals that it seems to endorse. Beneath the excessively poetic language, the typically Marquezian, lavish descriptions, and the nature of the unrequited love story itself, lies a strong undercurrent of political unrest and social unease. Whereas the façade of the novel presents itself as universal and timeless in a typically nineteenth century fashion, its theoretical substance is inherently bound to specific historical contexts and problems. That is to say, there are two contradictory levels at work here. One would have the reader believe that there is nothing more than what is being presented on the manifest level—the power of love to transcend time and social boundaries, that love is timeless, classless, ahistorical and apolitical, and that love prevails over all obstacles. The other level, a latent one, insists that love is inexorably contingent on time and place—that love is indeed historical, cultural as well as very politically charged. Brinda Bose (1998, 65) identifies a similar paradox when analyzing Arundhati Roy’s The God of Small Things. Bose writes that “[although] it would be fairly simple to dismiss the beautifully written erotic passages of [The God of Small Things] as necessary ingredients of marketability… it would be more worthwhile to examine them for their ideological implication.”

García Márquez’s El amor en los tiempos del cólera also needs to be read beyond its romantic tendencies and analyzed for its political, cultural, and social implications. Indeed, the novel does make a potent commentary on those of “us entering the twenty-first century supposedly enlightened on psychological, social, and environmental issues,” by showing us the pitfalls and dangers of our march towards progress (Columbus 1992, 91). Problems with social mobility are also tackled because “the theme of love allows the representation of two different cultural orders” and the conflicts involved in the movement between classes (Moraña 2001, 3). Despite the various political, ideological, and socioeconomical studies of García Márquez and El amor en los tiempos del cólera, no work has been published that asks why it specifically employs the tropes of the romance novel in an attempt to inform and challenge our political and social consciousness. As enlightening as it may be, attempting to separate the romantic from the social and detach the sentimental from the political would overlook the novel’s multiple and simultaneous projects. When put into conversation with each other, it becomes apparent that love, even in its most romantic, sentimentalized forms, informs politics and that politics has a direct influence on expressions of love. In short, we can examine the politics of love, or the “sexual politics,” of this novel. We can see the connections the novel makes between love and politics, the ways in which politics enter the bedroom and vice versa.

Reconciling political and literary goals seems to be an ongoing project in García Márquez’s oeuvre. In a 1984 essay, a year before El amor en los tiempos del cólera would be published in Spanish and four years before the English translation, Regina Janes (1999) examines the ways in which García Márquez blends Colombian politics with his idiosyncratic writing style. Accordingly, she divides his works into two periods. In his earlier works, politics are either “allegorized or serve as an indistinct backdrop.” This is in contrast to his later works such as Cien años de soledad and El otoño del patriarca in which “the political serves as an organizing principle” (Janes 1999, 126). Following Janes (1999), it would seem that El amor… is a return to earlier works when politics and history were used as tools for some other ends—used more as setting and plot devices than as fundamental elements of the novel. Indeed, there are but fleeting references to the ongoing civil war, the country’s political situation or the characters’ political affiliations. These insubstantial references to politics might lead readers to overlook these qualities as secondary to the novel’s focus on the “revival of the ‘for-
gotten art of telling stories’” (Moraña 2001, 27). However, although the novel does not directly place a strong emphasis on the political elements of the novel, politics do not merely comprise an “indistinct backdrop” in the novel. Throughout the action of the novel, we are constantly reminded of the characters’ contingency on their historical, social and political contexts. Florentino’s ability to court Fermina, to spend the rest of his life pining over her and to find some fleeting comfort through his numerous libertine affairs are enabled only because he, as the son of an unmarried woman, “escaped military service during the bloodiest period of [the] wars” (Márquez 1985, 170). So it seems that El amor marks a new stage in García Márquez’s (1985) use of politics. While not explicitly central, politics and history nevertheless crucially underpin the novel’s thematic substance. They are located somewhere in-between. They not only affect the novel’s transpiring action, providing the framework for the characters to interact, but they also directly provide the reader with insight into the characters’ motives, circumstances and contexts.

This is not to say that political ideologies should be read as peripheral and marginal to the plot. As Claudette Kemper Columbus (1999, 91) notes in her essay “Faint Echoes and Faded Reflections: Love and Justice in the Time of Cholera”, “[m]any readers read Love with the comfortable conviction that García Márquez is a ‘magical realist’ and forget that he is an open partisan of the far left.” El amor en los tiempos del cólera does contain strong latent themes of social, political, and cultural strife. There are forces at work that not only allow the events in the plot to unfold as they do, that in essence provide a zeitgeist within which the characters act, but also serve as an indirect critique of certain ideologies. It is easy for the passive reader to be enthralled by the overly maudlin, romantic elements—Florentino’s unrequited, yet undying love for Fermina, the numerous references to classical romantic poetry, and the novel’s overall fixation with the idea of timelessness. These characteristics, though essential to the novel, may cause the reader to overlook certain aspects that expose García Márquez’s (1985) “far left” convictions about political, cultural and socioeconomic problems.

Accordingly, the novel appears to work on two separate levels that seem to be uninformed of each other. On the surface is the hyper-romanticized style that is concerned with themes of love, timelessness, and emotions. It is the aesthetic level, where the main plot, setting and character development take place. This level is stagnant; that is, it is restrained by its inherent tenets of universality from forming any workable critiques outside of itself. It is self-interested and directly targets the reader’s pathos. Consequently, because of its sentimental nature, it does not invite a strong, politically charged criticism. The other level is actively aware of cultural failings, socioeconomical discrepancies, and political strife. Concealed under the guise of poetic language lie the social maladies that give the former level its working backdrop. This level concerns itself with problems of class mobility, class conflict, tradition, modernity and political unrest. The latter level, in fact, works contrary to the former. It serves as a mode of critique and analysis of the events transpiring throughout the course of the novel. Columbus (1992) notes these two levels working simultaneously within the novel and appropriately asserts that there are two types of readers of the novel. The “sentimental reader” reads the novel for its surface value, with little or no consideration for its context, historical, political, or otherwise (Columbus 1992, 91-92). The “suspicious reader,” to whom her essay is addressed, is called to question the novel’s apparent lack of interest in its historical situation (Columbus 1992, 91-92).

Columbus (1992) argues that it is satire that allows these contradictory messages to act together. Like Jonathan Swift’s A Modest Proposal, “Love in the Time of Cholera can be read as an exemplar of high satire in chronicle form” (Columbus 1992, 89). However, due to the claims and styles of the two satires, readers are more likely to overlook El amor’s satire of romanticism and sentimentalism than Swift’s ‘solution’ to 18th century Ireland’s economic situation. García Márquez (1985) takes certain tropes of the 19th century romantic and realist novels and adapts them to fit his needs. In a sense, El amor en los tiempos del cólera marks for García Márquez “un retorno intencionado al realismo del siglo XIX” (Beltrán 1997, 225) [an intentional return to the realism of the 19th century]. “La sobrealubundance de detalles, la discursividad y una estructura episódica y dispersa” (Beltrán 1997, 225-6) [The over abundance of details, discursivity and an episodic and disperse structure] all point toward a parroting of the realist and romantic traditions. However, El amor is more than just “parodia irónica” [ironic parody] of these traditions (Beltrán 1997, 228). There is a marked difference between parody and satire: “although high satire draws on tropes of irony, such as unspoken meaning that opposes the manifest level, unlike irony, high satire aims for social change” (Columbus 1992, 89).

Although Columbus (1992) approaches a radical political reading of El amor, her final analysis shows the novel to be something of a universal warning against political and cultural passiveness or the dangers of sentimentalism. However, she fails to take into account the cultural milieu of the novel and accordingly her reading is ultimately limited by her understanding of politics. She continues to demonstrate that the novel’s “lack of social change contain[s] satiric ferocity” (Columbus 1992, 90). She argues that the satiric elements of the nov-
el hold a mirror to those who would read the novel as a sentimental tale. Those readers who are content reading the novel as simply romantic inevitably ignore the characters’ political apathy and its consequences. Their ‘timelessness’ is not read for its “destructive social consequences,” rather, it is read as the characters want it to be read, as romantic. Inevitably, all the characters become “lost in misreadings” (Columbus 1992, 98). However, are the two major aspects of this novel, the romantic and the critical, necessarily antithetical? Must a critical reading dismiss the romantic elements as overly sentimental and contrary to the novel’s latent, political message? If these questions are answered in the affirmative, then another question needs to be asked: why a romance novel? What could be gained and what is being challenged by a satire of the romance novel instead of a historical, chronic, or expository novel, which seem to be García Márquez’s preferred writing style?

If we are to read El amor en los tiempos del cólera as containing a political message, we need to take into consideration how its aesthetic level informs the theoretical level. Contrary to Columbus’ thesis, the novel does contain constructive elements that are politically, historically and socially aware. This is easy to overlook because the novel does privilege “love politics” over “meeting room politics.” It invokes a history that is lived rather than studied. Its social awareness is demarcated precisely. Different characters represent varying levels of political awareness and involvement; some characters represent the antitheses of the social and political climate in which they find themselves and others their champions. However, when taken as a fragmented whole the novel does, in fact, provide us with a politics of sex and love that is constructive and viable. To be precise, if we read the novel not only for its representations of a recreated world, but also for the silences, the cracks and the contradictions which form it, the politics of sex and love become all the more relevant and profound.

Contrary to previous readings that take its ‘love politics’ as negative, destructive or, at best, apathetic, I wish to suggest a positive reading. Without ignoring certain aspects of the novel that might suggest that the characters’ different loves are opposite to constructive, admirable politics, there can still be found “viable (rather than die-able)” politics (Bose 1998, 59) in El amor en los tiempos del cólera. It is dangerous for the ‘sentimental reader’ to be drawn into the story’s overly romantic aspects. To ignore that certain characters contribute to a climate of political apathy is to ignore the political and cultural climate of the novel—after all, disengagement from politics is just as consequential a political statement as any other. Instead of reading the main characters’ lack of involved, productive interest in the political climate of their times as politically and socially detached, this essay will examine how each of the characters respond to political turmoil and cultural change through their romantic choices.

Understanding the Politics of Love

How is a reading of love as politics justifiable? In the opening paragraph to his monograph The Political Unconscious: Narrative as a Socially Symbolic Act, Fredrick Jameson (1981, 17) openly argues for the “priority of the political interpretation of literary text” and considers all other modes of analysis, be they psychoanalytic, structural, historical, to be auxiliary. Drawing from theorists and philosophers such as Marx, Deleuze and Foucault, Jameson (1981, 20) locates political motivations in the center of all literary analysis, “that everything is in the last analysis’ political.” Though some critics have focused on García Márquez’s use of politics in the novel (see Columbus 1992, above), their analyses seem to be overly cursory in their understanding of the political. El amor en los tiempos del cólera is often read politically only in the instances of the novel that explicitly mention political conflict. These readings ignore the ideologies that are constantly at work behind the plot, giving meaning to the characters’ actions. While these readings are as politically charged and as critical of injustice and harmful marginalization as they should be, they almost inevitably read the novel as being politically negative at its core. That is they focus on problems of class mobility, modernization, and political indifference and they quickly point out the places where the novel is, in some aspect or another, critical of or oblivious to these standard issues of a Marxist, political reading.

However, if we are to take everything as political, indifference—or as I will argue, a certain brand of nihilism—cannot simply be disregarded as apathetic and must be examined for its political implications within its specific context. For, indeed, what critics overlook is that an aversion to politics is a comment on those politics and on the culture as a whole. Likewise, political inaction is tantamount to a kind of political action. An action has no inherent meaning, to suggest otherwise would ignore the basic concepts of linguistics. An action of any sort gains its meaning from the culture that produces it. A nihilistic view on cultural and political involvement does not always entail politically destructive or negative results. For those reasons, the definition of politics must be expanded from a narrow view of the liberal-conservative spectrum to account for the specific cultural milieu that produces the acting subject.

Here I will be working with the Foucaultian axiom that “everything is political.” Even in the simplest or the seemingly most innocent of actions, political ide-
The plot of *El amor en los tiempos del cólera* revolves around a love triangle that takes half a decade to unfold. Though, however different the three characters are, they are inexorably bound to one another—three sides to the same triangle. Florentino Ariza and Dr. Juvenal Urbino are bound through their love interest, Fermina Daza. They are “victims of the same fate and shared the hazards of a common passion” (Márquez 1985, 191). Each of these characters represents different levels of political engagement, cultural involvement, and socioeconomic standing. Each has their own love politics that is informed by these factors. The novel is set during a time of cultural change and political unrest in the unnamed Caribbean country. It takes place at the turn of the twentieth century when the country was starting to modernize. Across the culture’s ideological landscape, modernity, and tradition are in a constant dispute over cultural values, meanings, and beliefs. Inevitably, the country’s government chooses modernity and those who held on to the traditional beliefs and customs were increasingly marginalized. The characters are inevitably products of this and respond to it with varying consequences. A character’s choice to accept or reject a certain belief, or even to acknowledge it at all, reflects different position within a culture’s ideological debate.

Urbino, Fermina, and Florentino represent varying levels of political engagement and social status, not to mention different attitudes towards romance and sexuality. Dr. Juvenal Urbino is an upper class doctor during an extended period of cholera outbreaks. His profession puts him in the precarious situation of endorsing the more socially constructive aspects of European modernity, such as extending medical care to lower class citizens, and destructive ones, such as destabilizing the authority of traditional culture. Fermina Daza, his wife, is a part of a social class the modernizing country had hitherto not experienced. She comes from a lower class, traditional background and becomes upwardly mobile when she marries Dr. Urbino. To the embarrassment of her husband, she never completely sheds her traditional attitudes and beliefs. Florentino Ariza’s social position is not easily defined by his socioeconomic status. He places his own personal politics, as sentimental and maudlin as they may be, over those of the society. With the one exception of his unyielding love for Fermina, his worldview is nihilistic. Not unlike Dr. Urbino’s espousal of modernity, Florentino’s beliefs and actions have both constructive and destructive outcomes.

Analyzing Florentino’s and Dr. Urbino’s opposite personal politics in the hopes to make a qualifying judgment on them seems to be an insurmountable quandary. Besides demanding some sort of objective, quali-
fying criterion, this question still takes politics in their most literal sense. It presupposes that any of the character’s actions would be able to stop the homogenizing, adamant march of progress. Inevitably Dr. Urbino, for all his blind sightedness as a member of a changing, transforming culture, yields the more socially positive results. Despite his indifference towards the changing political landscape that is becoming increasingly more repressive towards (especially female) sexuality, working class struggles, and local culture and traditions, his involvement with social projects saves lives and promotes physical well being. Conversely, Florentino’s personal politics yield politically and ecologically negative and sometimes even devastating consequences. At the same time Florentino’s politics also generate radical cultural effects that serve to destabilize the dominant cultural and societal force of modernism. Therefore, the question is not which character’s personal beliefs are better or which are more productive for society as a whole. This irresponsible question can only restrict our reading of the novel to an incomplete critique. It forces us to make condemnatory choices that do not treat the novel’s simultaneous levels. The more worthwhile and maybe the more answerable question is: How do each character’s actions comment on and reflect the society they live in? Only after this is addressed can the full effect of their actions be analyzed.

Love in the Time of Nihilism

Florentino Ariza, the novel’s main protagonist, throws the entire cultural debate into disarray through a nihilistic and self-centered worldview that prohibits him from taking an active role in society. The novel “reveals cultural and ideological heterogeneity to be the characteristics of social development” (Moraña 2001, 9). Florentino is culturally and ideologically rebellious. He serves as the focal point for readers to understand the context of the novel not because of his representative qualities but for his negative ones. Florentino is a mirror held up to society, at once inverse and passive—inverse in the sense that his personal convictions serve to turn his culture’s beliefs back on themselves and passive because his convictions are so naturalized within himself that he does not realize his rebelliousness. Nihilism allows Florentino to distance himself from the ever-modernizing society without simply contradicting the values that modernity propagates. His personal choices point out absurdities within the culture by refusing to accept them as legitimate.

When viewed solely for his effects on political and cultural occurrences, Florentino is misleadingly read as apathetic. He shies away from any conflict with authorities, be they liberal or conservative, in the same way he shies away from any direct encounter with Fermina. However, Brinda Bose (1998, 60) notes that “one’s personal politics is often an extension of, but always greater than, one’s positioning—left, right, centre or beyond—and a politics of desire, even if merely proclaiming “the erotic as Truth,” could certainly be considered as viable a politics as any other.” Florentino’s lack of direct political engagement calls for a new perspective on the issue. It can be read as a different kind of politics, one that is fighting against the dominant culture’s expectation of participation in the Liberal/Conservative binary. That is, by adopting a worldview that does not recognize the dominant discourse, Florentino does not fully comprehend the political repercussions of his choices. This had led to him being read as politically indifferent, when in fact, his choice to remain politically indifferent is purposeful removal from the political context. His isolation brings into focus and comments on society’s drive for political engagement.

Florentino’s personal politics use sentimentalized, romantic love to destabilize cultural meanings and beliefs. For instance, Florentino’s obsession with out-of-date, Colombian romantic poetry, “those half-baked engravings taken from the Spanish romantics” (Márquez 1985, 75), can be seen as an act of cultural rebellion from his ‘modernizing’ country. In his unintentional insolence toward conventional authority, Florentino essentially deconstructs the existing power structures. For example, at the beginning of his courtship of Fermina, at a time in the history of his country when the city was torn by a raging civil war, Florentino clearly demonstrates his personal politics during a confrontation with national authorities:

In August of that year a new civil war, one of the many that had been devastating the country for over half a century, threatened to spread, and the government imposed martial law and a six o’clock curfew in the provinces along the Caribbean coast. Although some disturbances had already occurred, and the troops had committed all kinds of retaliatory abuses, Florentino Ariza was so befuddled that he was unaware of the state of the world, and a military patrol surprised him one dawn as he disturbed the chastity of the dead with his amorous provocations. By some miracle he escaped summary execution after he was accused of being a spy who sent messages in the key of G to the Liberal ships marauding in nearby waters.

“What the hell do you mean, a spy?” said Florentino Ariza. “I’m nothing but a poor lover.” (Márquez 1985, 70-71)

Florentino’s political positioning is neither Conservative nor Liberal. His one true political commitment is as a
“poor lover.” By identifying himself as such, he destabilizes authority. When confronted by a representative of larger power structures—the conservative government and the civil war itself—Florentino is placed in a double bind. He is indirectly forced to choose a side, in this case either Liberal or Conservative. To identify as a Liberal would be to rebel against the dominant force in an attempt to overturn it, to destroy it and to take power from it. In Florentino’s case, to do so would result in an inevitable execution. On the other hand, to identify as Conservative, to align with the immediately present power figure, would be an attempt to strategically manipulate the power structure against itself for his benefit. However, in recognizing the power structure as legitimate, both choices are supportive of the same power. They are different sides to the same coin. Florentino’s nihilistically romantic preoccupation blinds him from taking an active, participatory role in the political and cultural happenings of his time. He refuses to be subjugated by authority. By placing his personal romantic preoccupation above authority he renders that authority illegitimate. In the end, the befuddled authorities have no choice but to let Florentino go.

Florentino’s nihilism and preoccupation with romantic endeavors allows him to make insightful commentary on his culture. On his first trip with the riverboat company he would one day come to own, Florentino sees several cadavers floating by in the murky waters of the river. Upon observing them, the only thought Florentino has is that their pungent stench “contaminated his memory of Fermina” (Márquez 1985, 142). The seemingly ‘relevant’ questions of whether they are the result of cholera or war, where they came from or why they are floating lifelessly down the river do not preoccupy his mind in the least. While this morose romanticization may seem politically apathetic, in fact, this is an instance when his nihilistic romanticism frees him from thinking completely in terms of the cultural milieu. “No one ever knew if they were victims of the cholera or the war” (Marquez 1985, 142). In relating this event to Fermina, instead of the cultural events that might have caused them, he affirms that his personal politics of love are of higher importance than cultural events. In creating this narcissistic hierarchy, he again highlights the interplay of authority, cultural progression and modernity that float unnoticed with the cadavers. As Moraña notes: “Cholera, violence, and modernization form a representational triad…in the novel” (Moraña 2001, 5). Florentino’s nihilism and politics of love stand in direct ideological opposition to this triad. By deconstructing authority, his love politics brings this triad into view and exposes its inconsistencies.

**Medicine, Marriage and Modernity**

Beyond acting as the typical, passionless antagonist in the romance novel, Dr. Urbino shows the pitfalls of modernity’s march towards progress by almost perfectly mimicking modernity to the point of demonstrating its inconsistencies and flaws. Just as his parrot that “has progressed beyond mere imitation” (Columbus 1992, 93), Urbino can be read as mimicking the Europeans he reads about in the fashionable books he has shipped to him from Paris. And just as the parrot, which in its imitation learned to speak Spanish, French, and Latin as well, if not better, than its master, caused the accidental death of Dr. Urbino, Dr. Urbino in turn serves to show how modernity inevitably causes its own downfall (Márquez 1985).

The symptoms of cholera and the ‘symptoms’ of love are the prevalent themes in El amor en los tiempos del cólera. Indeed the themes themselves are treated as realistically and metaphorically similar. As García Márquez imagines them in the novel, the ‘symptoms’ of a person under the spell of love are nearly identical to the physical effects of deadly cholera. As a man of medicine, dedicated to bringing the latest medical advances even to those neighborhoods that are, in his own demeaning words, the “death trap of the poor,” Dr. Juvenal Urbino serves as the antithesis to the themes of love and cholera in a both realistic and metaphorical manner (Márquez 1985, 16). In the novel, both love and cholera represent “the vulnerability of a social order,” which, as an adherent to that cultural order, he seeks to implement and uphold (Moraña 2001, 3). His goal as a doctor is to expel the deadly disease from all socioeconomic levels of his society. As a solemn, European-educated and, hence, progressive man of high reputation and social standing, his place in society is to act as representative of all ideas and manners modern and progressive. For Dr. Urbino, included in this is a complete denunciation of the romanticism and sentimentality associated with the uneducated and irrational. “Passion becomes a disease—cholera, most notably—that it is his passion to eradicate” (Mattessich 2008, 341). His educated worldview causes him to view every event, including ones with obviously negative political overtones, in a cold, calculated manner, usually informed only by medicine and a supposedly ‘liberal’ political view. For instance, on an historical trip in a balloon across the country, marking the turn of the century, Dr. Urbino and Fermina observe dead bodies scattered across a banana plantation. Dr. Urbino remarks with his usual lack of irony or insight that “it must be a very special form of cholera, because every single corpse has received the coup de grace through the back of the neck” (Márquez 1985, 226-227).

It may seem at first that Dr. Urbino is directly involved with constructive and oftentimes progressive
social projects. Throughout his distinguished career as the city’s foremost physician, he is responsible for “the drastic new methods” used to prevent cholera (Márquez 1985, 43). He is the founder of a Medical Society, the center for the Arts and the restoration of various theaters throughout the city. In addition, he is involved with the Patriotic Junta, a group “composed of politically disinterested influential citizens who urged government and local businesses to adopt progressive ideas that were too daring for the time” (Márquez 1985, 43). However, despite his apparently liberal and progressive notions of society, his view of politics is just as disengaged as Florentino’s, though in a wholly different manner. He is nevertheless supportive of a repressive, immobile social order, one that is systematic to modernity. For Dr. Urbino, a confessed supporter of the Liberal party, “a Liberal president was exactly the same as a Conservative president, but not as well dressed” (Márquez 1985, 35). Moreover, Dr. Urbino contradicts the ideas of a progressive, democratic society of which he feigns to be a patron. Essentially, what hold the most sway in politics is one’s “merits of lineage” (Márquez 1985, 35). The irony in Dr. Urbino’s political stance is that, even though he holds himself to be a progressive, his flawless mimicry of old European bourgeois mentality and tradition illustrates their very faults. There is further irony when Florentino’s and Dr. Urbino’s passive politics are compared. Both Florentino’s nihilistic views on the happenings around him and Dr. Urbino’s ultra-bourgeois indifference amount to the same—nothing.

In his search for modernity and progressive values, Dr. Urbino instead ends up becoming something of a reflection himself. His indifference prevents him from examining the city, his personality or the absurdity of his political values. In their places are reflections and fantasies that feign towards modernity but end up a self-parody. As a result of his bourgeois worldview, he is prevented from seeing the material realities of the city in which he lives. Although his work fighting cholera and his various civic duties bring him in contact with lower class citizens, representative of the majority population, his conception of the city does not reflect the existing material realities. Rather, it is a “narcissist falsification and misinterpretation/unintentional truth-telling” (Columbus 1992, 99) that is symptomatic of his vaguely bourgeois ‘progressive’ views. As is widespread among the elite bourgeois in colonized areas, Dr. Urbino is obsessed with everything European. His politics and social behavior are considered overly regal and pomp by other members of the elite within the city. “He was perhaps the last member of the great families who still knelt when the Archbishop’s carriage drove by” (Márquez 1985, 44). In stark contrast to most houses in the city, Dr. Urbino’s house, located in the “district for the nouvelle riches at the beginning of the century” (Márquez 1985, 18), is decorated with “original English pieces from the late nineteenth century” and “Turkish rugs purchased at the World’s Fair in Paris” (Márquez 1985, 18-19). Dr. Urbino equates Europe with progress, rationality, safety, and modernity. In contrast, his own city “[stands] unchanging on the edge of time” (Márquez 1985, 16). For Dr. Urbino, the entire city, “which the young Juvenal Urbino tended to idealize in his Parisian melancholy, was an illusion of memory” (Márquez 1985, 17). He does not truly participate in the city. As a man of high social standing in the city with considerable social power, he is able to manipulate the social and civil projects mentioned in the previous paragraph to suit this illusion.

Indeed, “Dr. Urbino functions within the novel as the flag bearer of ideas and values associated with modernization” (Morañá 2001, 4). His views on marriage and gender roles are no exception. In contrast to Florentino’s over romanticized view, Dr. Urbino’s love politics conceive of marriage as a superficial necessity within the modernized world. Essentially, Dr. Urbino’s marriage is an opposition to the romantic ideal. “He loves Fermina conceptually, for being his wife and the mother of his children” (Pelayo 2001, 8). Through various trips to Europe, the couple attempt to escape the miseries of a loveless love, a marriage for marriage’s sake. Inevitably, though, they return to their home city where they are forced to adopt a strict adherence to a daily routine based on normative gender roles. Fermina and Dr. Urbino’s marriage is the accumulation of socioeconomic and cultural mores that permitted them to share separate personal lives in the silence of the same bed. This routine is broken only once. One year, on Fermina’s birthday, attempts Dr. Urbino took over the domestic duties. It ends in disaster and the realization that the foundations of their marriage rest on habit, conforming to the traditional gender roles. Without these performances and routines, their conjugal life can no longer function.

Dr. Urbino also serves as a point of comparison and contrast to Florentino. Where Florentino is removed, Dr. Urbino is engaged. Where Florentino holds illusory, hyper-romanticized views, Dr. Urbino holds illusory, hyper-rationalized views. An interesting contrast between Florentino and Dr. Urbino can be seen through their first encounter with Fermina. After weeks of admiring Fermina from a safe, yet noticeable distance, Florentino asks Fermina to accept a letter. After she accepts it, he returns home and succumbs to chill spells, vomiting and “the pale perspiration of a dying man” (Márquez 1985, 62)—the same symptoms of cholera. When Fermina’s father forbids Florentino any contact with his daughter, Fermina falls into a state of similar lovesickness. This prompts her father to call Dr. Urbino, believing her ill-
ness to be cholera. In contrast to Florentino’s hyper-adulation of Fermina from the moment he set eyes on her until their final reunion, Dr. Urbino admits “he experienced no emotion when he met the woman with whom he would live until the day of his death” (117).

Fermina’s Dissent

As envisioned in her monograph Profit and Pleasure, Rosemary Hennessy (2000, 224) sees the need for a new set of revolutionary love politics that “begin with human needs and in the process politicize capitalism.” Here, Hennessy (2000) creates a new approach toward forming love politics that use love as a subversive political tool. We have seen how Florentino’s love politics undermines dominant authority and helps to illustrate what that authority is. But, his love politics do seem to be too self-centered; they approach the ‘politicizing’ capitalism, but remain a symbolic act. Dr. Urbino’s love politics, too, politicize modernity, but they do so in a sycophantic, rather than revolutionary, manner. Only in Fermina do we find love politics that address both aspects of Hennessy’s revolutionary love politics.

Fermina’s place in the novel balances precariously between the two main male characters. On the one hand, her marriage to Dr. Urbino provides her with an opportunity to rise in social status from the daughter of a merchant to a socialite and an important member of the city’s cultural elite. Judging from the lack of social mobility throughout the novel, this chance would most likely not have been available to her were it not for her father and Dr. Urbino arranging a marriage. On the other hand, her connection to Florentino as the object of his youthful obsession and of his lifelong romantic desires, not only gives the novel its overarching plot structure, but it solidifies her position as inner-class. She is the object of the bourgeois aspirations of her father, who wishes to “turn his daughter into a great lady” (Márquez 1985, 100), and of Dr. Urbino, who, as we have seen, uses Fermina to project his desires and ideals of modernity. Though she does ascend in social ranking, Fermina is, nevertheless, inexorably linked to her upbringing in the lower class. She simultaneously performs within the cultural elite but can still “understand the code of anachronistic popular romanticism that is closely linked to national tradition” (Moraña 2001, 7). This allows her to also serve as the object of an ‘undying’ love for Florentino. For critics such as Columbus that read Florentino’s obsession with romanticism and apathy towards politics as negative, Fermina is attributed some degree of responsibility for the “absence of social change” (Columbus 1992, 90) in the novel. It is “Fermina’s absence [that] has destructive social consequences” (Columbus, 1992, 96).

It would seem that Fermina is yet another example of an objectified woman, constantly controlled by the dominant patriarchal society. Patriarchy is certainly present in modernity, as represented by Dr. Urbino, but Florentino’s romantic idealization and objectification are also culpable for a male-centered worldview. However, she steadfastly refuses to be controlled by either her place in society as a woman or by her upwardly mobile social position. To her husband’s dismay, she never fully integrates herself into the dominant social structure she marries into; though her socioeconomic position changes, her manners, beliefs, and habits do not. In fact, she does not feel at ease in her place as part of the elite. She expresses her contempt for the bourgeois lifestyle that involves lavish customs such as “setting the banquet table everyday with the embroidered tablecloths, silver service, and funeral candelabra so that five phantoms could dine on café con leche and crullers” (Márquez 1985, 207).

Her revolutionary love politics, then, come from functioning within the dominant social structure, while retaining her outsider’s perspective as a both a woman and a member of the lower class. She poignantly and accurately defines her husband as “a poor devil made bold by the social weight of his family names” (Márquez 1985, 207). Only through her participation in and distance from the elitist culture is she able to understand her husband and the social order he is a part of as such. She is able to see that Dr. Urbino, as an accurate representation of modernity, holds contradictory beliefs. Despite his professed liberal position, Fermina is able to discern that “he perfectly exemplifies the conservatism of the class he initially rebelled against, with all its anti-modern parachialism and close mindedness intact” (Matessich 2008, 341). Her dual position as a member of the affluent upper class while still holding the memory of her childhood as a member of the working class also allows her to make insights into the nature of capitalism itself—satisfying Hennessy’s hope of politicizing capitalism. Upon the death of her husband, she performs a “ritual of eradication” (Márquez 1985, 280). She burns everything that reminds her of her deceased husband: “the most expensive and elegant clothes seen in the city since the last century, the finest shoes, the hats that resembled him more than his portraits” (Márquez 1985, 281), etc. When she starts to clear the rest of the house for a second bonfire she hesitates and says “’It is a sin to burn this…when so many people do not even have enough to eat’” (Márquez 1985, 301). Her social conscious, a result of her origins, counteracts the bourgeois mentality she is surrounded by during her marriage. Her choices, first to burn most of the possessions her husband left her and second to refuse to burn the possessions, are symbolic of the predicament in which she finds herself. She wishes
to be part of the dominant structure but still retain her identity apart from it. Her revolutionary love politics allow her to do this. Finally, it is her choice to reunite with Florentino after her husband’s death that affirms her autonomy and vindicates her love politics.

A Final Word on Love and Politics

“‘And how long do you think we can keep this goddamn coming and going?’ [the Captain] asked.

Florentino Ariza had kept his answer ready for fifty-three years, seven months and eleven days and nights. ‘Forever,’ he said.” (Márquez 1985, 348)

Thus, El amor en los tiempos del cólera ends—with the same romantic tone constant throughout the novel and the same contradictory meaning beneath. It would seem nothing has changed as the two lovers sail down the long river of time, united in their old age after half a century of waiting and compromising. They raise the yellow cholera flag to prevent any disturbances on their voyage into “forever.” It is the same river that Florentino traveled once in his youth with the riverboat company that he now owns. However, it is not the same river Florentino once knew. While he was busy with his numerous liaisons and pining over an unrequited love long past, his neglect to take an interest in his business allowed the entire jungle surrounding the river to be destroyed. By forming his personal politics centered on an undying, romantic love, and by refusing to engage in cultural discourse, he hindered himself from making material statements, as opposed to abstract or purely ideological statements, on the changing culture.

By the end of the novel, the love politics have drastically changed. Somewhere between Florentino and Fermina’s reunion and their voyage into “forever,” is a vital metamorphosis. This change occurred on both levels of the novel, the manifest and the latent. The novel’s manifest level transforms both aesthetically and thematically. The desolate scenery that Florentino and Fermina observe on their last trip stands in radical contrast to the picturesque scenery described on Florentino’s first voyage as a lovesick youth, trying to escape the city of his unrequited love. The riverbanks, the natural life along the river, and even the river itself have transformed into something unrecognizable. They have become a surrealistic landscape, void of life, nature and meaning. In true romantic fashion, on his first trip everything on the river is a projection of Florentino. The turbulent waters of the river reflect Florentino’s troubled inner state. Dawn breaking over the scenic “deserted pasturelands and misty swamps” (Márquez 1985, 140) are, for our narcissistic protagonist, yet another proof of unending love. By the end of the novel, the sublime magic of the tropical forest is replaced with “banks that meandered between arid sandbars stretching to the horizon” (Márquez 1985, 331)—a river cutting through a desert seemingly without end. The troubled waters have not become tame and serene to reflect the old age of the protagonists, as one might expect in a cliched romance novel. Instead they have become surrealistic, almost mechanistic waters that “gleamed like metal under the merciless sun” (Márquez 1985, 331).

Underneath this lies the ever-present political message of the novel. Florentino’s negligence as the head of the company caused a complete ecological disaster. “The alligators ate the last butterfly and the maternal manatees were gone, the parrots, the monkeys, the villages were gone: everything was gone” (Márquez 1985, 337). However, in spite of the complete river’s destruction, we are ironically comforted by the Captain who says that “there’s no problem…in a few years we’ll ride the dry riverbed in luxury automobiles” (Márquez 1985, 337). Modernity and capitalism have triumphed over tradition and nature. At the end of the novel, the romantic notion of two aged lovers sailing into forever is contradicted by the horrifying consequences of their actions.

Despite these consequences, the ending, complete with a private boat and full private symphony, follows the romantic trope perfectly. The two lovers are reunited, on a note of “forever,” after half a century’s wait. But coming from Florentino—who could not write a business letter without sounding romantic and who sold his expertise of writing love letters at the local market place—the response, indifferent to the inevitable passing of time, should be no surprise. The novel ends, in some strange ways, with the lovers sailing into forever and away from the ravished landscape. Florentino has not changed his romantic worldview at all. He refuses to accept that political and cultural forces have any power over him. His nihilistic attitude prevents him from seeing the political and cultural realities. At the end of the novel, the fundamental issue is Florentino’s continued blindness to his own destruction, despite its obviousness. Instead of rebelling against the dominant cultural forces, he fails to understand the consequences of his actions. The two lovers, united at last, seem to be victorious—after all, their goal was to overcome the political and cultural authorities and be together. But the novel’s final tone is not, in fact, a romantic one. The dominating oppressive cultural forces eventually triumph over the subtle symbolic opposition Fermina and Florentino pose. Despite Florentino’s deconstruction of authority and Fermina’s revolutionary love politics, the characters’ lack of engagement with the real, rather
than the romanticized, abstract or illusory, world seems to have inevitably negative consequences. Yet, their symbolic opposition still refuses to admit this as defeat. Their seeming defeat is negated by their devotion to romanticism, escaping from the tangible consequences of the imposition of a political and cultural reality.

Trying to reconcile a deeply rooted romanticism with an analysis of politics has presented several conundrums. Most important is the problem of love itself. Different forms of love politics are more than simply over-romanticized, sentimental ideals that carry a cumbersome burden of negative political consequences and implications. Necessary to such a reading is a radical understanding of love politics informed by the cultural surroundings in which they are produced and performed. In Florentino’s case, placing one’s personal, romantic interest above those of a culture and stubbornly refusing to acknowledge its changing, supposedly progressive values has radical effects. The authorities, both real and metaphorical, that Florentino faces can respond to resistance but not to indifference. In Dr. Urbino, we see mimicry of modernized values, holding them so rigid that they become a self-parody. Fermina presents the readers with an escape from modernity and patriarchy through her revolutionary love politics. Ultimately, as Wendy B. Faris (1992, 132) notes, the end of El amor en los tiempos del cólera shows us that “love can triumph over time, but not over history or political reality.” While the romantic story of El amor en los tiempos del cólera comes to a complete, fulfilling and contented conclusion, the ideological level is left confused and ambiguous. Though the two lovers reunite at last, the underlying question of the politics of love is left lingering. With the end of the novel offering no overt resolution between these two conflicting levels, what has happened to the notion of the politics of love?

Finally, in El amor en los tiempos del cólera Gabriel García Márquez presents romanticism as a two edged sword. It has the potential to free those that employ it from dominant political and cultural forces. Conversely, the romanticist must be aware that this detachment has real repercussions. Just as Florentino’s political indifference is a commentary on politics themselves, the novel’s lack of resolution is a commentary on the resolutions that the novel could have had. The novel does not have a purely romantic ending, as critics such as Moráñ (2001) and Pelayo (2001) suggest. The reader cannot ignore the political consequences of Florentino’s lack of involvement and romantic isolation. Conversely, the novel’s ending is not one that declares love and romanticism a lost cause, as Columbus (1992) and Mattessich (2008) believe. Even though the two lovers are painfully blind to the destruction around them, they do, after all, reunite in full romantic fashion. As they sail away from the repercussions of their actions, Florentino boldly affirms his intention to remain in his romantic idealism and escape from the surrounding political and ecological destruction forever.
BIBLIOGRAPHY


NOTES


2. All translations of journal articles are my own.

3. See: Mattessich (2008), Columbus (1992), Moraña (1990) respectively.
THE DOWNING STREET IRREGULAR:
POST-REICHENBACH FALLS SHERLOCK HOLMES AND
THE TRIUMPH OF CONSERVATIVE INTERNATIONALISM

Ben Welton

“I think sir, when Holmes fell over the cliff, he may not have killed himself, but all the same he was never quite the same man afterwards.”

A Cornish boatman to Sir Arthur Conan Doyle, 1909

I have no great affection for the twentieth-century Holmes. But I will give the warmest welcome to as many adventures of the Baker Street Holmes as Watson likes to reconstruct for us.

A.A. Milne in If I May (1920)

The Game is Afoot

Detective fiction, until quite recently, has not been seen as a literary genre worth the attention of “serious” literary scholars. Many critics and scholars see detective fiction works as merely “promotions of the values of the modern police discipline, defending bourgeois property values, sexual morality and bureaucratic rationalities” (Kayman 2003, 44). Even Sir Arthur Conan Doyle, the legendary creator of Sherlock Holmes and Dr. Watson, the most recognizable figures in all of detective fiction, lamented that his detective fiction “takes my mind from better things” (Reitz 2004, xiii). Likewise, Victorian crime fiction scholar Dr. Caroline Reitz (xiii) asserts in her book Detecting the Nation: Fictions of Detection and the Imperial Venture that most “readers of detective fiction consider themselves distracted...from more serious fiction.” This view of detective fiction as a frivolous enterprise is one way to explain why detective fiction has been so long neglected by academic critics. Raymond Chandler, the highly acclaimed author of American “hard-boiled” detective fiction, offers another possible explanation for this critical ignorance:

“The detective story for a variety of reasons can seldom be promoted. It is usually about murder and hence lacks the element of uplift. Murder, which is a frustration of the individual and hence a frustration of the race, may, and in fact has, a good deal of sociological implication. But it has been going on too long for it to be news. If the mystery novel is at all realistic (which it very seldom is) it is written in a certain spirit of detachment; otherwise nobody but a psychopath would want to write it or read it.” (1988, 1-2)

Chandler’s insistence on the “sociological implication(s)” of the crime fiction genre is the quarry from which I will extract my overall argument concerning the second half of the Sherlock Holmes canon. This latter portion of the Holmes’s canon I will call the Post-Reichenbach Falls era; for it concerns the thirty-three short stories collected in The Return of Sherlock Holmes (1905), His Last Bow (1917), and The Casebook of Sherlock Holmes (1927) as well as the final Holmes novel, The Valley of Fear (1915). This Post-Reichenbach Falls era, which ran roughly from 1905 until 1927, tends to be seen as inferior to its Pre-Reichenbach Falls successor, which ran from 1887 until 1893.

For many Doyle scholars, biographers, and critics, the Post-Reichenbach Falls era represents a turning point in which the character of Sherlock Holmes throws away his former independence and Bohemianism for the sake of serving hegemonic interests. The Pre-Reichenbach Falls Holmes was an ardent outsider who is “frequently skeptical, if not downright contemptuous of the people he represents” (Drabble 2006). This contemptuous attitude on the part of Holmes solidifies his position as a private detective or as he calls it a “consulting detective,” without any strong connections to the professional police force. In this earlier era, typical Holmes clients often include baffled Scotland Yard detectives or middle-class women in distress, such as Mary Sutherland in “A Case of Identity” (1891). In the Post-Reichenbach Falls era, many of Holmes’s cases seem to only reinforce “the existing social order,” i.e. Holmes is called into action to tackle cases that threaten British political, imperial, and social hegemony rather than cases that merely disrupt the fabric of private affairs (Drabble 2006). Holmes’s most frequent client during the Post-Reichenbach Falls era is the British government. As such, Holmes’s amazing abilities no longer serve to make the professional police look foolish; they in fact serve to bolster the status quo. Furthermore, most critics simply argue that the
Post-Reichenbach Falls era stories are grotesque caricatures of their Pre-Reichenbach Falls predecessors.3

Detective fiction scholar Ian Ousby characterizes the Post-Reichenbach Falls era as one of “progressive decline” with Sherlock Holmes as “a more crudely drawn and less impressive figure than earlier” (1976, 151). This is an attitude that I simply cannot share. My argument seeks to show that the separation between the Pre-Reichenbach Falls era and the Post-Reichenbach Falls era is not an actual separation so much as it represents a shift in the continuum. Also, my argument views the Post-Reichenbach Falls era in the light of its predecessor and not as a stand-alone entity as it is described by Joseph A. Kestner in his 1999 book The Edwardian Detective, 1901-1915. The Post-Reichenbach Falls shift begins and ends at the level of Sherlock Holmes. Unlike Conan Doyle biographer Andrew Lycett, I see the Post-Reichenbach Falls era change as a change in the cultural currency of the Sherlock Holmes character. I wish to argue that what readers of the Sherlock Holmes stories invest into the Holmes character changes during the Post-Reichenbach Falls era, hence this notion of a “cultural currency,” or the symbolic worth of the Sherlock Holmes character in terms of Edwardian and early Georgian British culture.

By the turn of the twentieth century, British audiences seemed more concerned with the threats posed by international politics than the threats posed by common criminals or disgraced gentry members. As a result of this new found fear, the Holmes character shifts his attention to cases that involve threats to the British establishment. I wish to argue that not only did Post-Reichenbach Falls readers invest different material into the Post-Reichenbach Falls stories, but they also placed far more stock into the character of Sherlock Holmes during the Post-Reichenbach Falls era. No longer were readers simply placated by a Holmes character involved in the private affairs of English country houses, Holmes’s readers desired to have their “great detective” involved in issues of British security. Namely, in the Post-Reichenbach Falls era, the readers of the Sherlock Holmes stories invested heavily in Holmes as a character because he could dispel some of their fears about the perceived European threats to British imperial hegemony. In essence, the Post-Reichenbach Falls era stories increase the cultural worth of Sherlock Holmes as a character because in these stories he is heavily involved in the machinations and workings of imperial British politics, and therefore his value as a literary figure is much higher in the Post-Reichenbach Falls era than the Pre-Reichenbach Falls era.

It is my assertion that this change in the cultural currency of the Post-Reichenbach Falls era Sherlock Holmes is a product of the social and political upheavals of the Edwardian and early Georgian periods, and not the product of Conan Doyle’s changing political and social beliefs, as biographer Andrew Lycett argues. Instead, I contend that the three specific political and cultural factors that lead to a shift in the cultural currency of the Sherlock Holmes character in the Post-Reichenbach Falls era are as follows: 1) the influx of central and eastern European immigrants into Great Britain around the turn of the century and the resulting xenophobic fears of anarchism and immigrant radicalism, 2) the rise in “well directed and concerted strikes” promoted by “more militant trade unionists” in Great Britain between the years 1910 and 1914 (Briggs 1964, 97), and 3) the popular rise in “British Germanophobia” resulting from the naval arms race between the British Royal Navy and the German Kaiserliche Marine (Kestner 1999, 212). All of these political and cultural factors found their way into the Post-Reichenbach Falls Holmes stories, and they forever changed the cultural currency of not only Sherlock Holmes but also succeeding fictional detectives. For the Post-Reichenbach Falls era, this change in cultural currency meant that the Sherlock Holmes character transforms from a once Bohemian fin-de-siècle figure who can “penetrate the foggy chaos of London with his mastery of disguise and his uncanny ability to guess occupations through telltale signs,” into a more conservative, nationalistic, and political figure (Damrosch and Dettmar 2006, 1556).

In doing all of this, my argument seeks to change the way in which readers view and understand both the Pre-Reichenbach Falls Holmes and the Post-Reichenbach Falls Holmes; for, undoubtedly, Holmes stands alone as the premiere archetype of the fictional detective. Although Holmes was certainly not the first detective in English or English-language fiction (that honor belongs to Edgar Allan Poe’s C. Auguste Dupin), he has become “the detective, a near-mythic character whose cloak and deerstalker cap, pipe and magnifying glass have defined our image of the ‘private eye’ for over a century” (Damrosch and Dettmar 2006, 1556). Without the ability to draw upon the precedents set by the Pre-Reichenbach Falls era as well as the Post-Reichenbach Falls era, then other famous fictional detectives such as Raymond Chandler’s Philip Marlowe, Georges Simenon’s Jules Maigret, and Agatha Christie’s Hercule Poirot would not have a model to either imitate or politely reject. In essence, when the Post-Reichenbach Falls era shift in cultural currency dictated that Holmes should be involved in cases with international meaning, then the cultural currency for all succeeding fictional detectives changed as well.
Analyzing the Pre-and Post-Reichenbach Falls is Elementary

If we are to proceed in analyzing the political and cultural transformations of Sherlock Holmes as a character, then a closer examination of the Pre-and Post-Reichenbach Falls Holmes stories is called for. The first appearance of Sherlock Holmes, alongside his ever-faithful chronicler Dr. John Watson, was in the 1887 novel *A Study in Scarlet*. In the novel, Holmes and Watson are called upon to solve a murder in Brixton. The victim, one Enoch Drebber of America, is found strewn under a wall with the German word “Rache” written in blood above his lifeless corpse. “Rache” is German for revenge, and Drebber’s killer, Jefferson Hope, explains his use of this particular word at the crime scene by stating that

“I don’t know what it was that put it into my head to write upon the wall with it. I don’t know what it was that put it into my head to write upon the wall with it. Perhaps it was some mischievous idea of setting the police upon the wrong track, for I felt light-hearted and cheerful. I remember a German being found in New York with RACHE written up above him, and it was argued at the time in the newspapers that the secret societies must have done it. I guessed that what puzzled the New Yorkers would puzzle the Londoners, so I dipped my finger in my own blood and printed it on a convenient place on the wall.” (Conan Doyle 2003, 1:91).

By “secret societies,” Hope is referencing the shadowy and much feared anarchist and socialist movements that were large parts of Victorian American and British social consciousness (Leeds Mercury 1887). It is also noticeable that this crime, with its use of a German word, links these “secret societies” with non-Anglophonic Europeans. But we must also recognize that Jefferson Hope is a U.S. national and this German threat is all a ruse meant to deflect suspicion away from him. This action by Hope speaks to the level of fear that late Victorian society had of foreigners and their supposed predilection for crime.

This fear of the criminal foreigner would only increase during the Edwardian and early Georgian eras due to the massive influx of central and eastern European immigrants into Great Britain during the late nineteenth century and early twentieth century. As a result, by the turn of the century, the epicenter of the British Empire, London, had become the focal point of “national anxiety” (Blom 2008, 340). The Edwardian slums of London, which teemed with overcrowded tenements mostly populated by working class central and eastern European immigrants, painted “a disturbing picture” (Blom 2008, 340). A Post-Reichenbach Falls story that deals with this issue of unwanted European immigration is “The Adventure of the Red Circle (1911),” which “concerns a dangerous Italian secret society” known as the Red Circle (Kestner 1999, 212). The criminal antagonist of “The Adventure of the Red Circle” is Giuseppe Gorgiano, who is described as “a devil and a monster” (Conan Doyle 2003, 2:408). This motif of the dangerous foreigner, which can be stretched into the larger context of the dangers posed by foreign nation-states, is a recurring one in the Post-Reichenbach Falls era Holmes stories.

These more internationally-minded Post-Reichenbach Falls Holmes stories, which will be discussed more in-depth shortly, describe Holmes as more willingly involved in the actual apparatuses of the British government, hence Holmes’s fin-de-siècle Bohemianism is replaced by a more nationalistic Edwardian and early Georgian conscience. More importantly, unlike the Pre-Reichenbach Falls Holmes stories, where the European threat to British power is perceived as being as fabricated as Jefferson Hope’s intentional ruse, the European threat to Great Britain is real in the Post-Reichenbach Falls era. While foreigners are threatening in both the Pre-and Post-Reichenbach Falls stories, only in the Post-Reichenbach Falls stories are these foreigners linked to larger political mechanisms. In the Pre-Reichenbach Falls stories, dangerous Australian, South African, Anglo-Indian, and American criminals antagonize Holmes and Watson. But these criminals are individual nuisances who terrorize private individuals. In the Post-Reichenbach Falls era, German, Russian, and Italian criminals are usually connected with larger threats to British domestic and foreign hegemony. German spies Hugo Oberstein and Von Bork may operate within British soil, but they are clearly written as being motivated if not directed from Berlin. Likewise, the culprit in “The Adventure of the Golden Pince-Nez” has strong ties to Russian revolutionaries.

In her article “The Visible Empire and the Empire At Home, 1832-1905,” Dr. Antoinette Burton asserts that Victorians were “preoccupied with a pure, unadulterated Englishness” which eventually manifested itself into the Aliens Act of 1905, which was “designed to curb...the displacement of the native-born.” The act, which for the first time set immigration controls and introduced registration in Great Britain, was also designed to prevent undesirable immigrants from coming into British ports. In the first article of the Aliens Act of 1905, anti-immigrant attitudes are clearly discernable:

An immigrant shall not be landed in the United Kingdom from an immigrant ship except at a port which there is an immigration officer appointed under this Act, and shall not be landed at any such port without the leave of the that officer given after an inspection of the immigrants made by him on the ship, or elsewhere if the immigrants
are conditionally disembarked for the purpose, in company with a medical inspector, such inspection to be made as soon as practicable; and the immigration officer shall withhold leave in the case of any immigrant who appears to him to be an undesirable immigrant within the meaning of this section.

Most historians today recognize the Aliens Act of 1905 as a piece of legislation that sought to curtail further Irish, South Asian, and Russian Jewish immigration into Great Britain, as well as a good example of how widespread anti-immigration sentiments in Great Britain were during the time period.

Beginning in the Pre-Reichenbach Falls era and then becoming a main point of concern in the Post-Reichenbach Falls era, Sherlock Holmes takes on the role of a sort of surveillance mechanism for British imperialism, which “was, and remains, notorious for the kind of surveillance it turned on native peoples in all its dominions” (Aliens Act of 1905). As such, critic Martin Kayman asserts that Victorian (and in my opinion Edwardian and early Georgian) detective fiction is “a literary reflection of, if not propaganda for, a new form of social administration and control based on state surveillance” (Kayman 2003, 44). During the Pre-Reichenbach Falls era, Holmes’s efforts at domestic and state surveillance are undertaken in response to the threats posed by returning colonists. Thus, Holmes is called upon to solve crimes that are committed by the machinations of Americans, Australians, South Africans, and Anglo-Indians operating in and around southern England. During the Post-Reichenbach Falls era, however, Holmes’s skills are called upon in both domestic and foreign cases that involve the machinations of central and eastern Europeans. This is one instance of the shifting cultural currency of the Holmes character; for, because of the political anxieties of the Edwardian and early Georgian eras, British readers were no longer worried about the threats posed by the colonies. Edwardian and early Georgian British audiences were instead worried about the threats posed by increasingly powerful European nation-states and their nationals.

While certain Pre-Reichenbach Falls stories like “A Scandal in Bohemia” (1891) establish Holmes as a willing participant in international matters, it should be duly noted that for the most part these affairs are private ones amongst upper to upper middle class individuals.4 Far more common during the Pre-Reichenbach Falls era are stories like “The Adventure of the Crooked Man” (1893), “The Five Orange Pips” (1891), and the oft-cited “The Adventure of the Speckled Band” (1892). In these stories, Holmes and Watson immerse themselves in cases which originate in Anglophone lands and which involve British citizens who have spent many years in either the colonies or the former colonies. “The Five Orange Pips” concerns the machinations of the Ku Klux Klan against British subjects, while “The Adventure of the Speckled Band” is primarily an entirely domestic story with only the spectre of India apparent in the story’s antagonist, Dr. Grimesby Roylott. In “The Adventure of the Crooked Man,” Holmes establishes that Henry Wood, a jilted lover who was sent on a suicide mission by his superior during the Indian Mutiny, is responsible for the death of Colonel Barclay, his former superior in the army and his former rival for the hand of Nancy Barclay.5 This story deftly combines private, drawing-room melodrama with actual military history. In this regard, “The Adventure of the Crooked Man” echoes the second Holmes novel, The Sign of the Four. In that novel, Holmes is called upon to solve the crime of murder committed against Captain Morstan, a former British Army officer in India. The culprits, Jonathan Small and Tonga, an Andaman Islander, are members of “The Sign of the Four,” a collection of three military convicts and one guard, who have sworn to secrecy the location of a treasure stolen during the Indian Mutiny. Once again, in the Pre-Reichenbach Falls era, Holmes asserts his abilities in cases that involve British domestic disturbances caused by returning subjects from the colonies.

The Pre-Reichenbach Falls era also establishes Holmes as a figure entrenched in the Victorian pseudo-science of phrenology as well as the burgeoning science of criminology. Holmes’s links to these pseudo-scientific fields is in large part due to the Victorian cultural uncertainties about what “Englishness” truly denotes. As Ronald R. Thomas states in his article “The Fingerprint and the Foreigner: Colonizing the Criminal Body in 1890s Detective Fiction and Criminal Anthropology,” the character of Sherlock Holmes “should be understood as the literary personification of an elaborate cultural apparatus by which persons were given their true and legitimate identities by someone else” (Thomas 1994, 655). As such, the popularity of Holmes was “made possible by the successful colonization of the minds of English citizens” (Thomas 1994, 657). This colonization of the collective British social consciousness manifests itself within the Pre-Reichenbach Falls Holmes stories in ways that Thomas believes are directly connected back to British political policies:

Holmes’s emergence as an authoritative cultural hero in the 1880s and 1890s corresponds to a transformation of Britain’s national identity during the same period. Notably, during the first few years of the 1890s, Britain’s identity as a nation-in its own eyes and the world’s-was being radically redefined with respect to its vast global empire. Once an embattled and suspect pursuit, a ‘New Imperial-
While Thomas’s argument is sound, it is my contention that Holmes’s involvement with Victorian pseudo-scientific issues is more connection with Holmes’s status as an intellectual. As critic J.K. Van Dover aptly puts it, Sherlock Holmes, as a “detective, who claims to speak the language of the thinking scientist yet who acts morally in the sphere of the common man, offers an imaginative bridge between the two worlds of the scientist and the layman” (1994, 24). As such, the Pre-Reichenbach Falls tales explore “the heroism of the intellectual,” and the Pre-Reichenbach Falls era focus upon pseudo-scientific issues of ‘Englishness’ are a part of the general academic discussion of the time, and directly involved in the politics of New Imperialism. In several of the short stories, Holmes is depicted as a functioning, if not a little erratic academic of sorts. In Pre-Reichenbach Falls story “The ‘Gloria Scott” (1893), Holmes reveals to Watson that he developed his “own little methods” of criminal detection during his two year stint in college (Conan Doyle 2003, 1:446). Similarly, in the Post-Reichenbach Falls story “The Adventure of Bruce-Partington Plans” (1912), Holmes is shown to be the author of a monograph concerning “the Polyphonic Motets of Lassus” (Conan Doyle 2003, 2:430). Holmes’s cultural currency as an intellectual hero continues through both the Pre-Reichenbach Falls era and the Post-Reichenbach Falls era.

Holmes’s involvement in other scientific issues is continued throughout the rest of the canon. In both eras, Holmes is described as having interest in the pseudo-science of physiology, which dictated that criminals and other social deviants could be identified as such by merely charting their physical characteristics. For Holmes’s purposes, physiology served “to indentify the criminal body” (Thomas 1994, 657). As such, in the final Pre-Reichenbach Falls story “The Final Problem (1893),” Professor James Moriarty, the so-called “Napoleon of crime” is described as having “hereditary tendencies of the most diabolical kind” (Conan Doyle 2003, 1:559). Furthermore, “a criminal strain ran in his blood, which, instead of being modified, was increased and rendered infinitely more dangerous by his extraordinary mental powers” (Conan Doyle 2003, 1:559). The importance of “The Final Problem” cannot be understated, for, as a story, it hints at the thematic direction in of the Post-Reichenbach Falls era stories. “The Final Problem” has both an international setting (the majority of the story takes place in Switzerland) and the story also comments upon the dangerous nature of foreigners, since Professor Moriarty has Irish blood. In a similar vein, in the Post-Reichenbach Falls story “The Adventure of Charles Augustus Milverton (1904),” Holmes’s reliance upon physiology is evident in Watson’s description of Charles Augustus Milverton, the “king of all blackmailers.”

Charles Augustus Milverton was a man of fifty, with a large, intellectual head, a round plump, hairless face, a perpetual frozen smile, and two keen gray eyes, which gleamed brightly from behind broad, gold-rimmed glasses. There was something of Mr. Pickwick’s benevolence in his appearance, marred only by the insincerity of the fixed smile and by the hard glitter of those restless and penetrating eyes. (Conan Doyle 2003, 2:113-114)

As the excerpt above shows, Holmes’s method of criminal deduction relies heavily upon notions of “otherness,” i.e. Holmes makes assumptions about his antagonists by merely charting their physical appearances as they either correlate to or run counter to accepted notions about the proper Englishman. In this regard, Holmes’s method of detection is heavily indebted to the work of Italian criminologist Cesare Lombroso. In his 1876 book Criminal Man, he “presented his theory of the ‘atavistic’ or born criminal” (Hoobler and Hoobler 2009, 165):

Lombroso held that criminal deviance arose because of biological traits that made criminals less fully evolved than other members of society. These throwbacks could be identified by outward physical traits that Lombroso called stigmata. Such traits included a low forehead, bushy eyebrows, and long arms that gave the individual an apelike appearance. Other indicators of criminal tendencies were excessively large or small hands, too large jaws or cheekbones, oversize lips, and ears of unusual size. (Hoobler and Hoobler 2009, 129)

Not only did Lombroso’s theory help to inspire later, Social Darwinist criminology theories, it also helped Alphonse Bertillon develop the bertillonage system, or the “system of identification of criminals by anthropometric measurements, finger-prints, etc.” So great was the influence of the bertillonage system that Holmes actually makes a quip about Bertillon and his system to a prospective client in The Hound of the Baskervilles:

‘I am suddenly confronted with a most serious and extraordinary problem. Recognizing, as I do, that you are the second highest expert in Europe—’

‘Indeed, sir! May I inquire who had the honor to be the first?’ asked Holmes, with some asperity.

‘To the man of precisely scientific mind the work of Monsieur Bertillon must always appeal strongly.’

‘Then had you not better consult him?’

ism’ became equated once again with morality and patriotism in England, rising to the status of a national cult also referred to as the ‘Pax Britannica.’ (1994, 656)
‘I said, sir, to the precisely scientific mind. But as a practical man of affairs it is acknowledged that you stand alone. I trust, sir, that I have not inadvertently—’

‘Just a little,’ said Holmes. (Hecht 2003, 165)

This minor jab at Monsieur Bertillon aside, both the Pre- and Post-Reichenbach Falls era Holmes is indebted to the criminology theories and practices of the Victorian and Edwardian ages. Holmes himself not only recognizes these theories, but also practices them as part of his own methods. Holmes is in a position to do this in the stories because, as an illustrated figure, Holmes is depicted as the ideal figure of English intellectualism. As can be seen from the picture, Sidney Paget, the most famous Holmes illustrator in *The Strand* magazine, portrayed Holmes as “not merely a striking but a suavely commanding figure” (Ousby 1976, 160). Holmes is clearly shown to be a relaxed figure, i.e. Holmes is not only a thinking machine characterized by excessive bursts of energy; he is also a creature of leisure. Images such as these, along with the fact that the majority of Holmes stories were published in mass-circulation magazines, established Holmes as the preeminent English middle-class figure. As critic Ousby (1976, 151) asserts, Holmes is “calculated to appeal to a middle-class readership.” In describing Holmes this way, it becomes evident that the Pre-Reichenbach Falls Holmes (and in many ways the Post-Reichenbach Falls Holmes) has a cultural currency that sees him as the model middle-class English citizen. As such, when the cultural currency of the Holmes character in the Post-Reichenbach Falls era shifts, it dictates that Holmes, like a proper British subject, must defend the empire against foreign incursion. In this regard, Holmes popularized a “vigilant policing of the personal identity of the average British citizen” (Thomas 1994, 656). Although there are continuities here between “The Final Problem” and “The Adventure of Charles August Milverton,” it should be recognized that Holmes’s client in the latter story is a British noble subject, Lady Eva Blackwell. In “The Final Problem,” Holmes is his own client looking after his own ends. Once again, the Post-Reichenbach Falls Holmes firmly entrenches himself as a cultural authority within hegemonic British power structures. The Post-Reichenbach Falls Holmes character therefore has a substantial cultural currency, and this cultural currency is invested in him because his readership desired to give him this greater authority. It can be said that not only is the Post-Reichenbach Falls Holmes a more conservative figure, he is also a far more established figure. On a certain level, these two elements run parallel to each other.

**Becoming the Domestic Conservative**

Holmes’s cultural authority and Holmes’s established identity as a distinctly English character themselves undergo transformations, and herein lies the point of contention between the Pre-Reichenbach Falls era Holmes stories and the Post-Reichenbach Falls era Holmes stories: the Pre-Reichenbach Falls Holmes was a character who delighted in the consumption of his own seven-per-cent solution of cocaine and his own Bohemian lifestyle, and who also unequivocally proclaims “I am a consulting detective” in *A Study in Scarlet* (Conan Doyle 2003, 1:18). As a “consulting detective,” Holmes is very much an outsider, even though his work brings him into contact with members of Scotland Yard, namely Inspectors Lestrade, Bradstreet, Gregson, and Hopkins. Of note also is the fact that the Pre-Reichenbach Falls Holmes frequently uses the services of his so-called Baker Street Irregulars, a collection of London street urchins who perform surveillance work in many of the Pre-Reichenbach Falls stories. In the Post-Reichenbach Falls stories, Holmes is far more willing to cooperate with and work as a member of established British authorities, namely British royalty in “The Adventure of Charles Augustus Milverton,” and British government agencies in “The Adventure of Bruce-Partington Plans” and “His Last Bow.” The Post-Reichenbach Falls transformation of the Holmes figure also takes on the shade of political action, i.e. the Holmes stories both bring awareness to political and social problems, and offer solutions. Notably, the Post-Reichenbach Falls era solutions to these problems tend to promote more conservative ideals, such as the need for law and order and the need to maintain im-
perial British hegemony in the face of continental Euro-

The earliest perceived threat to British conserva-
vatism occurred during the Edwardian era with the
ascendency of the Liberal Party, with backing from the
growing Labour Party, in the 1906 election. When Ar-
thur Balfour, the Conservative Prime Minister from 1902
to 1905, resigned in December of 1905, immediate
elections were called for. By 1906, the issue of tariff reform
split the Conservative party, which allowed the Liber-
al Party to form a domestic majority. In the election of
1906, the Liberals swept the day, and immediately set
upon social reform initiatives. This Liberal insistence
upon social reform would, “from 1906 to 1914,” help
to establish “the origins of the mid-twentieth century
‘welfare state’” (Briggs 1964, 87). Within a few years, the
Liberal governments of Sir Henry Campbell-Bannerman
and H.H. Asquith passed sweeping reforms such as The
Old Age Pensions Act of 1908, “which introduced non-
contributory pensions ‘as a right’” and the Mines (Eight
Hours) Act, which “was the first definite statutory regu-
lation of the hours of work for adult males, as distinct
from children or women” (Briggs 1964, 87). These acts
and others frightened British Conservatives who saw
these social reforms as tantamount to Socialism, which
was “growing strength” in Germany and France (Paul
Mall (London) Gazette 1900). This growing fear of social-
ism was also linked back to the ongoing influx of central
and eastern European immigrants into Great Britain. On
Monday, May 14, 1900, an anonymous journalist from
The Pall Mall Gazette characterized European socialism
as thus:

The English nation are profoundly impressed with the su-
preme necessity of adapting their institutions to suit new
needs, while they decline to force the pace to please the
Socialists. It explains, likewise, the enormous and growing
strength of Socialism in Germany, where the sound prin-
ciples of State control that the Socialists would be the first
to adopt are bound up with incompatible dogma of the
divine rights of Kings. It explains the dangers of French
Socialism whose claim for freedom of thought is neces-
sarily irreconcilable with the spirit of authority embodied
in the infallible religion that is at the same time one of the
strongest political forces in the country. It explains the
anarchical spirit of Nihilism, which, in its life and death
struggle with a bureaucratic and military despotism, has
no time to think out a new order of society. (Paul Mall
(London) Gazette 1900)

It is noteworthy that this article links together French
and German socialism with anarchy and nihilism. It
should be noted also that The Pall Mall Gazette is a news-
paper that takes its name from a rather fashionable dis-
trict in London which is known for its large collection
of private, usually upper-class, clubs. In this regard, the
author, who writes for a paper that targets the British
upper middle-class, argues that only the British way of
governance is acceptable in Great Britain. It is therefore
not much of a leap to assume that many Edwardian Brit-
ish subjects viewed socialism and anarchism as entirely
alien notions brought to Great Britain by central and
eastern European immigrants, who were more often
than naught located in the working class slums of East
London. This fear of socialist and anarchist foreigners
is manifested in many Post-Reichenbach Falls stories,
wherein Holmes’s cultural currency invests him with
the authority of British law and order. This same cul-
tural currency shift also dictates that Holmes has the
authority to police the boundaries of the conservative
British class and ethno-social structure.

While Conan Doyle was “nominally a Liberal,” he
nevertheless held “deeply Conservative sympathies”
(Lyce 2007, 129-130). Throughout much of his life,
Conan Doyle “enthusiastically supported” the British
Empire and all of its endeavors.7 Conan Doyle’s “Con-
servative sympathies” manifest themselves in certain
Post-Reichenbach Falls era Holmes stories (Lyce 2007,
129), wherein Holmes is no longer portrayed as a “Bo-
hemian redolent of foggy late-Victorian England” but as
“a sadder figure, who, though still nominally operating
around the turn of the century, was ill at ease with the
mores of a harder, modern age” (Lyce 2007, 446). Even
without the political sympathies of Conan Doyle, the
transformation of Holmes into a more conservative char-
acter seems inevitable in the light of his anxious middle-
class readership and his changing cultural currency; for
the shift in the type of cases Holmes deals with is due to
the fact that fears of foreign radicalism, fears of an in-
creasing power in Germany, and fears of labor violence
were all on the minds of the people who devoured the
Holmes stories during the Post-Reichenbach Falls era.

Holmes, as a character, has cultural currency
as a figure symbolic of an idealized not-so distant past.
Born of a more conservative late Victorian era, he is sad-
dened most by the rapid social transformations that took
place during the Liberal period of political power (1906-
1922). More specifically, the Post-Reichenbach Falls Hol-
mes stories can easily be read as correlating the rapid
Liberal social reforms with the supposed breakdown in
traditional Victorian mores. For instance, Holmes is dis-
gusted by the tactlessness of “Baron Gruner’s ‘lust diary’
of female conquests” in the story “The Illustrious Cli-
ent” (1924) (Lyce 2007, 446).

Although we do see a more dour Holmes in
the Post-Reichenbach Falls stories (which might have
something to do with his aging, after all), Holmes nev-

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albeit reforms that favor native British middle-class persons. Unlike the much more domestically inclined Pre-Reichenbach Falls era Holmes stories, the Post-Reichenbach Falls era has Sherlock Holmes more involved in cases with international roots. Two stories in particular, “The Adventure of the Six Napoleons” (1904) and “The Adventure of the Golden Pince-Nez (1904),” have Holmes involved in cases that examine “culture in the context of social disturbances and terrorism” (Kestner 1999, 91). In “The Adventure of the Six Napoleons,” Holmes, Watson, and Inspector Lestrade investigate a series of disturbances in London whereby some unknown assailant keeps smashing privately-owned busts of Emperor Napoleon I. Much like the later “The Adventure of the Red Circle,” “The Adventure of the Six Napoleons” involves crimes committed by an Italian immigrant (Beppo), who is described as “an alert, sharp-featured simian man with thick eyebrows, and a very peculiar projection of the lower part of the face like the muzzle of a baboon” (Conan Doyle 2003, 2:130). Similar to “The Adventure of Charles Augustus Milverton,” Holmes and Watson both view their antagonist as something foreign, in this case as something close to an animal; for Watson clearly describes Beppo as behaving similarly to “a hungry wolf” (Conan Doyle 2003, 2:137). This nativist loathing of immigrants is also coupled with a pseudo-scientific conjecture that sees these central and eastern European immigrants as atavistic in comparison to average British subjects. This same pseudo-scientific belief in the atavism of central and eastern European foreigners was coupled with a strong belief in the inherent threat of radical politics:

In the manuscript, Doyle had originally described Beppo as ‘missing link’ (381): foreigners and/ or revolutionaries are associated with atavisms and the frightening theories of evolution. The animus against Napoleon is thought to be ‘madness’ (176) or a ‘monomania’ (179), so the culture is beset by a wide range of fears...The fact that the busts are of Napoleon might also suggest massive power drives and the fantasies of the men who purchase them. That the manager of Gelder’s is ‘a big blond German’ with ‘blue Teutonic eyes’ (186, 187) evokes the fear of Germans in Edwardian society, here German potency commanding a company in Britain named Gelder. (Kestner 1999, 93).

The Edwardian and early Georgian British fear of revolutionary foreigners is another important aspect of “The Adventure of the Six Napoleons,” wherein one of the victims claims that Beppo’s actions were all “A Nihilist plot,” and that “No one but an anarchist would go about breaking statues” (Conan Doyle 2003, 2:132). In this story, Holmes himself acts as somewhat of a social reformer, in that he takes it upon himself to rid the London streets of a malign foreign influence. In this sense, Holmes, as a detective, becomes an extension of “rather than anathema to English national identity” (Reitz 2004, xiii). “The Adventure of the Six Napoleons” is very much a story about us versus them, imperial British law and order versus the anarchy and revolutionary spirit of central and eastern Europeans.

Another story that deals with these same issues is “The Adventure of Golden Pince-Nez,” which deals with the murder of Willoughby Smith, the secretary of the irascible Professor Sergius Coram. The murderer in the story is Coram’s “estranged wife Anna” who was formerly “a revolutionary in Russia” (Kestner 1999, 91). At the story’s conclusion, it is revealed that Anna “had tried to steal papers from Coram which would free Alex- is, her lover and fellow anarchist, from imprisonment in Siberia” (Kestner 1999, 91). Upon her capture, Anna herself proclaims to Holmes that “We were reformers-revolutionaries-Nihilists, you understand?” (Conan Doyle 2003, 2:137). Much like “The Adventure of the Six Napoleons,” this story “plays on two areas of concern to the Edwardians and early Georgians, one being the anxiety about anarchy” and the other being a “preoccu-pation” with “Fenian and Socialist disturbances from the later nineteenth century” (Kestner 1999, 92).

Becoming the Conservative Internationalist

Edwardian and early Georgian preoccupations with the “disturbances from the later nineteenth century” had a lot to do with the fact that these “disturbances” had not fizzled out with the conclusion of the nineteenth century (Kestner 1999, 92). Furthermore, two particular concerns re-emerged with a vengeance during the Edwardian and early Georgian periods: the labor movement and Irish nationalism. Both of these movements during these periods became more militant, as well as becoming larger. Labor union membership “rose by two-thirds between 1910 and 1913” and it became clear that “the more militant trade unionists of 1910 to 1914 were openly skeptical about parliament ever being able to accomplish ‘a democratic revolution in the name of labour’” (Briggs 1964, 97). Alongside this new, more militant British labor movement, radical Irish nationalist groups such as the Fenians were becoming a powerful political bloc in Great Britain. These two movements, which certainly caused alarm in bourgeoisie British society, can be found as Sherlock Holmes’s antagonists in the final Holmes novel The Valley of Fear (1915).

Because it was published only a year before the Easter Uprising of 1916, The Valley of Fear’s anti-Irish stance seems fitting in the context of an English novel. And yet the story owes much of its plot to Allen Pinker-
ton's 1877 book Molly Maguires and the Detectives. In that book, Pinkerton chronicles the exploits of James McParlan, a Pinkerton detective who disguised himself as James McKenna in order to infiltrate the Molly Maguires, a secret brotherhood of violent Irish miners operating in the anthracite regions of eastern Pennsylvania (Pinkerton 1973). As a force, the Pinkerton Detective Agency was notorious for “spying on labor organizers” as well as investigating “robberies, murders, and other major crimes” (Repetto 2004, 11). By having Sherlock Holmes linked to a Pinkerton agent (who’s killing of a man he investigates), Conan Doyle links his private detective to Anglo-American feelings of disdain for labor unions and Irish revolutionaries. Arguably, the extensive investment in the cultural currency of the Post-Reichenbach Falls Holmes was done by both British and American audiences. As such, Holmes's cultural currency allows him to be a cultural authority even in America; for, while The Valley of Fear presents specifically British attitudes about Irish agitation, it also involves itself in the historical Anglo-American discourse about the inferior status of Irish-Americans.

Conan Doyle, who ironically was of Irish ancestry and who was also raised Roman Catholic, had a lifelong view of the Irish as “untrustworthy agitators,” and this view is reflected in his fiction when the Irish are depicted as “members of the conspiratorial Molly Maguires or as Professor Moriarty” (Lycett 2007, 25). Furthermore, by setting the majority of the novel's action in America, Conan Doyle links the American struggles against radicalized labor movements with the British one; thus creating a unified bourgeoisie battle against syndicalism. This struggle “echoes the tension of the era in a number of ways:”

With its presentation of the violence of the Scowrers (Conan Doyle's version of the Molly Maguires) in the Vermissa Valley (Conan Doyle's version of the Susquehanna Valley), it deploys the anxiety about terrorist organizations but now in a context of violent labour disputes. The terrorist group is exported from the United States to Great Britain. (Kestner 1999, 346)

Once again we see Holmes involved against an agency of terrorism, much like in “The Adventure of the Six Napoleons,” “The Adventure of the Red Circle,” and “The Adventure of the Golden Pince-Nez.” Likewise, in The Valley of Fear, Holmes, who is “deeply involved in both the incidents and ideology of Empire,” engages in the role of imperial British defender (Reitz 2004, 65-66). In the case of The Valley of Fear, Holmes defends British domestic law and order by involving himself in a case that manages to include both radicalized labor and Irish nationalist militancy. Once again, the Post-Reichenbach Falls Holmes is invested with enough cultural currency that he is able to successfully tackle both of these troubling issues.

Holmes's role as an imperial British watchdog is further advanced in the stories “The Adventure of Bruce-Partington Plans” (1912) and “His Last Bow” (1917). While both T.S. Eliot and Ian Ousby accuse these stories of descending Holmes “to the level of Bull-Dog Drummond,” they are nevertheless in keeping with the Post-Reichenbach Falls era Holmes’s tradition of engaging in matters of British national security (Eliot 1984, 18). These two particular stories, along with the Pre-Reichenbach Falls story “The Naval Treaty” (1893) and the Post-Reichenbach Falls short story “The Adventure of the Second Stain” (1904), form what I call Holmes’s “Major Government Assignments.” These particular stories all share a certain level of Germanophobia, which is only fitting considering that they were all written when the German Empire was Great Britain's military and naval nemesis.

During the Pre-Reichenbach Falls era, Holmes does have some encounters with somewhat sketchy German characters. For instance, in “The Adventure of the Engineer's Thumb” (1892), Holmes becomes involved in the case of Victor Hatherly and his severed thumb. Hatherly, a hydraulic engineer, is recruited by one Colonel Lysander Stark, who is depicted as being a rather shady German criminal, to work on a hydraulic press that is stored in a house in Oxfordshire. Although Hatherly eventually escapes certain death and presents Holmes with a lucid account of his assault, Holmes nevertheless fails to capture Stark and his fellow criminals. Though the German character in that story is presented in a rather unflattering light, he is little more than a common criminal. In the Post-Reichenbach Falls era, Germans become much more sinister.

In the “The Adventure of Bruce-Partington Plans,” Holmes is called upon by the British government to retrieve the stolen blueprints of the Bruce-Partington submarine. While Conan Doyle would go on to write another submarine tale called “Danger!” in 1914, “The Adventure of Bruce-Partington Plans” is indebted to the political climate in which it was written. During the years before World War I, the British Royal Navy and the German Kaiserliche Marine engaged in a significant arms race that put both countries on edge. Germany's “building of a fleet was a direct threat aimed at Great Britain in her most vulnerable spot” (Kemp 1964, 491). Because of this fear of the growing naval might of Germany, the British Royal Navy, under the leadership of First Sea Lord John Fisher, 1st Baron Fisher of Kilverstone, enacted a series of sweeping naval reforms that thoroughly modernized its ships and armaments. This dual spirit of naval intrigue and Germanophobia is cen-
But also of importance is the fact that “The Adventure of Bruce-Partington Plans” is part of a trio of stories that all deal with the same issue. “The Adventure of Bruce-Partington Plans” is more or less a retelling of the Pre-Reichenbach Falls story “The Naval Treaty.” In that tale, Holmes is hired by Percy Phelps, an employee in the Foreign Office, to retrieve an important naval treaty that has been stolen from his office. The treaty itself is described as being of “immense value,” and as such it is feared that the treaty has been stolen by foreign agents (Conan Doyle 2003, 1:157). As it turns out, the treaty was stolen by Joseph Harrison, the brother of Phelps’s fiancée Annie Harrison. Holmes explains that Harrison stole the treaty because he had recently lost a considerable amount of money on the stock market, and he believed that he could pay off his debts by selling the treaty to either Tsarist Russian or French agents. While these two-nation states would later become Great Britain’s allies during World War I, at the time they were perceived as threats to British hegemony. Holmes, as the defender of all things British, steps in and prevents Harrison from completing his task. Since this story is a Pre-Reichenbach Falls tale, the cultural currency invested in Holmes is somewhat less than it will be in the succeeding years. First, this story is almost entirely a domestic intrigue. While foreign plots move in the periphery, the criminal is still a British subject acting upon purely selfish motives. While Colonel Valentine Walter is both a British subject and one of the criminal conspirators in “The Adventure of Bruce-Partington Plans,” his links to foreign intrigue are far more substantial than Harrison’s, thusly continuing the Post-Reichenbach Falls trend of giving substance to the threats that the Pre-Reichenbach Falls stories only hinted at.

Colonel Valentine’s German contact is a man named Hugo Oberstein. Oberstein can also be found in “The Adventure of the Second Stain,” although Oberstein is only mentioned in passing. This story details the theft of a document from the home of Trelawney Hope, the fictional Secretary of State. The document itself is described as a letter “from a certain foreign potentate” who resembles the German Kaiser Wilhelm II (Conan Doyle 2003, 2:211). Hope avidly tells Holmes that if this letter is published, it will cause Great Britain to become “involved in a great war” (Conan Doyle 2003, 2:211). When Holmes eventually foils the machinations of Eduardo Lucas, a fellow spy operating in London, he basically halts the outbreak of an international conflagration. This story serves as a perfect example of Holmes’s shifting and increasingly powerful cultural currency in the Post-Reichenbach Falls era; for Holmes is enough of an authority that the British government entrusts him with the responsibility of preventing a full-scale European war.

Holmes’s rival Oberstein in “The Adventure of Bruce-Partington Plans” and “The Adventure of the Second Stain” in many ways serves as the model for the German spy Von Bork in “His Last Bow.” Both characters, while sharing German heritage, are depicted as being enemies within the island of Great Britain itself. Oberstein’s address is given as “13 Caulfield Gardens, Kensington,” (Conan Doyle 2003, 2:425) while Von Bork’s “English mission” calls for him to immerse himself in an entirely English way of life, a way of life which he oftenmocks to his confidant and fellow spy Baron Von Herling:

“They have strange limits and one must learn to observe them. It is that surface simplicity of theirs which makes a trap for the stranger. One’s first impression is that they are entirely soft. Then one comes suddenly upon something very hard, and you know that you have reached the limit and must adapt yourself to the fact. They have, for example, their insular conventions which simply must be observed.” (Conan Doyle 2003, 2:480-481)

Within the context of the of Holmes’s earlier, Pre-Reichenbach Falls concerns, Von Bork presents such a serious threat because he can “pass” for an English gentleman. On an even more interesting note, Holmes passes himself off as a non-English, Irish-American radical in an attempt to police the cultural and social borders of “Englishness.” In this regard, “His Last Bow” represents both a Pre-Reichenbach Falls thematic continuation, while also presenting a Post-Reichenbach Falls Holmes who positions himself as a key and essential member of the British government.

This story, along with “The Adventure of Bruce-Partington Plans,” blurs the lines between detective fiction and spy fiction. As Reitz (2004, xvi) argues, these Holmes stories contain “intersections and imbrications with other writing, especially the imperial adventure story.” From this vantage point, the Post-Reichenbach Falls stories blur these lines between genres because of the cultural necessity to involve Holmes, as the preeminent fictional British figure, in matters of state security. As such, this Post-Reichenbach Falls era intersection between detective fiction and imperial, quasi-spy thriller narratives solidifies the position that the Edwardian and early Georgian Sherlock Holmes transforms himself into a more conservative figure as a result of both his concerns with social agitation at home and his increasing involvement against threats to British imperial hegemony. In short, Holmes’s conservative internationalism is a product of his cultural currency as the embodiment of British hegemony.
Because of the issues of the Edwardian and early Georgian ages, the Post-Reichenbach Falls era Holmes stories directly refute T.S. Eliot’s assertion that “Sherlock Holmes reminds us always of the pleasant externals of nineteenth-century London” (1984, 17). Not only are the Post-Reichenbach Falls era Holmes stories heavily involved in the socio-political events of the twentieth century, they offer up a cadre of distinctly unpleasant externals and internals that are in need of Holmes’s assistance. For instance, the Post-Reichenbach Falls Holmes combats both the external threats from the industrial and military powerhouse of Germany and the internal threats posed by labor radicals and central and eastern European immigrants. Holmes’s transformation from an almost entirely domestic, Bohemian London figure to a more conservative internationalist is brought about by the socio-political anxieties that plagued Great Britain in the Edwardian and early Georgian eras. The Post-Reichenbach Falls era Holmes stories seem to suggest that as a result of increased political and military threats to the British Empire, it is necessary for Holmes, as the embodiment of British law and order, to confront these threats. Furthermore, these stories seem to also suggest that the more Holmes becomes involved in international matters, the more it is needed for him to become a conservative figure without any attachments to his previous decadence.

Of course, Holmes is in a position to accomplish all of these things because of the shift in cultural currency that occurs between the Pre-Reichenbach Falls era and the Post-Reichenbach Falls era. When readers during the Edwardian and early Georgian periods decided to invest a greater cultural currency in the figure of Sherlock Holmes, they intentionally created a version of the Holmes character who reflected their conservative sensibilities. As such, the Post-Reichenbach Falls era Holmes stories are worthy of critical attention because they clearly display the impact that readers can have upon literary characters. This shift during the Post-Reichenbach Falls era allows Holmes to become a cultural figure, rather than just simply a literary figure. As he stands in our culture today, the Holmes that often gets represented in other forms of media is the Post-Reichenbach Falls Holmes, not the Pre-Reichenbach Falls Holmes.
BIBLIOGRAPHY


NOTES

1. Reichenbach Falls, Switzerland was the location of Sherlock Holmes's supposed death at the hands of his arch rival Professor James Moriarty in “The Final Problem” (1893). Conan Doyle, who had already grown tired of the character, initially intended this to be the final Sherlock Holmes story, but in 1902 he published The Hound of the Baskervilles. This novel details a case which “seems to be set in 1889, long before Holmes’s fatal tumble at Reichenbach Falls” (Freeman 2003, xxxiii). Then, in the 1903 short story “The Adventure of the Empty House,” Holmes tells Watson about how he escaped death and found his way back to London.

2. The Pre-Reichenbach Falls era is composed of the first two Holmes novels, A Study in Scarlet (1887) and The Sign of Four (1890), as well as the stories collected in The Adventures of Sherlock Holmes (1892) and The Memoirs of Sherlock Holmes (1894).

3. Sherlock Holmes enthusiast and editor of both volumes of Barnes & Noble’s The Complete Sherlock Holmes, Kyle Freeman claims that the stories collected in The Return of Sherlock Holmes have plots that “are remakes of older ones” (Freeman 2003, xxvi). Furthermore, Freeman asserts that the stories collected in the final Holmes short story compilation, The Casebook of Sherlock Holmes, are so bad that because of “the poor quality of many of them, the details that differ significantly from the earlier stories, and the erratic characterization of Holmes himself,” many Doyle scholars have “concluded that several stories are spurious” (Freeman 2003, xxxiii). While Freeman comes to the conclusion that several Post-Reichenbach Falls stories are representative of “cartoon fiction” (Freeman 2003, xxxvi), famed British adolescent and detective fiction author A.A. Milne claims that after The Return of Sherlock Holmes, he would prefer it if Holmes would stay permanently retired on “his farm on the Sussex downs” (Freeman 2003, 703).

4. In “A Scandal in Bohemia,” the first Holmes short story, Holmes is involved in a case concerning the Grand Duke of Bohemia and his attempts to retrieve a photograph before his upcoming marriage. In the photograph, the Duke is seen with his former liaison, the American opera singer Irene Adler.

5. The Indian Mutiny, also known as the Sepoy Mutiny, was “an uprising, in 1857 and 1858, against British rule in India” (Freeman 2003, 699). During the rebellion, “Indian soldiers, known as sepoys, who were employed by the British East India Company, massacred the Europeans at Meerut, then joined with other Indian forces as the rebellion spread, but were eventually suppressed by British troops” (Freeman 2003, 699).


7. Conan Doyle was knighted as Sir Arthur Conan Doyle in 1902 after his work in a field hospital and his treatise on the Boer War, The War in South Africa: Its Cause and Conduct. In that treatise, Conan Doyle defended the conduct of the British Army against accusations of war crimes during the Second Boer War (1899-1902).
8. Since many Holmes scholars nominally set the action of this story in 1894, it seems probable that Anna is referring specifically to events in Russia during in 1881. During that year, a Russian anarchist group called Narodniki, “blew up Tsar Alexander II with a bomb” (Wilson 2000, 290-291).
For centuries, authors, poets, and filmmakers have used ghosts for a myriad of purposes. In terms of the cultural history of Poland, ghosts and revenants have appeared throughout several works of literature. Beloved Polish poet and playwright Adam Mickiewicz used the motif of the supernatural in his Romantic poetic drama Dziady (Forefather’s Eve 1823-1832) to propagate the Romantic notion that Poland was a messianic nation doomed to suffer constant martyrdom for the sake of Christian Europe. Likewise, another famous Polish man of letters, Stanisław Wyspiański, wrote his 1901 drama Wesele (The Wedding) using the motif of the supernatural to comment upon the perils associated with Polish independence movements following the November Uprising (1830-1831) and the January Uprising (1863), both of which ended in abject failure. As scholar and author Marek Haltof (2004, 74) points out, Poland has many “phantoms from the nation’s intricate history.” It is therefore not surprising that the motif of the supernatural, and especially the use of ghosts as characters, should appear within the oeuvre of Krzysztof Kieślowski, arguably Poland’s finest film director. In his films Blind Chance (Przypadek 1987), No End (Bez konca 1985), and Decalogue I (Dekalog I 1988), ghosts play important roles not only as observers and watchers, but main characters. In Blind Chance, the main character, Witek Długosz (Bogusław Linda) is first shown to the audience during a flashforward sequence in which he perishes aboard an airplane, rendering him a doomed individual throughout the rest of the movie. In a sense, after the first scene of Blind Chance, Witek is a ghost of sorts. Throughout the rest of Blind Chance, the audience watches as Witek looks “back at his life at the moment of his death” (Haltof 2004, 56). In essence, the audience of Blind Chance gets to indulge in playing the role of Saint Peter by observing and weighing Witek’s various life choices and consequences. In No End, the first character introduced to the audience is the recently deceased lawyer and political activist Antek Zyro (Jerzy Radziwiłłowicz). The character of Antek, while not necessarily a principal character insofar as the film’s action is concerned, nevertheless affects the decisions of the people around him, especially those of his grieving wife, Urszula (Grażyna Szapołowska). The film’s portrayal of “Urszula’s sadness and her gradual alienation from people and the outside world” is linked with her attempts “to erase Antek from her memory” (Haltof 2004, 67). In Decalogue I, death plays the central role in a story about the tragic death of Paweł (Wojciech Klata), the ten-year-old son of university professor Krzysztof (Henryk Baranowski). In the film, both death and a spiritual “God” are present in the character of the so-called Watcher/Angel (Artur Barciś), who, throughout the entire Decalogue series, performs the role of a harbinger in the context of any given film.

Examining these three films on the basis of their metaphysical and supernatural motifs, it becomes clear that, within Kieślowski’s oeuvre, they are undoubtedly his most spiritual. While Kieślowski did not consider himself a practicing Christian, let alone a devout Roman Catholic, these films attest to an underlying belief in “fate and predestination” (Di Bartolomeo 2000, 48). Furthermore, these films, which are intellectually-stimulating and deeply philosophical, create a discourse upon the ever-present nature of death. In a sense, these films are moral tales that are united not only by the presence of ghosts, but also by the presence of death as the answer to all moral quandaries. Essentially, these films highlight and enforce the reality of death as the eventual end for all living beings. I will examine this philosophical assertion by Kieślowski and his co-writer Krzysztof Piesiewicz through the prism of the three types of ghosts that appear in Blind Chance, No End, and Decalogue I: the ghost of fate, the domestic spirit, and the supernatural entity, respectively.

Fate and the belief in chance are the central themes of Blind Chance (hence the title). Originally writ-
ten before the Solidarity period in 1981, *Blind Chance* “was immediately shelved by the authorities after 13 December of that year” (Haltof 2004, 55) due to General Wojciech Jaruzelski’s declaration of martial law. Only in 1987 was *Blind Chance* “quietly released with a group of other distinguished banned films” (Haltof 2004, 55). Of course, by 1987, *Blind Chance* did not inspire a widespread intellectual discussion among Polish viewers, because, as Polish film critic Tadeusz Sobolewski put it, *Blind Chance* was seen as “a souvenir of the past” (Haltof 2004, 63). Regardless of its unfortunate (very) late release, *Blind Chance* still presents a “pessimistic philosophical parable on human destiny shaped by occurrences beyond individual control” (Haltof 2004, 62), which was an undoubtedly relatable concept for those still behind the Iron Curtain.

This theme of destiny revolves around Witek’s ability to catch a Warsaw-bound train leaving Łódź Central Station. In three segments, we see Witek as a “young party apparatchik manipulated by old party functionaries, a dissident activist involved in underground publishing and a person isolated from others by his desire for privacy” (Haltof 2004, 56). Despite the fact that *Blind Chance* was made in a Poland that was severely divided by politics, Witek, in all three segments, is basically the same man: “sincere, honest, decent, passionate, eager to act and trying to do his best given the circumstances” (Haltof 2004, 61). Witek’s ability to remain a decent human being regardless of his politics, all the while his story eventually ends in his untimely death aboard a plane bound for Libya suggests the belief that no matter the choices we make in life, death is inescapable. As Kieślowski himself said, “the third ending is the one which means the most to me—the one where the aeroplane explodes—because one way or another, that’s going to be our fate” (Stok 1993, 113). But *Blind Chance* is not simply a nihilistic parable about the inescapability of death; it clearly depicts the importance of making good, moral, and ethical choices throughout life. Accordingly, the third section of *Blind Chance* is the most important for several reasons. First, the third section of the film not only refutes the messages of the earlier two sections, it in fact refutes the dictum that a person must take a stand in life. This notion that a person must never trod a middle path is a strong current within Slavic culture; from the works of Russian authors such as Dostoevsky and Tolstoy to the Romantic Polish tradition of glorifying national martyrs, the idea that an ethical and moral life could be achieved without attachment to a greater cause would seem ludicrous. Furthermore, Witek’s third decision not to involve himself in politics and instead to focus on his wife and children seems even more preposterous, considering that Witek’s background marks him as heir to the mantle of a distinctly Polish hero:

The protagonist (Witek) is born on 27 June 1956 in Poznań. The opening scene in a hospital, filled with the dying and wounded, blood on the floor, refers to the violent workers’ protest in Poznań in June 1956...During the strike, which concerned working conditions, reduction of work loads and salary increases, riots broke out and the army and security forces intervened and opened fire on the protesters...Witek reveals to his girlfriend Werka that both his great grandparents participated in the 1863 uprising...against the tsarist regime, that his grandfather took part in the ‘Miracle on the Vistula’—the decisive battle on the outskirts of Warsaw during the 1920 Polish-Soviet War, and that his father participated in the September 1939 campaign against the advancing German troops and in 1956 took part in the Poznań strikes (Haltof 2004, 57).

Witek’s final decision to pursue a life devoid of politics or Polish national causes presents a unique moral question specific to Kieślowski’s Polish audience: what if a potential Polish hero just simply decided not to be a hero?

*Blind Chance* showcases in the first two segments what happens when Witek decides to pursue each of two opposite paths—the first as a functionary in the Communist Party, the second as a member of the anti-Communist movement. In both instances, Witek ends disillusioned, heartbroken, and dissatisfied over his choices. In the third segment, Witek’s choice to lead a moral and ethical life devoid of politics does not prevent him from dying an unfortunate death aboard an airplane. Taken as a whole, *Blind Chance* is a film about a man whose life is completely encircled by death. In the sequence introducing Witek’s unified past, after the flashforward prologue, Witek’s mother perishes, along with Witek’s twin brother, during childbirth. In the film’s final sequence, the audience sees the image of Witek’s plane exploding only seconds after take-off. This tragic ending seems odd considering that Witek does not board the doomed airplane in either segments one or two, and the third segment clearly portrays Witek as being content with his decision to remain outside of politics. In this regard, Witek suffers moral and spiritual deaths in segments one and two. Although not physical deaths, the symbolic deaths in segments one and two are depicted as being more damaging to Witek, while his death is the third segment is only repugnant because it is so unexpected and tragic in the way that any unfortunate passing is.

Witek, as the film’s Everyman, showcases the reality that all human choices lead to death. Especially considering the film’s title, *Blind Chance*, death is shown as an extension of fate and destiny; the entire film’s premise of the consequences of choice and chance are rendered moot by the film’s climax. The basic under-
lying thesis of Blind Chance is that we, like Witek, will be rendered ghosts someday because we cannot avoid death as our ultimate fate. Fate and death are interlinked in Blind Chance, and as such the physical act of death is composed of fate and chance. Rather than seeing this reality as the foundation for a nihilistic outlook, Blind Chance presents a narrative that explicitly shows death as neither a reward nor a punishment, but only as an unexpected facet of daily life. Witek is therefore a “ghost of fate,” or rather a victim of fate, as we all are.

Much like Blind Chance, No End begins with the recognition of a death and ends with the actual death of one of the main characters. While the film itself follows the emotional turmoil of Urszula Zyro after the death of her husband Antek, the opening scene of No End foreshadows the motif of death and spirituality. As Haltof (2004, 66-67) describes it, the “opening scene offers a bird’s-eye view of a cemetery with flickering, burning candles during the All Souls’ Day on 1 November—a genuinely meaningful day in Poland.” This opening scene, combined with Zbigniew Preisner’s somber and ominous musical score, “sets the dreary and melancholy tone of the film and introduces its major themes of death, memory, and love” (Haltof 2004, 67). The death at the center of No End is that of activist lawyer Antek Zyro. It is important to notice that the second sequence has the ghost of Antek explaining to the viewer that his death was abrupt and sudden. Haltof (2004, 71) sees a connection between Antek Zyro’s sudden death and “the abrupt termination of the Solidarity movement on 13 December 1981.” While Haltof’s reading is a bit too facile only because the link between Solidarity and the death of Antek seems too convenient, “No End serves clearly as the symbol of the suppressed” (Haltof 2004, 71). Much has been written about No End and its presentation of the post-Solidarity, martial law era mindset, and undoubtedly the film takes a pessimistic view of the state of Polish politics and society in the early 1980s. This pessimistic outlook is embodied in the presence of the ghost of Antek; for, he, much like Witek in Blind Chance, represents a failed Polish hero, mainly because he is dead. For the rest of the characters in No End and especially so for Urszula and the defense lawyer Labrador (Aleksander Bardini), the ghostly residue of Antek’s idealism, legal abilities, and his seemingly overall goodness of character prove hard to overcome. In fact, one could argue that Urszula’s suicide at the end of the film was due to her inability to escape the emotional vacuum left by her husband.

The ghost of Antek, much like the character of Count Dracula in Bram Stoker’s 1897 novel Dracula, is sensed more than he is actually seen. The ghost of Antek “appears seven times throughout the film, either silently observing Urszula or intervening in her daily matters” (Haltof 2004, 70), and, furthermore, the presence of the ghost of Antek is mainly felt through a series of puzzling occurrences throughout the film:

Laborador’s watch, a gift from his student [Antek] Zyro, falls and stops during his conversation with Darek’s [an imprisoned Solidarity activist who was formerly a client of Antek] wife Joanna (Maria Pakulnis), while a man in black (perhaps Zyro) passes by; the mysterious red question mark appears on the directory of attorneys next to Labrador’s name; Urszula’s Volkswagen car stops on the street for no visible reason, saving her, in all likelihood, from a deadly accident; a newspaper disappears which is important in the context of the worker’s trial. In another scene, when Darek awakens in his prison cell during the hunger strike, the ghost is there and quietly looks at him. As a result of this visit, Darek changes his mind and ends this suicidal action (Haltof 2004, 71).

Although the ghost of Antek affects all the principal characters within No End, his presence is most strongly felt by his wife Urszula, and that is why I have termed him a “domestic spirit.” For the most part, No End focuses upon the impact of Antek’s death upon Urszula. Urszula’s grief over Antek’s death is only further heightened by the fact that Urszula is the only character who can both directly see and interact with the ghost. In one important scene, Urszula is unable to be hypnotized into forgetting about Antek because Antek’s ghost in the room with her. Even in the scenes where Antek is not physically present, his spirit remains as a force throughout the film’s entirety. This sense is heightened by the fact that the audience actually takes on Antek’s role as watchers and observers in the scenes where the ghost of Antek is not directly portrayed. The audience therefore is closely linked with the character of Antek, which can stem from the process of movie-going, with audience members acting like watching spirits amidst the action of characters who are unaware of their presence. In the final sequences of the film, the camera is positioned behind Urszula as she goes about the process of suicide via a gas-filled, open stove. This specific camera angle represents the point of view of the ghost of Antek, which is also the point of view of No End’s ghost-like audience. Once again, much like in Blind Chance, the audience is placed in the position of the ghost, this time the ghost of Antek.

No End and Blind Chance also share the motif of a central philosophical discussion surrounded by the reality of death. The central discourse at the heart of No End is the extent to which a person can truly overcome the memory of a lost loved one. Urszula, because she commits suicide at the film’s conclusion, answers this question with the assertion that some things are
insurmountable. While one can argue about her moral character or the rightness of her final decision to commit suicide, none can argue that Urszula is the character that the audience is supposed to empathize with most. Since No End details the many emotional hardships that Urszula is forced to deal with, her suicide at the end is somewhat justified by the film’s previous one hundred and four minutes. In this sense, No End de-vilifies Urszula’s suicide much in the same way that Blind Chance de-vilifies Witek’s multiple decisions. The charge that Urszula’s suicide is selfish because it leaves her son, Jacek (Krzysztof Krzeminski), without parents, is slightly neutralized by the fact that Jacek seems to be aware not only of his mother’s decision but also of her deep emotional pain. Lastly, Urszula’s suicide is depicted as leading to a reunion with her husband in a somewhat bleak final scene, which depicts the couple walking away from the camera into a brightly-lit, park-like setting. Death, which is also present in the first scene in No End, bookends the film with a somewhat happy ending (Happy Ending was initially the proposed title for No End). As in Blind Chance, the central concepts and philosophical questions of No End are answered by death. Even more so than Blind Chance, No End is intrinsically a meditation on death and its presence in our lives. As Kieślowski stated in an interview with Danusia Stok (1993, 134), “there’s a need within us—not only a need but also a fundamental kind of feeling—to believe that those who have gone and whom we dearly loved, who were important to us, are constantly within or around us.” Urszula’s suicide at the end of No End is not only a recognition of her inability to continue on living, but it is also the recognition that some people must “give-up the ghost” because that is simply their destiny.

In Decalogue I, the first installment of Kieślowski and Piesiewicz’s ten-part series continues much in the same vein as Blind Chance and No End with its ostensible central motif concerning the death of Paweł. But unlike Blind Chance or No End, the spiritual and the supernatural are far more potent in Decalogue I. The entire Decalogue series deals with how the Ten Commandments are followed and practiced in our everyday life, and Decalogue I corresponds with the First Commandment in the Roman Catholic enumeration—Thou Shalt Have No Other Gods Before Me. The presence of spirituality and indeed the presence of a “God” are best exemplified in the character of the Watcher/Angel who appears in the majority of the Decalogue films. Decalogue I is no exception; the Watcher/Angel is first introduced as the mysterious man warming himself by the fire on the fateful pond in the opening scene. The Watcher/Angel character in Decalogue I is symbolic of a seemingly divine force that acts as a harbinger for the ensuing events in the film. Therefore, because Pawel dies after falling through the pond’s ice while skating, the Watcher/Angel’s presence on the icy pond can only be taken as foreshadowing the film’s ultimate tragedy. The Watcher/Angel character, as a manifestation of the supernatural, also points to other strange premonitions throughout the film: “a dead dog, probably frozen to death, found by Pawel; a frozen bottle of milk, and milk that turns sour; and a computer that switches itself on inexplicably” (Haltorf 2004, 82). But even more important than the Watcher/Angel character, who represents the supernatural, is the use of color, specifically blue and green, in Decalogue I.

Kieslowski scholar Dr. Lisa Di Bartolomeo writes in her 2000 article “No Other Gods: Blue and Green in Krzysztof Kieślowski’s Dekalog I” that “blue lighting effects” are used “repeatedly to evoke loss and sadness, and also to suggest the enduring presence of the transcendent, the spiritual” (47). In this sense, the color blue in Decalogue I represents and often foreshadows the death of Pawel. In one of the earliest scenes in the film, Pawel’s grieving aunt Irena (Maja Komorowska) watches television footage of Pawel as he runs with several classmates through his school. This shot of Pawel is “swathed in blue,” which coincides with a medium close-up shot of Irena that is “heavily blue-tinged” (Di Bartolomeo 2000, 50). This presence of blue foreshadows the death of Pawel, and furthermore, this blue-heavy shot is a flashforward much in the same vein as Blind Chance. Both films use the motif of the flashforward to enhance a sense of mystery in their films, and both flashwards display the later deaths of their respective characters, Witek and Pawel.

But blue is not the only color present in Decalogue I; Di Bartolomeo (2000, 49) also points out that the color green points to “a spiritual void, philosophical error, or moral quandary.” Green, within the context of Decalogue I, is most associated with the computer, which, as many scholars have pointed out, is the “false god” associated with the First Commandment. Pawel’s father, the university professor Krzysztof, believes in the “supremacy of calculation and reason, and in the pronouncements of science” (Di Bartolomeo 2000, 49). Krzysztof’s belief in the “false god” of logic, reason, and the computer “seems to incur the wrath of the divine” (Di Bartolomeo 2000, 49), which inevitably leads to his son’s death. In this reading, Pawel’s death is a manifestation of divine anger over the worship of another god, i.e., Krzysztof’s computer. Divinity, in the context of Decalogue I, is ultimately associated with death.

The presence of the divine within Decalogue I is represented by three factors, all of which are associated with the tragedy at the center of the film. First, the Watcher/Angel character is the physical manifestation of the divine or supernatural, and within the context of Decalogue I, the Watcher/Angel character foreshad-
ows the death of Paweł. Second, as already stated by Di Bartolomeo, the presence of the color blue within various scenes of the film invokes not only sadness, but also “fate and predestination” (Di Bartolomeo 2000, 48). Finally, the divine is powerfully portrayed in the scene where a distraught Krzysztof encounters a “makeshift altar with the icon of the Black Madonna of Częstochowa (Matka Boska Częstochowska) in the centre” (Haltof 2004, 83). Krzysztof, unable to control his grief, upends this replica of the foremost Polish religious symbol. Of great symbolic importance, wax from overturned candles dribbles upon “Mary’s face, and the icon now appears to be crying, grieving with the bereft father” (Di Bartolomeo 2000, 55). As with Blind Chance and No End, death is once again at the forefront of not only the symbolism of Decalogue I, but also as the element that ties the entire narrative together.

In accordance with the mode previously established by Blind Chance, Decalogue I presents a non-linear format, with Paweł being already dead by the first frames of the film. Also, much like the aforementioned film, Decalogue I ends with the depiction of Paweł’s death, thus mirroring the Ouroboros-like nature of Blind Chance’s plot. Also, chance plays an enormous role within Decalogue I. The film suggests that Krzysztof’s mortal error is that he trusts his calculations concerning the density of the ice, calculations that suffer because they do not measure or consider the existence of chance. Decalogue I and No End also share plots full of abject misery, arguably making these movies among Kieślowski’s most depressing. Much like the emotional strain endured by Urszula in No End, the final scenes of Decalogue I depict how the death of Paweł leads the previously atheistic Krzysztof to throw himself upon the altar in a makeshift church. Noticeably, Krzysztof’s grieving leads him to commit sacrilege somewhat similar to but by no means comparable to Urszula’s suicide (which is often considered a sin punishable by eternal damnation).

But the truly uniting factor among these three films is their ruminations upon death. All three films strive to show that no matter the given situation or given moral quandary, death is the one constant in our lives. While Witek and Paweł die at the hands of fate, Urszula takes it upon herself to end her own life. In the guise of these three films, death is presented as, on the one hand unknowable and beyond rational logic, while one the other hand allowing for much-desired closure. It must be noted that not only do all of these films offer dialogues upon the nature and presence of death, but that they all also use the motif of the ghost to create and further along this dialogue. Witek in Blind Chance, Antek in No End, and Paweł and the Watcher/Angel in Decalogue I are all ghosts in their representative narratives. Witek and Paweł are ghosts because they are already dead by the first scenes in their representative films, and therefore they are ghosts in all ensuing scenes because the audience already knows their fate. And yet it should be recognized that Witek and Paweł are not necessarily supernatural or traditional ghosts similar to Antek. Witek and Paweł are only ghosts throughout their representative film because both films use the motif of the flash-forward to hint at their eventual deaths in some early shots.

Antek, much like Witek and Paweł, is already dead by the beginning of the film. Antek’s ghost is also highly influential regarding the other characters in No End, with his presence being able to both prevent death (ending Darek’s hunger strike) and provide the catalyst for death (Urszula’s suicide). The Watcher/Angel in Decalogue I is a ghostly entity who foreshadows the death of Paweł by his mere presence. The Watcher/Angel character is also the most supernatural figure in regards to these three films, for his origins and even his humanity can be questioned.

By focusing so much attention upon the inevitability of death, these three films are in fact preparing their audiences for their own deaths. Much scholarship and questionable psychoanalysis (I cannot hide my scorn) has been done on the theory that reading and film audiences are drawn to horror, war, and other genres of violence because these artistic renderings of death aid humans in their search to become comfortable with death. To it put more bluntly, by reading and watching the process of death, humans become more desensitized to the reality of death in their own lives. Blind Chance, No End, and Decalogue I, by presenting philosophical and moral tales about how death exists within our everyday lives, act similarly to horror films in that they allow any given audience member to indulge in his or her fears of death through the films themselves. But we must recognize that these films are not horror films; they do not attempt to either glamorize or fetishize death as many horror films do. These films should instead be seen as continuing the uniquely Kieślowskian theme of depicting the everyday facets of life. Death in these films is devoid of horror or any trace of romance; it is depicted realistically and with great emotional performances from the actors. Underlying this depiction of death as part and parcel of our human existence is the presence of the otherworldly. The appearance of chance, destiny, fate, and the Watcher/Angel character all point to the subtle theme of a spiritual presence throughout these three films.


PHYSICAL & NATURAL SCIENCE
TUNABLE SINGLE-WALLED CARBON NANOTUBE FLUORESCENCE EMISSION VIA ASSOCIATED DNA SEQUENCE

Jourdan T. Aromin  
Bridget D. Dolash  
Letha J. Sooter

Abstract

Single-walled carbon nanotubes, or SWCNTs, are nanomaterials that possess unique characteristics, most importantly their differing structural arrangement in terms of chirality. Each single-walled carbon nanotube exhibits a unique fluorescence spectra that is dependent upon its chirality. The association of single-stranded DNA (ssDNA) with SWCNTs is monitored by near-infrared fluorescence spectroscopy. The DNA:SWCNT hybrid exhibits fluorescence spectra dependence upon both the selected sequence and the selected chirality.

Introduction

Single-walled carbon nanotubes (SWCNTs) are a type of carbon-based nanomaterial that show unique optical, electrical, and thermal properties. These properties can be manipulated for molecular detection. SWCNTs normally vary in their physical structure in terms of chirality (Saito, Dresselhaus, and Dresselhaus 1998). Variations in chiralities correlate with variations in properties such as diameter and conductivity. Each chirality appears at different wavelengths in optical spectra. This allows the use of optical spectroscopy to differentiate between each chirality. This can be accomplished by analyzing the absorbance and fluorescence emission spectra from SWCNTs. When specific sequences of single-stranded DNA are bound to the SWCNT, changes from the native spectra may also be observed using this method. Comparisons and characterizations of different SWCNT suspensions are therefore straightforward.

SWCNTs are composed of 1-carbon thick walls and are cylindrical in shape. Diameters of SWCNTs typically range from 1 to 2 nm, but vary depending on chirality. The chirality associated with the SWCNT is denoted by a (n,m) system, where n and m represent the number of vector units along their corresponding directions. These units in each direction dictate how the SWCNT will wrap around itself, which in turn alters the interactive properties of the SWCNT. SWCNTs can be synthesized using chemical vapor deposition (CVD). CVD is a process in which gaseous molecules are decomposed into their reactive species, eventually resulting in new particle growth (Che et al. 1998). CVD allows the production of these SWCNT and provides control over the synthesized structure.

A major challenge in the characterization of carbon nanotubes is their extreme hydrophobicity. In order to overcome poor aqueous solubility, SWCNTs must be dispersed using a surfactant such as sodium dodecyl sulfate (SDS) or sodium cholate. Aqueous dispersion of SWCNTs can also be achieved by using DNA, which has a stronger association than other surfactants (Sánchez-Pomales, Santiago-Rodríguez, and Cabrera 2009). It is hypothesized in the literature that the DNA interacts with SWCNTs through non-covalent interactions, in particular through π-stacking between the nucleotide bases of the DNA and the highly π-conjugated sidewalls of the SWCNTs (Yang et al. 2008; Zheng et al. 2003). Efficient dispersal depends on the sequence of DNA used—most effective short sequence identified being a 30-nucleotide alternating thymine-guanine nucleotides (TG15) (Zheng et al. 2003).

Here, SWCNTs were dispersed by SDS or varied DNA sequences. The SWCNTs are sonicated with the surfactant to produce DNA/SWCNT or SDS/SWCNT conjugates. The conjugates were characterized by ultraviolet-visible (UV-VIS) and near-infrared (NIR) absorbance spectroscopies and NIR fluorescence spectroscopy. UV-VIS spectroscopy allows a method of quantifying the concentration of DNA attached to SWCNTs by comparing it to the SDS sample, void of DNA, attached to the same chirality. The SDS/SWCNT spectra serve as a background spectra allowing quantification of DNA. SWCNTs have spectral features in the NIR region using fluorescence spectroscopy. DNA is void of spectral characteristics in this region. By monitoring changes in the NIR-fluorescence region as the DNA sequence is varied, conclusions can be drawn as to how different DNA sequences interact with individual chiralities of SWCNTs.
Results

Three different chemically synthesized DNA oligonucleotide sequences (IDT, Coralville, IA) were individually sonicated with a mixed SWCNT sample (Sigma-Aldrich, St. Louis, MO). Table 1 lists the three sequences used.

Table 1. Oligonucleotide sequences used with each corresponding name.

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Oligonucleotide Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>T30</td>
<td>5’-TTT TTT TTT TTT TTT TTT TTT TTT TTT TTT-3’</td>
</tr>
<tr>
<td>TG15</td>
<td>5’-TGT GTG TGT GTG TGT GTG TGT GTG TGT GTG-3’</td>
</tr>
<tr>
<td>R.LS.N52</td>
<td>5’-ACG TCT CGT CAA GTC TGC AAT GTA-3’</td>
</tr>
</tbody>
</table>

NIR fluorescence spectroscopy (using excitation wavelengths of 638 nm, 690 nm, and 784 nm) showed peak shifts between each of the DNA sequences used. At the 638nm excitation, peak emissions between 1035nm and 1050nm correspond to the (7,5) chirality for CVD synthesized single-walled carbon nanotubes. The wavelength of the peak maxima differ between all three DNA sequences. At the 638 nm excitation, peaks corresponding to the (7,5) chirality, R.LS.N52 yields a peak position at 1046.11 nm, while T30 and TG15 peaked at 1043.449 nm. Another peak can be seen for T30 prior to its characteristic (7,5) peak. This represents an additional SWCNT hybrid, but there is insufficient data to determine what chirality has caused the peak to occur (see Figure 1). Spectra intensities varied according to DNA sequence with T30 being the least intense and R.LS.N52 being the most intense.

At an excitation of 690 nm, fluorescence spectra also show shifted peaks at wavelengths that correspond to different chiralities when the DNA sequence is varied. Peaks corresponding to the (6,5) chirality were positioned at 991.7304 nm for both the R.LS.N52 and TG15, but the T30 peaked at 990.4086 nm. The peaks corresponding to the (7,5) chirality at an excitation of 690 nm shifted with sequences similarly to the shifts seen at 638 nm. R.LS.N52 peaked at 1044.78 nm, whereas the T30 and TG15 were shifted at 1043.449nm. See Figure 2. Peak intensities varied according to DNA sequence as they did with the 638nm excitation.

At a 784 nm excitation, the fluorescence spectra show shifts between all three sequences can be found in the wavelength that corresponds to the (7,5) chirality. The R.LS.N52 sequence shifts the peak to 1046.11 nm, while the T30 shifted peak is at 1039.459 nm. The TG15 sequence yields a shifted peak at 1043.449 nm (see Figure 3, next page). Again, peak intensities are weakest for the T30 sequence and greatest for the R.LS.N52 sequence.

Data from the NIR fluorescence spectra were also used to determine the relative soluble abundance of chiralities present when dispersed with differing DNA sequences. This is an indicator of how well the individual DNA sequences associate with the SWCNT. The (6,5) chirality was the predominate chirality for each of the three sequences. Other chiralities exhibited varied numerical data that varied when the sequence of DNA was changed (see Table 2).
Figure 3. Near-infrared fluorescence emission spectra at an excitation wavelength of 784 nm. Emission spectra are shown for each DNA sequence and SDS bound to SWCNTs.

Table 2. Relative abundance percentage of chiralities in each mixture containing different DNA sequences.

<table>
<thead>
<tr>
<th>(n,m)</th>
<th>R.LS.N52</th>
<th>T30</th>
<th>TG15</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6,5)</td>
<td>24.2823</td>
<td>20.7167</td>
<td>23.7913</td>
</tr>
<tr>
<td>(9,4)</td>
<td>11.536</td>
<td>6.2637</td>
<td>0</td>
</tr>
<tr>
<td>(8,4)</td>
<td>0.2697</td>
<td>7.3453</td>
<td>18.00823</td>
</tr>
<tr>
<td>(7,6)</td>
<td>8.537</td>
<td>6.633</td>
<td>7.13</td>
</tr>
<tr>
<td>(13,2)</td>
<td>0.0233</td>
<td>0.2033</td>
<td>0.06074</td>
</tr>
<tr>
<td>(12,7)</td>
<td>0.4247</td>
<td>0.4953</td>
<td>0</td>
</tr>
</tbody>
</table>

Discussion

The results at all three excitations (638nm, 690nm, and 784nm) exhibited fluorescence emission peak shifts when the DNA oligonucleotide sequence was changed. This data indicates that the optical properties of SWCNTs are indeed altered in respect to SDS-dispersed SWCNTs and the shifts are dependent on the sequence selected. However, not all peaks corresponding to chiralities within the spectra were shifted with sequence variation. This provides further support that chiralities interact with different DNA sequences at differing levels of strength. A previous study has shown that the wrapping of carbon nanotubes by single-stranded DNA is sequence dependent (Zheng et al. 2003). Our data expands upon this observation, showing that the electronic and optical properties of the SWCNT are affected by the sequence of the associated DNA. These properties account for the highly specific and sensitive spectra of a DNA:SWCNT hybrid.

The relative abundance of each chirality found in Table 1 reiterates the importance of the DNA sequence for the SWCNT hybrid. While some chiralities like (6,5) may interact extremely well with all three of the tested sequences, other chiralities such as (9,4) exhibit a wide variation. It can easily be bound to form a hybrid with R.L.S.N52, but when TG15 is used this chirality is absent in the mixture.

Due to the sensitivity of the spectra, optical spectroscopy of SWCNTs can be utilized for many different applications. Unique electrical and optical properties provide the opportunity for biosensor development in conjunction with DNA aptamers. Aptamers, which can be generated through in vitro selection, are biomolecules that bind with high affinity and specificity to a target. The sensitivity of the spectra based on sequence variation and interactions with different chiralities supports the further use of in vitro selection using ssDNA. This preliminary experimental data on DNA/SWCNT hybrids collected during characterization supports that the chiralities present in a mixture is dependent on the DNA sequence.

Methods

Preparation of DNA/SWCNTs.

Single-walled carbon nanotubes (2 mg) are measured in the aluminum weigh boat and then transferred into a 5-mL round-bottom culture tube. Phosphate buffered saline (PBS, pH 7.4) (2 mL) are then also added to the round-bottom culture tube. The selected DNA sequence is added to the SWCNT solution at a 1:1 weight ratio. After the DNA is added, the 5-mL round-bottom culture tube is placed into a test tube holder contained in an ice bath to reduce heat during sonication. The mixture is then sonicated using a probe sonicator at approximately 8 watts for 120 minutes.

The sonicated DNA/SWCNT sample is aliquoted into two separate 1 mL samples and centrifuged for 90 minutes at 16,000 g. Centrifuged samples are separately placed in Amicon Ultra-4 Centrifugal Filter Devices and diluted with double-distilled water (ddH₂O) to a total volume of 4 mL. The samples were then filtered according to the manufacturer’s protocol. Briefly the devices were centrifuged for 15 minutes at 4,000 RPM, the fil-
trate collected, and the sample diluted to 4mL. These steps were repeated two times, including the collection of filtrate between rounds of centrifugation. The filtered sample is collected and placed into two separate eppendorf tubes containing PBS (500 μL) for storage. The DNA/SWCNT hybrids are stored at room temperature and are stable for several weeks.

Preparation of SDS/SWCNTs

SWCNTs (2 mg) were weighed and placed into a 5-mL round-bottom culture tube. A 1% SDS solution (2 mL) was added. The tube was placed into a test tube holder contained in an ice bath to reduce heat during sonication. The mixture is sonicated using a probe sonicator at approximately 8 watts for 90 minutes. The sonicated SDS/SWCNT solution is still aliquoted into two separate 1 mL portions and centrifuged for 90 minutes at 16,000 g. The samples are collected and stored at room temperature.

Optical Spectroscopy

NIR fluorescence spectroscopy was obtained using a NanoSpectalyzer (NS1) from Applied NanoScience. Dilutions of each DNA/SWCNT were made to be 1:50 and the SDS/SWCNT to 1:10. The diluted samples were placed in a quartz crystal cuvette. The NIR fluorescence emission spectra were measured using excitation wavelengths of 638 nm, 690 nm, and 784 nm.
BIBLIOGRAPHY


Giant pulse detection in the Andromeda galaxy for future discovery of extragalactic pulsars

Tabitha Smith

Abstract

With the Green Bank Telescope (GBT) in Green Bank, WV, radio data from the Andromeda Galaxy (M31) have been collected by the Naval Research Laboratory (NRL) and brought to West Virginia University (WVU) for processing. A search is being conducted for giant radio bursts from pulsars. Currently, the data are halfway through being analyzed. Several candidates have been sighted, and radio frequency interference is in the process of being continuously mitigated.

Introduction

Neutron stars are stars that contain roughly 1.3 - 2 solar masses, have a 10 - 20 km radius, and spin rapidly on their axis with a period which may range from 1.5 ms to 8.5s. Neutron stars are the results of the deaths of massive stars in supernova explosions. They are the dense cores of stars and the second densest objects in the Universe, next to black holes. In the formation of the neutron star, due to the conservation of angular momentum, the star spins faster as it collapses, while the magnetic field grows very large. We can detect the emission of a neutron star from radio waves and other electromagnetic radiation. This radiation is due to particles being accelerated along the magnetic field lines of the star. As the neutron star quickly spins, we can detect the pulses of radiation as if they were part of a lighthouse beam sweeping across our view.

Giant pulses are a phenomenon attributable to pulsars such as the Milky Way’s Crab pulsar (PSR B0531+21). These giant pulsations are inferred to have an extremely high brightness temperatures – the brightness temperature is the equivalent temperature of a blackbody source required to produce the observed intensity - of 1035 K (Bhat et al. 2008). These high values imply that the emission mechanism is non-thermal in origin. These giant-pulses are the brightest ever detected in the universe (Cordes et al. 2004). It is predicted that the Andromeda Galaxy (M31) will have around 10 giant pulse emitting pulsars, assuming it as a spiral galaxy similar to ours, that the pulsars within have an age of 1000 years (similar to the Crab Pulsar), and that such pulsars are being born 1 in every 100 years (McLaughlin & Cordes 2003).

Currently, 1800 or so known pulsars are detected in the Milky Way Galaxy and the Magellanic Clouds. The discovery of extragalactic pulsars in M31 will contribute to future searches for neutron stars in other parts of space, helping to probe the extragalactic medium. Research is being done within West Virginia University’s Physics department to search for and study pulsars. Given their extreme properties and peculiar features, pulsars have been able to give insight to, and help further the theories of general relativity and gravity (Taylor & Weisberg 1982; Lyne et al. 2004).

The following report will explain the methods of obtaining data from M31 using the Green Bank radio telescope, processing the data, the M31 results thus far, and ongoing and future plans to continue researching the M31 data.

Obtaining Data from M31

The observations of M31 took place with the Green Bank Telescope (GBT) by a team led by Dr. T. J. W. Lazio at the Naval Research Laboratory (NRL). There were seven 10-hour pointings at 330 MHz, as seen in Figure 1 (INSERT M31_giantpulse.ps):caption(The M31 galaxy with the seven respective pointings. The diameter at each circle is the GBT’s primary beam at 330MHz with size of 35′ (source of optical image?) and data for pulsar B1937+21, which emits giant pulses (Soglasnov et al. 2004) was also collected with the GBT for testing purposes.

The data were taken between August 17, 2004 and August 20, 2004 using the pulsar SPIGOT backend (Kaplan et al. 2005). The SPIGOT is an autocorrelation spectrometer which was used to synthesize a filterbank sampling a 50 MHz band split into 1024 contiguous frequency channels, sampled every 81.92μs per file.

In alliance with West Virginia University (WVU), the M31 data were transported from NRL, and
then copied from hard-drives onto the WVU servers for offline processing.

### Processing the Data

This search for radio bursts within M31 began October 2008. The computer code implemented to process M31 data was first created and tested on test pulsar data, before serious trials were to commence.

A C-coded shell script program aptly named M31_search was created to turn the radio data into readable plots that could be interpreted. Within this program, the M31 data were processed using pulsar signal processing programs or sigproc-4.3. Autocorrelation data from SPIGOT were first converted to the equivalent representation as a 1024 channel spectrometer (or “filterbank”). These filterbank data were then corrected for the effect of interstellar dispersion (see below) to produce a number of time series which were searched for individual pulses.

The dispersion measure (DM) is the integrated column density of electrons in space (INSERT, integral from 0 to l’ n_e dl) that produces a medium with a frequency dependent refractive index though which the electromagnetic waves from the pulsar propagate. Electromagnetic waves with higher frequencies travel faster through this medium and arrive earlier than waves with lower frequencies resulting in a dispersion effect observed at the telescope. To correct for this effect, the data are dedispersed by delaying the high frequency channels in the filterbank files with respect to the lower frequency channels for many different trial values of DM.

Each pointing was dedispersed through a long list of approximately 9600 DM values that topped off at approximately 1000 pc cm-3. The list of DM values were generated by asserting that the distance over which to integrate was the distance to M31, being 2.53 + 0.07 Mly, while also taking into consideration the angle at which the M31 galaxy is tilted with respect to the view of the Earth, which is roughly 70°. By including the electrons which would contribute in the line of sight from the Milky Way, the with t being the thickness of M31, at 1.01 kpc, the contributing DM from an emitting pulsar from M31 could then be estimated being:

\[
DM = \text{integral from 0 to l} \cdot 2(n_e(t/cos(70))) \text{ dl.}
\]

The method of single-pulse searches was utilized, due to this method having more sensitivity than standard searches of periodicity, when looking for giant pulse pulsars (McLaughlin & Cordes 2003). The algorithm used averages each time series by adding together progressively greater numbers of adjacent time samples. At each averaging step, statistically significant signals are sought by computing the amplitude of each averaged sample to the local root-mean-square value. This quantity is known as the signal-to-noise ratio (S/N). The result of this so-called “matched filtering process” is to optimally search the data for pulses of a variety of widths. Specifically the signal-to-noise (McLaughlin & Cordes 2003) of a pulse from a single pulse search S/ Nsp is

\[
(S/N)_{sp} = \eta(N_{pol} \cdot \Delta \nu \cdot W)^{1/2} \cdot S^{-1}_{sys} \cdot S_{max},
\]

where $S_{sys}$ is the system noise, $N_{pol}$ represent the number of polarization channels summed, $\eta \sim 1$ is the pulse shape dependent factor, $\Delta \nu$ is the total bandwidth, and $W$ is the pulse width.

The M31_search program generated single-pulse plots, and within each plot there contained three smaller plots; the first being the number of pulses versus S/N, the second being the number of pulses versus DM, the third S/N ratio versus DM, and a final plot to the bottom that shows pulses plotted versus DM and time.

### Results

Each single-pulse plot generated has a time axis that ranges from 0 - 80 seconds, as the DM axis ranges from 0 - 1000 pc cm-3. Observations of the test pulsar B1937+21 were successful, in that discernible pulses are seen at the catalog DM of 71.04 pc cm-3, as seen in Figure 2.

As of now, there is no definite conclusion as to whether giant pulses have been found for M31. So far, probable candidates, such as the one seen in Figure 3, show a possible faint pulse. The S/N of this pulse is 7.1, the DM is calculated to be 55 pc cm-3, the width of the pulse was 31.92s, and the implied energy output was 8.45x10^4 Jy kpc2.
In addition to candidates, there have been periodic, slanted pulses perhaps induced by narrow-band emission from an unknown source of radio frequency interference (RFI), as seen in Figure 4. RFI (most often originating from terrestrial electronics) interferes with radio astronomy and must first be recognized and excised. The S/N of this pulse was 17.6, the DM of the pulse was 188.8 pc cm⁻³, the width of the pulse was 0.50 s and the implied energy output at the distance of M31 is 1.676x10⁶ Jy kpc².

The implied energy outputs for the largest giant-pulses currently known from emitting pulsars, that have been run through a single pulse search (Johnston & Roman 2003), using 12 for the S/N—which is the average between the two M31 candidates—are as follows:

Crab Pulsar: 4.8x10⁴ Jy kpc²
B0540-69: 2.01x10⁶ Jy kpc²
B1937+21: 3.26x10³ Jy kpc²
B1821-24: 8.7x10³ Jy kpc²

Compared to what is known about pulsars in the Milky Way Galaxy, these implied energy outputs suggest that pulsars detected from M31 at these variables are much brighter and energetic than the usual. It would also imply that the second M31 candidate is simply RFI, since it has such a high flux that it could not be real.

Ongoing and Future Research

Initial processing of the test pulsar data has been completed and successful, and the research of actual M31 data is ongoing, with portions of the data yet to be analyzed. Further adjustments and calibrations must be made for certain files which had incorrectly applied initial calibration and were not working correctly with the sigproc-4.3 programs during processing.

Other searches of M31 and other galaxies are sure to follow by pulsar astronomers in the future and present, as technology and the software for observing extragalactic objects continues to improve.

Acknowledgements

Thanks to the NASA WV Space Grant Consortium, my research mentor Dr. Maura McLaughlin, and Dr. T. J. W. Lazio at the Naval Research Laboratory for making this research experience possible. I would also like to send acknowledgments to West Virginia University, for if it had not been for the existence of this school, then the WVU Physics department would not have been in existence, and therefore I would never have had the opportunity to study here and do pulsar research.
Figure 4 - Unknown source, potentially Radio Frequency Interference (RFI), causing slanted pulses, at a DM of approximately 188.8 pc cm$^{-3}$.

BIBLIOGRAPHY


NOTES

CAPILLARY ELECTROPHORESIS: A METHOD FOR EVOLUTION AND ANALYSIS OF MOLECULAR RECOGNITION ELEMENTS

Briana D. Vecchio

Abstract

Molecular Recognition Elements (MREs) are compounds capable of binding a variety of inorganic and biological molecules. These MREs have a variety of applications including incorporation into biosensors, drug discovery, diagnostic testing, and therapeutics. MREs are evolved via a generalized process known as the Systematic Evolution of Ligands by Exponential Enrichment, or SELEX. Traditional SELEX techniques have limited the variety of MREs that can be derived for a given target, and can take several days to complete. Capillary Electrophoresis has emerged as an alternative method for evolution of MREs. It allows for evolution of MREs with increased affinity for a given target in significantly fewer rounds of selection. In addition, a range of capillary electrophoresis binding assays have been developed which can very accurately determine dissociation constant values for MRE/target complexes. Capillary electrophoresis has greatly influenced both evolution and characterization of MREs over the past decade. It will likely continue to facilitate the development of MREs for applications which were previously inconceivable using traditional SELEX techniques.

Introduction

Molecular Recognition Elements (MREs) are organic molecules such as DNA, RNA, or polypeptides capable of binding a target with high affinity and specificity (Klussmann 2006). Applications of MREs include biosensors for drugs and explosives, drug discovery, diagnostic testing, and therapeutics (Klussmann 2006) (Knopf and Bassi 2007). The broad range of applications paired with ease of production of MREs ensures that they will be a topic of great interest for many years to come.

The evolution of MREs is a process known as the Systematic Evolution of Ligands by Exponential Enrichment (SELEX). In this process, a pool of random sequences is screened for affinity to a given target (Klussmann 2006). With each round of selection, MREs with higher affinity for the target are selected while others are discarded. Thus the selection process has been called in-vitro evolution. MREs can be derived via a number of selection methods including capillary electrophoresis. Capillary Electrophoresis SELEX, or CE-SELEX, is a method of selection which has begun to take footing in many traditional SELEX labs. Capillary electrophoresis offers several benefits when compared to traditional selection methods. These include increased target binding affinity and fewer rounds of selection (Klussmann 2006).

This review will detail advancements in CE-SELEX and CE-affinity assays over the past decade. Background information regarding traditional selections and MRE applications will be provided. With CE-SELEX becoming a valuable tool for a variety of fields, optimization of this relatively new assay has become a priority. CE-SELEX studies will be reviewed which have made great advancements in refining this selection technique. In addition, four forms of post-SELEX binding assays will be examined. Capillary electrophoresis has allowed for development of MREs with high specificity and unique binding properties. When paired with the technique's efficiency, these benefits will likely aid in development of MREs for applications which were previously inconceivable.

MRE Selection

MREs bind with their target in a lock-and-key model using non-covalent interactions such as hydrogen bonding and dipole-dipole interactions (Klussmann 2006). In many ways, they are comparable to antibodies. However, unlike antibodies, they can be easily created and selected against without the use of a living organism. MREs can be formed from DNA, RNA, or amino acids. DNA MREs are remarkably stable under varying conditions and can be readily synthesized. RNA MREs have additional means of synthesis, but are not exceptionally stable. Amino acid MREs provide increased variability of the pool and the prospect of alternative selection methods. The target and potential application
will determine the type of molecule used for selection (Klussmann 2006). For example, DNA MREs would be the best suited for biosensors due to their stability and ease of regeneration (Knopf and Bassi 2007). Amino acid MREs are ideal for creating novel “proteins” for therapeutic use and can bind larger targets with ease. RNA MREs have similar applications to DNA MREs, but are notably useful therapeutically. They are capable of mimicking small-interfering RNA, thus silencing the expression of a given protein (Klussmann 2006). Studies detailed here-in primarily use DNA or RNA MREs.

Prior to selection, a random pool of $10^9$ – $10^{16}$ different sequences must be obtained (Klussmann 2006). These sequences are typically commercially ordered from a synthesis house. The researcher will specify their known primer regions and then the length in nucleotides of the random region. The random region is generated via standard phosphoramidite synthesis (Behlke and Devor 2005). In this synthesis, each nucleotide base is added sequentially to a growing chain. In traditional synthesis, the base to be added is predetermined and a very pure solution of this is added to the reaction. When synthesizing a random pool, a mixture of bases is added instead. The concentrations of these bases are adjusted such that each base adds to the growing chain with the desired probability. Oligosynthesis consists of four steps. First, a phosphoramidite monomer is immobilized onto a surface and the 5’ dimethoxytrityl (DMT) group is removed – thus activating the monomer. Next, through a condensation reaction, the next base to be added attaches to the 5’ end of the growing chain. The resulting compound contains an unstable trivalent phosphate group which is then oxidized to the stable pentavalent phosphate. Finally, any unreacted 5’ hydroxyl groups are acetylated in a process known as “capping” which prevents internal base deletions. The process is repeated beginning at the de-titrylation step until an oligonucleotide of the desired sequence or length is formed (Behlke and Devor 2005). This process is fully automated, and custom oligonucleotides can be ordered for next day delivery.

Once a random pool is obtained, the selection process can begin. MRE evolution can be generalized into three distinct steps regardless of the technique used (Fig. 1). First, the pool is incubated with the target. The target may be immobilized on a substrate or in solution depending on the selection procedure (Klussmann 2006). Sequences with high affinity for the target will bind forming a sequence/target complex. Bound sequences are potential MREs for the given target, and are separated from non-binding sequences typically via a washing step. The bound sequences can then be amplified, via processes such as the polymerase chain reaction (PCR), and again incubated with the target. Further rounds of selection will yield MREs with increasing affinity for the target (Klussmann 2006).

The first SELEX techniques developed required immobilization of the target onto a surface. Typical immobilization surfaces include streptavidin coated beads or tubes. The target can then be biotinylated and the biotin-streptavidin interaction will immobilize the target on the selection surface (Rosoff 2002). This strategy is very effective for large targets such as proteins, but is not ideal for smaller molecules such as explosives. Small molecules can have potential MRE binding sites made unavailable due to biotinylation (Rosoff 2002). Other targets cannot be biotinylated as easily. For these targets, an alternative method of selection which does not require target immobilization is preferable (Landers 2008). There are several free solution selection methods, but the most prominent of these is capillary electrophoresis.

Capillary electrophoresis SELEX does not require target immobilization, and therefore this technique decreases non-specific binding to the immobilization surface and increases overall affinity of the MRE for the target (Landers 2008). During CE-SELEX, the MRE pool is combined with a target in buffer solution and loaded via
a pressure plug into a small capillary (Fig. 2) (Mendonsa and Bowser 2004). One end of the capillary is placed in a source vial containing the cathode, while the other is placed in a waste vial containing the anode. As current is passed through the solutions, molecules migrate at different speeds through the capillary based on their charge to mass ratios. This migration is monitored at the capillary window by a UV absorbance or fluorescence sensor. This sensor is capable of detecting the target, MRE, and bound target/MRE complexes. The change in these values creates peaks on the resulting electropherogram which can be monitored. The unbound pool elutes first, due to its decreased mass/charge ratio. When the fraction containing the MRE/target complexes reaches the sensing window, the time to fraction collection can be calculated based on the complex’s previous velocity through the capillary to the sensing window. A very small fraction containing the MRE with bound target can then be collected as the pool elutes. The collected MREs can then be amplified and subjected to further rounds of selection until an MRE with high affinity and specificity for the target has evolved. In Figure 2, the MRE pool has been fluorescently tagged, and this emission is being detected (Mendonsa and Bowser 2004). Once these binding motifs are identified, mutation and truncation experiments will help to optimize the MRE. Mutation experiments help more clearly identify the binding motif. Point mutations which change one nucleotide or amino acid may enhance or reduce target binding (Klussmann 2006). Once the exact binding motif is identified, non-binding sequences will be removed to create the truncated, smallest functional unit of the MRE. The resulting optimized MRE can then be synthesized for potential use in its intended application.

Figure 2, Generalized Representation of CE-SELEX - The peak in the red box corresponds to the unbound fluorescently tagged MRE pool, which elutes first. The second peak corresponds to the MRE/Target complex which is to be collected.

MRE Optimization

Immediately following selection, the collected fraction of MREs is amplified and sent to one or more oligo-houses such as Integrated DNA Technologies (IDT) or Invitrogen for separation, sequencing, and synthesis. Once a potential MRE candidate has been sequenced, it will undergo a series analyses. Sequencing provides vital information about the binding motifs of each MRE. Various programs have been developed which can readily predict the tertiary structure or folding of an MRE when given a particular sequence of amino acids or nucleotides (Klussmann 2006). Potential target binding motifs vary according to the target but often include large extended loops or hairpin structures where the MRE is not complimentary to itself (Fig. 3) (Mendonsa and Bowser 2003). Once these binding motifs are identified, mutation and truncation experiments will help to optimize the MRE. Mutation experiments help more clearly identify the binding motif. Point mutations which change one nucleotide or amino acid may enhance or reduce target binding (Klussmann 2006). Once the exact binding motif is identified, non-binding sequences will be removed to create the truncated, smallest functional unit of the MRE. The resulting optimized MRE can then be synthesized for potential use in its intended application.

Applications

When regarding potential applications, MREs are often compared to antibodies. However, MREs have been evolved which have far higher binding affinities for their targets, making them ideal for additional applications. For example, biosensors capable of detecting drugs with the same or better precision as trained
police dogs are currently being developed using MREs (Knopf and Bassi 2007). These levels of detection were unreachable using traditional antibodies. Clearly, MREs will help to create devices which rival or exceed our current expectations. In addition to sensors for detection of drugs, MREs can be used in drug discovery, microarrays for medical diagnostics, separation of chiral compounds, and therapeutics.

Biosensors are devices capable of detecting inorganic or organic compounds using a biological probe. MREs are providing more stable and easily produced probes for these devices. In a recent study, a fibre-optic evanescent field - FET biosensor capable of detecting the explosive TNT was developed using MREs. (Fig. 4, next page) (Forster et al. 2008). This sensor relies on a fluorescently labeled MRE which binds to immobilized TNT on the surface of a sensitive fiber. When a fluid sample is added which contains TNT, the MRE will release from the fiber and bind to the TNT in solution. This decreases the fluorescence signal which is being detected on the fiber. This device represents one of the most sensitive classes of biosensors, capable of detecting a target in the low picomolar range (Forster et al. 2008).

Figure 4, FET based TNT Biosensor - a. Sensing fiber with immobilized TNT and bound MREs eliciting a strong fluorescence signal; b. Sample solution containing TNT is added, causing dissociation of the MRE from the fiber and decreased fluorescence signal

Pharmaceutical companies are also beginning to use MREs for drug discovery and therapeutics. The first MRE to be used therapeutically was designed to target and inhibit VEGF, a protein which plays a key role in age-related macular degeneration. The resulting drug, Macugen, has helped to reduced severe vision loss by about 50% in those receiving treatment (Lee et al. 2005). Other therapeutic MREs have been developed to treat a variety of diseases, including HIV, Alzheimer’s, cystic fibrosis, and several forms of cancer (Dua, Kim, and Lee 2008).

Finally, applications of MREs extend to general chemistry through the enantiomeric separation of chiral compounds. DNA MREs have been evolved which specifically bind and target specific chiralities of a given compound. These MREs can be immobilized onto a chromatographic surface for use in HPLC. Successful separation of D and L enantiomers of the oligopeptide arginine-vasopressin has been conducted at high temperatures (Michaud 2003). With additional studies and optimization, MREs could provide an attractive new means of separation of chiral compounds.

Capillary Electrophoresis - SELEX

Capillary Electrophoresis is a promising tool for MRE selection. It has been used to evolve MREs with higher specificity and affinity than traditional SELEX methods. This high affinity can be achieved because the target is not immobilized – thus increasing surface area available for MRE binding (Klussmann 2006). In addition, this free solution assay decreases the non-specific binding of MREs to the immobilization surface. This benefit eliminates the need for multiple rounds of negative selections. The speed at which CE-SELEX selections occur is also highly attractive as it can greatly reduce the time needed to evolve a potential MRE candidate (Landers 2008). One example of a typical CE-SELEX selection is reviewed to highlight the benefits and shortcomings of this technique.

CE-SELEX: Evolution of the HIV-RT MRE

In hopes of creating an MRE for therapeutic or diagnostic use for HIV, Mosing, Mendonsa, and Bower (2005) set out to create an MRE which specifically bound HIV’s reverse transcriptase protein (HIV-RT). For this study, they chose a single-stranded DNA library or pool consisting of 40 random nucleotides flanked by 20 nucleotide primers which assist in pool amplification. Approximately 1.8 x 10^13 random sequences were introduced in the initial round of CE. The system relied on the simple detection of UV-absorbance and monitoring...
the migration peaks of bound and unbound sequences. Fractions containing the MRE/HIV-RT complexes were amplified via PCR and used for subsequent rounds of selection (Mosing, Mendonsa, and Bower 2005).

This study is of specific interest as it demonstrates two of CE-SELEX’s shortcomings when compared with traditional methods. First, CE limits the size of the initial MRE pool, possibly eliminating potentially high affinity MREs. This is due to the compromise which must be reached between peak resolution and plug or sample size. If one were to inject a plug containing \(10^{15-20}\) random sequences, as in traditional SELEX, the peaks of the bound and unbound complexes broaden (Fig. 5) (Mosing, Mendonsa, and Bowser 2005). This broadening will not allow for separation of distinct fractions, thus limiting the efficiency of CE. Secondly, a unique phenomenon nearly completely attributed to CE-SELEX is the bell-curve of dissociation constants with increasing rounds of selection. With rounds 1-4, an exponential increase in binding affinity is observed. After round four, subsequent rounds yield decreasing binding affinity of MREs. This phenomenon is speculatively attributed to possible target contamination or experimental error (Mosing, Mendonsa, and Bower 2005). One more distinctive attribute of CE-SELEX is the heterogeneity of MREs which can be derived. In typical SELEX, very few MREs are evolved and they often have similar binding motifs. CE-SELEX provides the researcher with many MREs which have few apparent similarities. Overall, however, the benefits of CE-SELEX far outweigh its flaws which may be improved upon in the future.

MRE Binding Assays: Determination of Equilibrium Dissociation Constants

Determination of equilibrium dissociation constants, or \(K_d\) of MREs is one essential assay which can either be performed post-SELEX or derived from the selection process itself. Dissociation constants are key in understanding target/MRE interactions and can often help predict the MREs applicability under varying conditions (Klussmann 2006). \(K_d\) can be defined as \(k_{off}/k_{on}\) – where \(k_{off}\) is the rate of dissociation of the target/MRE complex and \(k_{on}\) is the rate of association or binding of the complex (Krylov 2007). Several binding assays are capable of determining \(K_d\) with varying degrees of accuracy. Depending on the MRE’s proposed application, more or less accurate \(K_d\) values are acceptable (Landers 2008). For example, MREs to be used in biological systems therapeutically would require very precise \(K_d\) values. On the other hand, an MRE to be used in a biosensor for anthrax need not be as accurate. While it is only necessary to use one assay to determine the \(K_d\) using two or more assays will help to achieve greater accuracy (Krylov 2007).

Affinity Probe Capillary Electrophoresis: Determining \(K_d\)

Affinity Probe Capillary Electrophoresis (APCE) was one of the first assays to be used post-SELEX to determine the \(K_d\) of a given MRE. This method of determining \(K_d\) can give quick, but vague \(K_d\) values. In APCE, potential MREs are labeled with a fluorescent tag and added to a known concentration of the target (Landers 2008). The target concentration can be increased or decreased with each successive run, yielding a linear dynamic range (Krylov 2007). Traditionally, antibodies have been used in APCE, however their large size can limit the resolution of bound and unbound peaks when binding to small target molecules. The small size, relative stability, and easy labeling of MREs make them an ideal probe for this type of assay (Landers 2008).

The first MRE based APCE assay was conducted by Krylov (2007). This study used MREs which had previously been evolved for IgE, or Immunoglobulin E. The MRE was fluorescently tagged and incubated with varying concentrations of IgE prior to electrophoresis. The resultant electropherograms displayed two distinct

![Figure 5. Correlation between plug size and peak broadening.](image)

**Figure 5.** Correlation between plug size and peak broadening - As injection size increases, peaks broaden leading to merged fractions. Injection size increases from C to A – showing only the unbound fraction peak.

\[
\frac{I_o - I}{I_o} = \frac{c}{K_d + [\text{target}]}
\]

**Equation 1. Calculation of Dissociation Constants** - \(I_o\) = peak area of MRE, \(I\) = peak area of MRE/target complex, \([\text{target}]\) = concentration of the target, \(K_d\) is the dissociation constant, and \(c\) is a constant determined by the internal standard peak of the lone fluorophore.
peaks: free MRE and MRE-IgE complexes. To determine the dissociation constants from this data, the following formula is used:

\[
\frac{I_0 - I}{I_0} = \frac{C}{K_d + [\text{target}]}
\]

Equation 2, Determination of \(K_{\text{off}}\)

This study showed the efficacy of using MREs in APCE assays. The dissociation constants were determined to be comparable to those achieved with antibodies in the same procedures (Krylov 2007). In addition, the specificity of the MRES allowed the assay to use a serum buffer containing known IgE “imitators”. This serum assay displayed nearly identical binding coefficients to the purified IgE solution (Fig. 6) (Krylov 2007).

This specificity of MREs allows for selection of minute quantities of a given target in complex solutions, thus opening the door for biosensors which can readily detect small molecules in biological samples (Knopf and Bassi 2007). While the \(K_d\) values determined in this study are comparable to antibodies, they do not easily compete with those seen in MREs derived from recent CE-SELEX procedures.

Non-Equilibrium Capillary Electrophoresis of Equilibrium Mixtures: Determining \(K_{\text{off}}\)

Non-Equilibrium Capillary Electrophoresis of Equilibrium Mixtures (NECEEM) is a technique employed in CE-SELEX and MRE Analysis. It can readily determine \(K_{\text{off}}\) values with reasonable accuracy in a short period of time (Landers 2008). In NECEEM, a mixture of target and MRE is incubated until equilibrium is reached. It is then loaded as a plug into a capillary which is pre-filled with running buffer (Krylov 2007). Separation is carried out with running buffer containing no target or MREs (Fig. 7). Provided that certain conditions are met, only dissociation and no binding will occur during electrophoresis. As dissociation predominates, this assay is most sensitive to determination of \(K_{\text{off}}\) (Krylov 2007). \(K_{\text{off}}\) can readily be determined by relating peak areas and elution times determined from the electropherogram (Eq. 2, Fig. 8). In this example of fluorescence CE, \(A_1\) is the peak area of the lone MRE with fluorescent tag, \(A_2\) is the peak area of the target/MRE complex, \(A_3\) corresponds to the area where dissociation is readily occurring, and \(t_{L*T}\) is the time of complex elution.

\(K_d\) can also be roughly determined by this electropherogram in a similar manner to APCE as detailed above. Previous studies by Krylov on NECEEM have cited this method of \(K_d\) determination to be within ±10% of the known value. However, determination of \(K_{\text{off}}\) was far more accurate, being within ±3% of the known value (Krylov 2007).

Sweeping Capillary Electrophoresis: Determining \(K_{\text{on}}\)

Another affinity binding assay which can be used to better determine an MRE’s dissociative properties is Sweeping Capillary Electrophoresis, or SweepCE. Prior to SweepCE, the only known method of directly determining \(K_{\text{on}}\) was via stopped flow spectroscopy. This method was not ideal for use with DNA/protein interactions due to its reliance on spectral property changes of the com-
plex (Okhonin, Berezovski, and Krylov 2004). As these changes are very slight in DNA or RNA/protein complexes, the determined $K_{\text{on}}$ values are often imprecise. SweepCE offers an alternative means for measuring $K_{\text{on}}$ and is especially useful for MRE/protein complexes derived from SELEX.

In SweepCE, the start reservoir contains a solution of the target and the capillary is preloaded with an MRE or other ligand solution (Fig. 9) (Krylov 2007). During electrophoresis, the target is continually binding to the MRE and very little dissociation occurs. The process is known as SweepCE due to the sweeping of the DNA or RNA through the capillary by the highly mobile protein targets (Okhonin, Berezovski, and Krylov 2004). As the DNA/target complex is the most prevalent species in the capillary, this method is most sensitive to measurement of $K_{\text{on}}$.

**Figure 9. Depiction of initial conditions in SweepCE - No plug is loaded. The intake reservoir contains the target solution. The capillary is prefilled with MRE or other ligand solution.**

A typical fluorescence SweepCE run will yield one peak corresponding to the MRE/protein complex (Fig. 10). The $K_{\text{on}}$ value can be determined by analysis of the shape of this sweeping region through a series of differential calculations which are not detailed here (Okhonin, Berezovski, and Krylov 2004). Using multiple assays such as APC, NECEEM and SweepCE will ensure that the most accurate dissociation constant values are determined.

**Figure 10. Typical Electropherogram of SweepCE - In red is a typical SweepCE run with single peak corresponding to the fluorescently tagged MRE/protein complex. In blue is the baseline of fluorescently tagged MRE moving through the capillary without addition of target protein into the intake reservoir.**

**Equilibrium Capillary Electrophoresis of Equilibrium Mixtures: Development of “Smart” MREs**

Smart aptamers or MREs are molecules which bind to their target within predefined kinetic or thermodynamic parameters. The ability to predict and evolve MREs with specific $K_d$ values has been key in creating MREs for therapeutic or diagnostic testing within biological systems (Klussmann 2006). One process used to develop smart MREs is known as Equilibrium Capillary Electrophoresis of Equilibrium Mixtures or ECEEM.

ECEEM relies on maintaining quasi-equilibrium concentrations of the MRE pool and target in solution while running CE (Krylov 2007). This is accomplished by adding one of the components, typically the target, directly to the running buffer and reservoirs. The plug contains an equilibrium mixture of the target and the MRE pool (Fig. 11) (Krylov 2007).

**Figure 11. Depiction of initial conditions in ECEEM - Both the intake and outlet reservoirs contain running buffer and target. The equilibrium mixture, EM, contains the MRE/Target complex.**

As the solution is separated, MREs are in a dynamic equilibrium with target in the running buffer and target in the initial equilibrium mixture, causing them to migrate at varying speeds through the buffer, based on their affinity for the target (Krylov 2007). MREs which spend more time in free solution will migrate at a faster rate through the solution, corresponding to higher $K_d$ values. MREs which spend more time in complex with the target migrate slower, corresponding to lower $K_d$ values (Landers 2008). In order to elute a fraction containing MREs within a specified $K_d$ range, the following relation can be used (Eq. 3) (Drabovich, Berezovski, and Krylov 2005). Prior to ECEEM, the elution times of the pool and pool/target complex are previously deter-

\[
\frac{1}{t} = \frac{1}{t_{\text{DNA}}} \frac{K_d}{[T]} + \frac{1}{t_{\text{T-DNA}}} \frac{1}{[T] + K_d} + \frac{1}{t_{\text{DNA}}} \frac{1}{[T]} + \frac{1}{t_{\text{T-DNA}}} \frac{1}{[T] + K_d}
\]

**Equation 3, Determination of Elution Time for a Desired Kd Value = Where t is the time of elution of desired fraction, tDNA is the elution time of the free pool, tT-DNA is the elution time of the pool/target complex, [T] is the concentration of the target in the equilibrium mixture, and Kd is the desired dissociation constant**
mined using NECEEM.

In a study by Drabovich, Berezovski, and Krylov, three smart-MREs with different predefined $K_d$ values were evolved using ECEEM (2005). These MREs targeted the protein, MutS. Figure 12 shows the predicted dependence of $K_d$ on migration time in red. The blue boxes represent the collection windows of the chosen MREs with desired $K_d$ values of 10, 75, and 350 nM respectively. The MREs derived from each round of selection were analyzed by NECEEM and their $K_d$ values are shown as black bars (Drabovich, Berezovski, and Krylov 2005). As can be seen, this particular selection required three rounds of CE-SELEX to reach the desired and predicted $K_d$ values. While three rounds of selection is far faster than traditional SELEX methods, CE-SELEX has made great strides in reducing this number even further.

![Figure 12, Correlation of Experimental Data with Predicted Kd Values and Migration Times](image1)

This study shows the promise of creating MREs with predefined affinities for their target. Other similar assays are capable of predicting thermal stability of the MRE/Target complex as well (Klussmann 2006). Advances such as these will facilitate evolution of therapeutic MREs to be used in living systems.

**Non-SELEX Selections: Eliminating PCR Amplification**

In a study by Berezovski et al. (2006), they have eliminated the need for PCR amplification between successive capillary electrophoresis separations. This greatly reduced the time and associated cost of MRE evolution. Successive rounds of NECEEM were used to partition the equilibrium mixture. For example, a solution containing both target and MRE library was separated via NECEEM and the eluted target/MRE fraction was collected and added to a new solution containing only target. This was repeated three times without amplification between successive NECEEM runs (Fig. 13) (Berezovski et al. 2006). Small samples of the collected fractions were analyzed via NECEEM and quantitative PCR for relative $K_d$ values and MRE abundance respectively.

![Figure 13, Schematic Representation of Non-SELEX Selection of MREs](image2)

To compare evolved MREs, researchers ran Non-SELEX NECEEM and SELEX NECEEM in parallel. The same starting pool was used to target the protein h-Ras, an important protein in cell growth and proliferation (Berezovski et al. 2006). Analysis of the final separations of both methods revealed comparable $K_d$ values. The non-SELEX method evolved MREs with $K_d$ values around 0.3 μM and the traditional SELEX yielded MREs with 0.6 μM $K_d$ values (Berezovski et al. 2006). These values are not statistically different, thus proving the efficacy of the Non-SELEX selection technique.

Advantages to this new approach include reduced time and MRE evolution within non-amplifiable pools. This particular study notes the entire non-SELEX selection to have taken place in one hour on an automated system, while the traditional selection took several days (Berezovski et al. 2006). In addition, eliminating the PCR amplification step opens new doors for evolving MREs out of completely random pools which do not contain known primers for amplification (Klussmann 2006). This is of particular interest in development of DNA tagged small molecules for therapeutic use (Gartner et al. 2004). With advances in CE technology, the evolution of MREs will likely become even more efficient in the future.

**Concluding Remarks**

Molecular Recognition Elements are versatile compounds which have potential uses in a variety of fields. These compounds were originally derived by SELEX selections which required immobilization of the target. These methods restricted use of small molecule targets and limited the variety of evolved MREs. Capillary Electrophoresis has certainly transformed SELEX selections and MRE analysis. Free solution selection has remedied many of these prior short-comings. However, CE-SELEX does come with its own set of weaknesses which will be improved upon in the future. This optimization will likely be achieved by technological advances combined
with increased interest in CE for development of recognition elements.

Capillary Electrophoresis has become an incredibly useful tool for both selection and studying of MRE/target interactions. CE-SELEX has greatly reduced the time and increased the efficiency of MRE evolution. New methods of partitioning the target and MRE have resulted in the ability to predict and evolve MREs with specific affinities for a given target. Capillary electrophoresis has also provided a new means of measuring target/MRE interactions. Combining several CE affinity assays can produce very accurate dissociation constant values. This degree of accuracy is expected to improve in the future and open the door to further MRE applications.
BIBLIOGRAPHY


ABBREVIATIONS

APCE - Affinity probe capillary electrophoresis
CE - Capillary Electrophoresis
DNA - Deoxyribonucleic Acid
ECEEM - Equilibrium capillary electrophoresis of equilibrium mixtures
FET - Field Effect Transistor
HIV - Human Immunodeficiency Virus
HPLC - High Pressure Liquid Chromatography
$K_d$ - Equilibrium dissociation constant
MRE - Molecular Recognition Element
NECEEM - Non-equilibrium capillary electrophoresis of equilibrium mixtures
PCR - Polymerase Chain Reaction
RNA - Ribonucleic Acid
RT - Reverse Transcriptase Protein
SELEX - Systematic Evolution of Ligands by Exponential Enrichment
SweepCE - Sweeping Capillary Electrophoresis
TNT - Trinitrotoluene
STUDENT HIGHLIGHTS
REFLECTING ON DISPARITIES IN RESEARCH METHODS

Emily Wight is graduating in May 2011 with a B.A. in history. Emily hopes to move on to a career in educational outreach.

Over the course of this past semester, I began to have a disorienting feeling. It became particularly apparent this past spring break when I was catching up on schoolwork. I was doing reading for the Micro-history class I was taking, while working on a presentation for my psychology research lab, when I noticed my brain would have trouble shifting between the two projects. My mind, cluttered with information and ideas, knew no disciplinary boundaries. Instead of conceiving of the projects separately, I felt I was working on one, huge, research project. Partly induced by sleep deprivation perhaps, but as I reflected on my work for the two subjects, I began to compare them, or more accurately, recognize the similarities between the two. It seemed to me both subjects shared the same research problems, despite their obvious methodological differences, and that an analysis of the different issues each discipline faced could shed light on how best to approach these challenges.

Both psychology and history are very conscious of their role in the social sciences and seem to feel the need to legitimate their place in comparison with the more experimental sciences. The advent of computers and technology revolutionized history and psychology’s ability to apply statistics to human behavior, to quantify as a means of validating their hypotheses. Micro-history is not so much a backlash, as a challenge to the reality created by the homogenizing effect of ignoring statistical outliers. The quantitative approach does not take into account an individual’s agency, their ability to negotiate with the world and thus create their own reality. Meaning, the statistical approach does not enable historians to understand how, the Industrial Revolution for example, was actually experienced by workers, it distorts the image.

Psychology has also been consumed by statistics, an issue that seems to threaten its readership outside the discipline. Pages of syntax and the emphasis on more complex statistical methods alienate readers unfamiliar with the nuances of psychological methodology. This is not a concern only of history and psychology, but is an issue prevalent throughout academia as researchers and their research become more divorced from the public. However, one could argue, human behavior is complex and complex methods are necessary in order to analyze it. But where is the balance? How can researchers connect with the public again? Which methods are most fruitful in understanding human behavior? I am reminded of how anthropology influenced history and produced a form of micro-history, a self-reflection within the field, and wonder about the benefits of interdisciplinary research. And while I am cognizant of the differences between fields in the liberal arts and sciences, these differences should not inhibit productive communication, communication which could challenge and improve our research.
RESEARCH PROFILE: KATHY LARRIMORE

Kathy Larrimore graduated from the Eberly College of Arts and Sciences in May 2010 with a B.S. in Biology and a B.A. in Philosophy.

How did you begin working in a lab?

One afternoon I was looking at the Honors College blog and there was a post by a researcher, Dr. Carina Barth, who was looking for undergraduate honors students to do research in her lab. I was interested in finding a lab around that same time, and the projects she described on the blog looked interesting so I decided to email her about the positions.

What were the main ideas of your undergraduate research/honors thesis?

I worked on two main projects when I was an undergraduate student. The first involved researching how alterations in endogenous vitamin C content in Arabidopsis (a model plant commonly used in plant physiology research) affects flowering time. The second project which became my honors thesis involved determining whether constitutive defense priming found in vitamin C deficient Arabidopsis mutants is dependent on hydrogen peroxide, salicylic acid and certain pathogen related defense genes.

What are your post-graduate plans?

I will be a graduate student in the Molecular and Cellular Biology PhD program at Arizona State University. My focus will be protein engineering with an emphasis on the use of plants as novel expression systems.

How did your experience in the lab influence your undergraduate academic experience?

I think classroom lecture and textbooks are an integral aspect of education but real world experience is invaluable. The research gave me technical laboratory skills but also taught me experimental design, proposal writing, time management, presentation and manuscript formulation. Research brought a new level of experience in laboratory science I wouldn’t have gotten otherwise during my time as an undergrad.

How did your experience in the lab influence your post-graduate plans?

I had been planning on doing research in graduate school before I was a freshman but until I did research I had always planned on going into a Masters program after graduating. After doing research in the lab I felt more confident going straight into a Ph. D. Program after graduating. I couldn’t be happier with my decision, and I think the skills I gained in the lab and being active attending national and international conferences helped me have a well-rounded application to graduate school.
The West Virginia Dialect Project (WVDP) is an ongoing study of language variation and culture in West Virginia. Directed by Professor Kirk Hazen, the WVDP offers unique research opportunities to students. Dr. Hazen knows the importance of undergraduate research. According to Hazen, “Research is the best kind of education you can get—it is the essence of active learning.” As a testament to this philosophy, Hazen gives the seven students currently working on the WVDP a huge voice in the project. These students are involved in every aspect of the dialect studies, from planning, to carrying out the research, to contributing to scholarly articles.

Recently, the WVDP has completed studies of demonstrative them (e.g. Do you see them birds?), consonant cluster reduction (e.g. past θ pas’), and was leveling (e.g. We was there. vs. We were there.) Currently, the WVDP is studying how “be like” is used as a quotative verb in Mountain State (e.g. She was like, “I just love undergraduate research!” vs. She said, “I just love undergraduate research!”) Quotative like is a language feature that originated on the West Coast during the 1970s. It is interesting to linguists because it has spread rapidly across the continent in just a few decades.

Dr. Hazen believes that there are three reasons why the study of language variation is important. One is its scientific aspect. Though language is an essential part of being human, it is far from being fully understood. Then, there is the sociological aspect, as language can also tell us something about our cultural makeup. Finally, part of the study of language variation is about activism. Speakers of many non-standard English dialects face discrimination based on inaccurate cultural assumptions about language. The WVDP works to reduce this discrimination by dispelling language myths.

Hazen enjoys all aspects of the study of language variation. “My favorite thing about research is the diversity of the intellectual work,” he says. “I’m still learning. I like to learn.”
Odbadrakh Tuguldur, who goes by “Togo”, is an upperclassman pursuing a Bachelor of Science in chemistry. Born in Mongolia, and hailing from Raleigh, North Carolina, Togo came to WVU when his parents moved to West Virginia. Initially a biology major with plans for medical school, Togo took Dr. Xiaodong Shi’s organic chemistry course and promptly switched to a chemistry track.

Togo is quite active as an undergraduate researcher, and was recently third author on a publication by Dr. Shi’s lab group entitled “One-Pot Synthesis of Substituted Di-Hydrofurans from Lewis Base-Catalyzed Three-Component Condensation”. As Togo explains it, one-pot synthesis is a way to run a chemical reaction in one step. “Pharmaceuticals usually go through different synthesis steps, all separate reactions. Here we are just doing it as a one reaction, but the mechanism is a three step cascade.”

While working under Dr. Shi, Togo screened reactions at the microscale level (millimolar) by varying experimental conditions including temperature, concentration, equivalencies, as well as switching in different reactants, such as dinucleophilic compounds. Togo also extracted and purified the target compounds using column chromatography and confirmed his results with NMR.

Togo plans to author his own paper on Mitsunobu reactions, which will combine alcohol conversion reactions with Dr. Shi’s triazole compounds. He plans to once again vary reaction conditions, and “…start with simple alcohols like butanol, t-butanol, and scale up to large-chain alcohols.”

When asked why he is passionate about organic chemistry, Togo responded with “…there are so many unexplored reactions and so many open doors. Organic chemistry is everything. We are all organic. Applications of organic chemistry are huge, from polymers to pharmaceuticals and medicine --even a new car paint.”

Togo is looking forward to grad school in organic synthesis, and when asked about his future, said “I think I’ve found my niche.”