

# Nanorobots:

## A New Treatment for Brain Tumors?

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Taking on the Land of *Teranga*  
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Voter Perception in 2008 Election  
Flame Retardant Pollution in Texas  
*Wuthering Heights*: Literary Filters  
Water Reclamation in Space

# LETTERS FROM FACULTY



Dear Readers,

Texas A&M University has a long history of supporting and encouraging undergraduate research and scholarship. With the inaugural issue of Explorations, we are opening a new chapter in that history. The increasing emphasis on engaging our undergraduates in independent scholarly activity as part of their capstone experiences clearly called for a new venue to present and celebrate that scholarship.

Several student-led publications offering such an outlet have periodically emerged, but the organizers of Explorations felt that we needed to join forces with the students to form a sustainable partnership that will provide a long-term outlet for these scholarly publications.

The team putting together this first issue has worked tirelessly to create a high-quality student journal dedicated to presenting the results of some exciting student scholarship. I think that the level of accomplishment shown by these young scholars will impress you. After reading this issue, if you are a student who is interested in becoming involved in this new forum for undergraduate scholarship, I hope that you will look into the opportunities available to you through Texas A&M. If you are a faculty member and have the opportunity to mentor a student on one of these projects, I hope that you will seriously consider doing so.

To all friends, colleagues, and members of the Aggie family, we appreciate your interest and support.

Sincerely,

A handwritten signature in black ink that reads "Robert C. Webb".

Robert C. Webb  
Associate Dean for Undergraduate Research

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Dear Readers,

Research programs at Texas A&M University are among the best that the nation can offer. They provide outstanding experiences for inquisitive undergraduate students and dedicated faculty. It has been said, "Undergraduate research at Texas A&M forms an integral link in the production of knowledge." These research experiences give our undergraduates an opportunity to maximize their potential and to expand their intellectual horizons. Students learn to ask important questions, assemble evidence, develop persuasive answers, reach logical conclusions, and report results both orally and in print.

A synergy occurs when high-achieving, highly motivated undergraduates and outstanding faculty unite to engage in these scholarly pursuits. In many ways, these undertakings resemble the apprentice-master relationships of yore. Both contribute to the success of the discovery; both learn from the other. These interactions are not limited to a few departments or faculty but rather are widespread throughout the university, and they enrich the vibrant intellectual dialogues across campus.

These undergraduate researchers are beginning their careers as the knowledge producers of the future. They have been mentored by faculty who provide vision and guidance in the discovery process. Publishing accounts of these activities in Explorations documents this exciting aspect of the undergraduate experience. We hope as you read these articles that you will appreciate the extra effort of inquiring students and dedicated faculty alike.

Sincerely,

A handwritten signature in black ink that reads "Edward A. Funkhouser".

Edward Funkhouser  
Director of the Honors Program



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# explorations

THE TEXAS A&M UNDERGRADUATE JOURNAL



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## TAKING ON THE LAND OF *TERANGA*: WOMEN'S IDENTITY IN SENEGALESE SOCIETY

*Senegalese women construct their identity through dance, dress, literature, food preparation, and religious practices. Their role represents the beliefs and values of Senegal's contemporary urban culture.*

Tahni Candelaria

On the westernmost tip of Africa lies Dakar, the vibrant capital city of Senegal. Dakar bustles with people who live their lives and express their diverse identities in myriad ways. In the summer of 2008 I spent 3 months in this dynamic city. My article, the result of research I conducted in Dakar, explores how urban Senegalese women express their identity in contemporary culture—particularly in, but not limited to, dance, dress, literature, participation in Islamic rituals, food preparation, and use of the French language. Furthermore, it addresses how the expressions demonstrate what Senegalese women value, as well as the structures and institutions that have influenced such values over the years.

### Introduction

To understand how identity is constructed in a culture is to take significant steps toward cultural understanding. Through interactions with other people, we understand more about ourselves and the humanity in which we all partake. Here I examine several expressions of urban women's identity in contemporary Senegalese culture. I also relate these expressions to the values of urban Senegalese women and explain various structures that have influenced these women's identity. This study contributes to intercultural dialogue and understanding, which are increasingly important.

### Background

Senegal is a culturally sophisticated, democratic country in West Africa. In 1960, it gained independence and emerged from French colonialism. However, the country's colonial past continues to influence

its society. A mélange of Wolof (the dominant ethnic group) and Islamic traditions serves as a foundation for women's place in society. The interplay between these traditions adds to the value of relationships and brings together friends and family to socialize (*"pour discuter"*). Traditions from Senegal's French colonial past also mix with this mélange. In the capital city, Dakar, this cultural mélange is greatest.

As a student of international studies, I spent 3 months, from May to August 2008, in cultural immer-



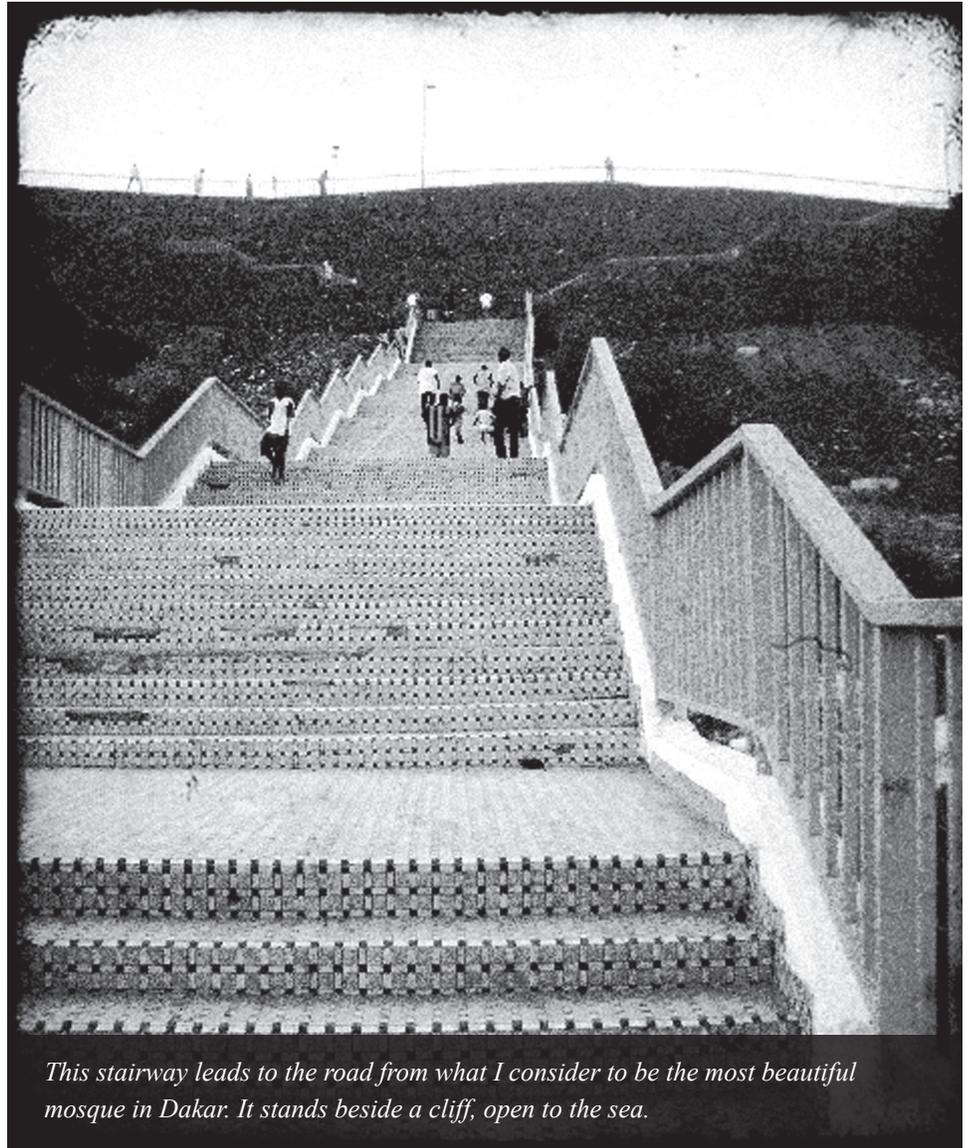
sion in Senegal. I spent the first half of my stay in the vibrant city Dakar, which bustles with many types of people, living their lives and expressing their diverse identities in a myriad of ways. There I divided my time between hands-on participation and formal classes to learn about West African dance and drum and Senegalese literature and film. I spent the second half of my stay in St. Louis, a coastal town in the north of Senegal. In the mornings, I volunteered at a school, playing games with children and teaching French. My afternoons were spent teaching boys at a homeless center how to paint. Throughout my stay in Senegal, I lived with host families.

To explore identity is to explore the answer to the question “Who am I?” How one answers this question verbally differs from how one does so through actions. Outward expressions of identity come in many forms and differ among cultures. Every culture has unique practices, values, and beliefs, and these form the basis of identity. By understanding how women in a culture express their identities, we can pinpoint what they value most.

## Results

Urban Senegalese women participate in various expressions of identity. These expressions include, but are not limited to, dress, dance, religious practices, literature, and food preparation. In Senegalese culture, dress connects a woman’s identity with her place in society, her belief system, or both. Some Senegalese women adopt either Western or traditional Senegalese dress, and some mix the two. Western fashion is much more common among younger, educated women. By dressing in Western styles, these women display their belief that women can and should be educated and have jobs outside the home. However, most women dress

traditionally at some times. In particular, when attending social gatherings such as weddings or baptisms (Senegal has a substantial Catholic community), women wear their most exquisite boubous (long, flowing garments) and finest jewelry. Women may also dress in fine clothing to exhibit pride in their social class, education, or marriage to a wealthy man.



*This stairway leads to the road from what I consider to be the most beautiful mosque in Dakar. It stands beside a cliff, open to the sea.*

*Sabar* also contributes to the urban Senegalese woman’s identity. *Sabar* is a multifaceted term for a type of drum, the music produced by this drum, a style of dance, and a social event incorporating all three. *Sabar* dance typically includes skilled arm and leg movements that may appear to an outsider as flailing. The pelvic thrusts, lifting of clothing, and gyration of the

lower torso and pelvic region in sabar dances usually elicit squeals of delight and laughter from the crowd. Participation in sabars provides an environment for expressing sexual identity, which is often dormant in everyday life. I observed that the more sexual and outlandish the dance moves, the greater was the approval expressed by the crowd. Sabar dance, which occurs often in Wolof society, is a cultural marker indicating that women are part of Senegalese society.

Outward demonstrations of the Muslim faith are significant to the expression of a Senegalese woman's identity because through such demonstrations, a woman shows that Islam is at the core of her beliefs and actions. Among these outward demonstrations are saying daily prayers, attending the mosque, fasting during Ramadan, and wearing a headscarf. Although almost all Senegalese are Muslims, actions and outward expression of faith distinguish Senegalese women who allow Islam to be a key feature of their identity. Some women participate in all the outward demonstrations, whereas others do not display much involvement.

A novel authored by a Senegalese woman provides distinctive insight into Senegalese women's identity. In her autobiographical novel *Une Si Longue Lettre*, or *So Long a Letter*, Mariama Bâ covers many subjects and thus helps paint a full picture of the Senegalese woman. Love, friendship, marriage, polygamy, motherhood, and modernization are some of the themes of Bâ's novel. Because this novel addresses identity with personal musings and stories, it illustrates Senegalese culture especially vividly.

A remarkable attribute of Senegalese women is that most can prepare and serve meals from a very early age. The ability to cook represents an adherence to womanhood, a woman's identity as a wife, and hospitality. Acquiring cooking skills and preparing meals for the family and guests are a woman's duty. Preparing meals for guests manifests the Senegalese value *teranga*, which means hospitality. Through the display of cooking abilities, a woman identifies herself as possessing *teranga*, an essential quality. *Teranga* is so sig-

nificant that the Senegalese often refer to Senegal as the "land of *teranga*."

I found that relationships with family and friends, as well as religious beliefs, are of utmost value to Senegalese women. Because they are raised to be good wives, women in Senegal generally assume that they will marry. Being a good wife is tied to a woman's pride and self-worth, and therefore marriage is an element of a woman's identity. Often, marriage is also necessary for survival. In a society where most of the workforce is male, marriage is a survival tool; "the economic dependence of women in urban and suburban areas ... creeps into the marriage relation."<sup>1</sup> Specific roles for men and women have been defined by cultural traditions to which most women adhere. Traditionally, men

have been the primary breadwinners, and women have cared for the home and children.

In Senegal, the ability to have children is closely linked with the concept of the

*“Early pregnancy, when it happens within marriage... is viewed as a blessing for the young married woman, no matter what her age, because it is proof of her fertility.”*

ideal wife. The ideal wife produces children, and therefore fertility is expected in Senegalese culture. In an article about motherhood in Sub-Saharan Africa, Therese Locoh states, "Early pregnancy, when it happens within marriage ... is viewed as a blessing for the young married woman, no matter what her age, because it is proof of her fertility."<sup>2</sup> In fact, as Locoh mentions, the inability to have children is viewed with shame. Also, children are regarded as an avenue of love. Bâ, in *So Long a Letter*, explains, "One is a mother to love, without beginning or end," indicating that mother-child relationships are emotionally significant.<sup>3</sup>

Friendships among women in Senegal are both the most open and the most treasured relationships. Common experiences, activities, social positions, and values help create intimacy among women. The social nature of urban Senegalese culture facilitates the growth of relationships among women. Senegalese women often spend their leisure time in the courtyard or outside a home, drinking tea with friends and participating in family *pour discuter*. I was regularly invited to drink tea and "discuss" for hours topics that ranged from George W. Bush to the weather. Other events that are

significant to the Senegalese community are sabars and important life-cycle events such as weddings, baptisms, and circumcision celebrations. In Senegal, nearly every event is an occasion for celebration and an opportunity for loved ones to gather. These events are where friendships are formed and reinforced.

Senegalese women's values cannot be considered without taking into account the importance of Islam. Islamic beliefs are integrated into every aspect of life. Islam specifies certain practices that Muslims should follow. In my host home and in public, I observed many women observing the "five pillars of Islam," a set of activities linked with their beliefs. The five pillars of Islam are *shahadah* (confession of faith), *salat* (ritual prayer), *zakat* (almsgiving), *sawm* (fasting during Ramadan), and *hajj* (pilgrimage to Mecca). The frequency with which these actions are practiced signals their importance. The clearest demonstrations of faith are ritual prayer and almsgiving. Many women complete prayers five times daily. They do so in the privacy of their homes or on the street if they are out. Like many developing countries, Senegal has a system that incorporates almsgiving. There are young boys, called *talibés*, who are given over to Islamic leaders called *marabouts* by parents who cannot afford care for them. The system has become corrupt, with the *marabouts* forcing the children to beg and then keeping the alms—all in the name of Islam. These children are left to sleep on streets, hungry and malnourished. Islamic values are evident in women who either set aside food to give to the *talibés* or give them money on the streets. Women who give alms even when money is scarce show that they highly value obedience to Islam.

Among the structures that have influenced contemporary culture in Senegal, Islam dominates. Islam came to Senegal in the 11th century via traders and missionaries and first became part of Tukulor culture.<sup>4</sup> Since the entrance of colonialism, Islam has grown to encompass more than 90% of the population.<sup>4</sup> Islam has entered almost all aspects of Senegalese life and culture: "In Islamic societies, religion governs everything from law and banking to dress and appropriate behavior when eating or even bathing."<sup>5</sup> Because Islam governs all as-

pects of life, it inevitably affects women's identity.

Cultural tradition (practices and beliefs that have long been upheld) also greatly influences the identities and actions of women in contemporary Senegal. The presence of the past is evident in caste organization, marriage, and women's roles. The Wolof people have for centuries been organized into a social caste system that has prevailed despite its formal abolition after Senegalese independence. This caste system provides social organization through the division of labor. The system comprises three main groups: the *gээр* (un-casted), *ñeeño* (casted), and *jamm* (slaves). This social organization assigns some aspects of a woman's identity, defining what she can and cannot do. A woman cannot, for example, marry someone from another caste without intense disapproval. Thus, cultural tradition acquires the status of a structure, a sort of status quo, which dictates identity to some degree.

A final structural influence on the urban Senegalese woman's identity comes from the remnants of French colonialism. The French took control of Senegal in 1677 and introduced many social, political, and cultural changes. Today, French is commonly spoken in urban areas, and the monetary unit is the franc. Other traces of French colonialism remain and have affected urban women's identity. One such influence is seen in the current education system, which is modeled after the French system. A consequence of the emphasis on

## Prevalence of Islam

*In Islamic societies, religion governs everything from law and banking to dress and appropriate behavior when eating or even bathing.*

education that took root in Senegal during French rule is that women are educated and therefore have more opportunities for a shift in identity.

### Discussion

Brazilian novelist Paulo Coehlo said, "Communicating with each other opens our eyes to the richness and plurality of our societies while strengthening our own identities. . . . We must welcome the opportunity to learn about different cultures, and embrace the benefits of diversity to cultivate harmony between all people."<sup>6</sup>

By studying urban women's identity in contemporary Senegalese society, we can explore the values, ideas, people, practices, habits, processes, and philosophies of Senegal's robust urban culture. Understanding other cultures is key to living in and interacting with the modern world. However, Senegalese culture is not the only culture that needs to be understood. We interact with many countries and cultures daily. Our interactions with other countries may prove fruitless if we fail to understand their cultures. Fostering communication with and understanding of different cultures encourages a more holistic comprehension of the relationships between cultures and of how different cultures may co-exist.

My study informs about Senegalese culture and provides tools for understanding other cultures. I have highlighted some areas that one may look at in quests to understand identity. My research also indicates the importance of discovering values and beliefs unique to a culture. If other cultures are inspected with the same observant and unassuming eye, the benefits would be endless.

### **Acknowledgment**

I especially thank Dr. David Donkor, of the Department of Performance Studies, who urged me along in the research and writing process, encouraging me to always embrace challenges.

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## MEASURING THE ENVIRONMENTAL IMPACT OF METEORITES

*When meteorites bombard Earth, impact modelers assess their environmental impacts by using three-dimensional magnetic images. Through analytical and numerical methods, one can refine the data for these images, allowing for better analysis of subsurface geologic trends.*

Andrew Muñoz

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*Figure 1. Thrusted limestone formation outcrop at the rim of the Odessa crater.*

Meteorites have bombarded Earth's surface throughout history. According to Dr. Mark Everett of Texas A&M University, moderate-sized meteors pose the greatest impact-related hazard; such occurrences, though rare, have great potential for destroying the environment. Events such as these threaten the safety of regions with large populations. By using three-dimensional magnetic images of the 63,000-year-old iron meteorite impact crater in Odessa, Texas, one can predict the severity of possible environmental damage. These images will provide an essential tool for impact modelers who wish to clarify uncertain conclusions regarding the mechanics of the meteorite impact and its environmental implications. This article will focus on refining the magnetic images and developing methods that can be used to further evaluate other impact sites efficiently. The described magnetic technique was used to analyze the subsurface images of the crater, and the results were enhanced with geophysical magnetic filters.

## Introduction

The greatest impact-related hazard results from moderate-sized meteors (about 160 meters, or 525 feet, in diameter) because of their frequency of occurrence and severity of environmental destruction. The impacts of these meteorites threaten the safety of densely populated regions. By analyzing three-dimensional (3-D) magnetic images of a moderate-sized meteorite crater in Odessa, Texas, that dates to about 63,000 years ago<sup>1</sup> (Figure 1), scientists can fully evaluate the various physical properties of the meteor impact to assess the hazard posed by other meteorites.<sup>2</sup>

Certain filters may be applied to magnetic data to enhance 3-D magnetic images for easier interpretation. A common type of filter is the reduction-to-pole (RTP) filter. Because of the tilt of Earth's magnetic field, the magnetic field lines create an angle with Earth's surface and distort the magnetic data. An RTP filter essentially removes the effect on the data of geomagnetic tilt or inclination at the measurement site.<sup>3</sup> Applying such a filter to data conceptually moves the experiment to

the magnetic north pole, where magnetic inclination is zero. By using analytical and numerical methods, one can find a 3-D RTP filter for any arbitrary magnetic dataset; we tested such a filter by using data from the

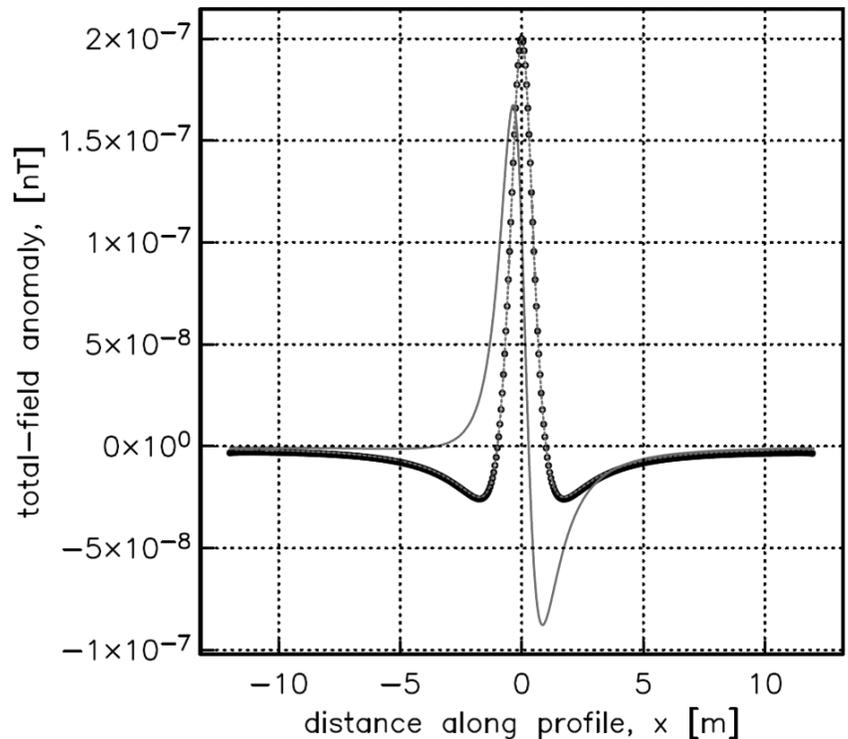


Figure 2. A test of the RTP filter. The solid black curve is the total-field anomaly computed from the analytical equation. The gray, dotted curve is the reduced-to-pole anomaly computed from the filtered total-field anomaly. The solid gray curve is the total field anomaly before applying the reduction-to-pole filter.

Odessa meteor site. The RTP magnetic dataset from Odessa may then be interpreted in terms of the subsurface geology.

## Background

Magnetics has long been used in geophysics to study the properties of the subsurface without digging, or what is commonly known in geophysics as “ground truthing.” Magnetic fields are caused by moving electric charges, or a current. When a second current comes near the field, a magnetic force is experienced. Earth's magnetic field lines (lines representing magnetic field direction) form approximately an ideal dipole. In essence, a dipole is equivalent to the magnetic field created by a small bar magnet. The dipole field lines account for most of the magnetic field strength; the smaller

component is negligible. The main geomagnetic field is due to currents in the outer core, whereas smaller intrinsic fields, which are magnetic fields caused by rocks, generate locally variable magnetic anomalies.

Earth's magnetic field strength is known at all latitudes and described by the International Geomagnetic

## Ferrous Rock

*Magnetic properties are directly related to the iron content of rock, which in turn is used to identify rock types and therefore describe the environments in which the rocks were formed.*

Reference Field (IGRF<sup>4</sup>). One can easily find the anomalies in local rocks by subtracting the IGRF magnetic field values from the total local magnetic field strength. The resulting value is known as the total-field anomaly. Knowing the total-field anomaly permits identification of the magnetic properties of the rock. Magnetic properties are directly related to the iron content of rock, which in turn is used to identify rock types and therefore describe the environments in which the rocks were formed. When rocks with ferrous (iron containing) material are formed, their iron-bearing minerals align with the existing direction of Earth's magnetic field. This magnetization produces the magnetic field in the rock.

Using a total-density magnetometer, we measured the total-field anomalies in a 2-D array over the Odessa Crater. We measured magnetic intensity at many points in the array, and we used this array to create a 3-D model of the crater. We plotted the values on a 2-D grid to visualize the raw data. Once such data are plotted, an assortment of enhancement techniques can be used to accentuate particular characteristics of anomalies.<sup>5</sup> Use of such techniques facilitates interpretation of the shapes and magnitudes that are unique to each anomaly.

Digital filtering can be much more efficiently accomplished if the domain (the variables in which the data are described) of the dataset is changed from the time domain to the frequency domain.<sup>5</sup> Whereas filtering in the frequency domain is straightforward, filtering in the time domain is difficult. This change in domain is accomplished by using a mathematical procedure called a Fourier transform, which changes the

variables. Once a change in domain is accomplished, a digital filter, in terms of the wave number, can be multiplied to the dataset. The filtered data are then changed from the frequency domain back into the time domain by using an inverse Fourier transform. The RTP filter is commonly used to remove the varying effect of magnetic inclination, which changes with latitude. Magnetic inclination is the angle between magnetic field lines and the surface of the earth. Because of the shape of the dipole, the magnetic inclination changes at various latitudes. In essence, applying an RTP filter is equivalent to moving the experiment to the

magnetic north pole, where the magnetic inclination is zero and the distortion caused by the magnetic inclination is negligible. Without the RTP filter, the size and shape of the local measured magnetic anomaly is skewed and difficult to interpret.

### Results

To create a 3-D RTP filter for the Odessa data, I derived the total-field anomaly analytically in three dimensions in the time domain. Given the governing equation for a magnetic field at point  $(x, y, z)$  due to an arbitrary 3-D uniformly magnetic body represented as point  $(x', y', z')$ , one can find the total-field anomaly analytically.<sup>3</sup> Once the total-field anomaly is found, it must be transformed into the frequency domain to find the RTP filter. Applying a 2-D Fourier transform analytically to the 3-D total-field anomaly equation (using integration) transforms it from the time domain to the frequency domain. Unfortunately, this integration was not possible and the RTP filter could not be found analytically. Therefore, the RTP filter must be found using a 2-D discrete Fourier transform. The discrete Fourier transform is a numerical method that uses sums instead of integration to solve for the RTP filter. Using the computer programming language FORTRAN 77, one can write a 2-D discrete Fourier transform algorithm to perform an RTP filter numerically for the magnetic dataset.

### Discussion

Being unable to solve for the RTP filter analyti-

cally is a hindrance because the 3-D RTP filter must be as general as possible for any dataset. Fortunately, the numerical method of solving for the RTP filter is viable. Writing the 2-D discrete Fourier transform into FORTRAN 77 and validating the implementation are still under way. Once I finish creating this program, I will test it by using a few test datasets, and then I will use it to filter the actual Odessa magnetic data. Because the RTP anomaly in the frequency domain is the total-field anomaly in the frequency domain multiplied by the RTP filter, we can distinguish the RTP filter easily.

After defining the RTP anomaly in the frequency domain, I will apply a 2-D inverse discrete Fourier transform to the data to produce the RTP anomaly in the time domain as the final result. I can then plot the RTP data on a grid to see the enhanced anomalies for interpretation. The size and shape of the anomalies should then equal the true size and shape of the intrinsic field of the measured anomaly. Figure 2 shows a simple example of this concept. From the inferred size and shape of the anomalies, one can identify the magnetic bodies, allowing for a full analysis of the crater. The enhanced data will allow identification of subsurface geologic trends and will make key impact-related features more obvious. Viewing the crater and its magnetic anomalies in three dimensions will aid environmental-impact modelers.<sup>6</sup> This enhanced view of the Odessa Crater may also prove useful in other impact-crater studies and in other environmental geophysics problems.

## Acknowledgments

I thank Dr. Mark Everett for providing me with this research project, the data used, and guidance in learning FORTRAN and geophysical magnetics.

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# VOTER PERCEPTION IN THE 2008 PRESIDENTIAL ELECTION

*In the heat of the 2008 election season, voters formed opinions through framing political candidates in terms of several factors, including emotion, race, party affiliation, respondent age, and views toward the media.*

David Paul Strohecker

The 2008 presidential election was one of the most hotly contested in American history. During the months before the election, the nation was being led by its most unpopular president to date, was embroiled in two wars, and was facing an economic downturn unparalleled since the Great Depression. In this context, the contest between Senators Barack Obama and John McCain became the most bitter, hard-fought, and tumultuous election in modern history. The election was not a contest between two individuals but rather a competition between two opposing worldviews and a referendum on America's ideological foundation. America had reached a precipice, and the people were vying for a new direction. But which direction? In this historic context, I sought to assess how voters viewed the election, candidates, and political process. I did so in a conceptual framework that emphasized the framing of political candidates in desired lights through narratives that they and their campaigns crafted about them and that were conveyed largely through the mass media.

## Methods

During September, October, and November 2008, I conducted 33 interviews with registered voters in the Bryan/College Station area in Texas during the heat of the election season. All respondents were over age 18 and had volunteered to be interviewed for this research project. Most respondents had spent much of their lives in Texas, and many self-identified as "native" Texans. The relative homogeneity of my sample sharply limits the generalizability of my research data. However, the data still offer a window into participatory democracy

in the mass-media era.

Respondents received a series of open-ended questions and were allowed as much time as needed to answer them, pose topics of their own, and provide anecdotes supporting their views. The interviews were tape recorded and then transcribed; all records of the interviews have been destroyed. Each interview lasted 1–2 hours. To protect the interviewees, I have replaced all their names with pseudonyms.

## Results

### *Significance of Emotion*

Respondents generally voiced support for the candidate who elicited the strongest positive emotions from them. This candidate was often described as "trustworthy," "honest," and "sincere." Negative emotions were expressed toward the other candidate, who was often labeled "untrustworthy," "dishonest," and "insincere." Each campaign seeks to frame its candidate in a positive light and malign its opponent with negative associations. This approach evokes the desired emotional reactions among voters.<sup>1</sup>

Also important to emotional perception is an individual's social background. For example, Gregory Bovasso predicted that voters would support a candidate of their own socioeconomic background, racial/ethnic heritage, or religious affiliation.<sup>2</sup> Many of the white voters exhibited distrust toward Obama because of his racial heritage. On the flip side, several lower middle-class respondents voiced distrust toward vice presidential nominee Sarah Palin because she came from a well-to-do family.



### *Party Affiliation*

Respondents' party identification often led them to view the events of the campaigns in a highly skewed manner, from deliberately seeking information that reinforced their own views to disregarding information that contradicted their preconceived beliefs.<sup>3</sup> I found that respondents' party alliance reflected their views of not only individuals, gender, race, and morality but also the state and society.

As Lakoff articulates with his "nation as family" metaphor, people's political orientation sharply colors their view of the state.<sup>4</sup> Those who self-identified as Republican (conservative) generally viewed the role of government as resembling that of a "strict father"; those who identified as Democrat (progressive) saw the role of government to be that of a "nurturant parent." This fact was made manifest in my interviews with Bryan/College Station voters.

Elizabeth, a 21-year-old self-identified conservative, stated her view of government as follows:

"Basically I don't believe government is here to fix society. Which I think a lot of times people have the assumption that government is there to take care of people and fix things ... almost like a utopian view of the world. And I guess I tend to view it like, 'This is not what government was set up to be.' There is a lot of individual responsibility on people. ... But I think we have definitely moved as a society more toward like 'the government is supposed to take care of me.'"

Elizabeth's view reflects the quintessential conservative argument against "government handouts." She views the role of government as being like that of a strict father, who must instill discipline in his children (the electorate) so they may one day provide for themselves. Such a worldview places a high premium on respect for authority and the need for individuals to take responsibility for their actions. This model of governance also tends to attribute success or failure to individuals, all of whom have an equal opportunity to make the most of themselves.

The centrality of the “strict father” figure to the conservative paradigm was manifest in the commentary of Jim, a 24-year-old Republican. Discussing the possibility of Sarah Palin’s succeeding John McCain to the office of president, he stated that “a woman should not be president, because the Bible calls men to leadership roles.”

it seems that college- and high school-age kids are so much more well informed on international and political issues [than we are]. Of course, there is always exceptions, but as a rule, I found that in countries where there was a safety net, health care, annuity, etc., people were just more kind to one another.”

Maggie’s view of government reflects Lakoff’s model of the “nurturant parent.”<sup>4</sup> She indicated that the government should care for its own people, what Lakoff calls “protection and empowerment.” In this worldview, one’s welfare is not simply the prerogative of the individual but a responsibility shared by the parent and child (state and citizen). This model acknowledges inherent inequalities in the structure of society and seeks to provide a basic modicum of welfare for all.

### *Respondent Age*

Respondents’ age influenced their interpretation of the 2008 campaign. Not only did younger voters have less experience to draw on regarding the political process, they also did not remember previous elections. The older respondents could compare the current election with previous elections and draw on past experiences when assessing the candidates’ claims. This disparity became apparent through respondents’ an-



*Respondents generally voiced support for the candidate who elicited the strongest positive emotions from them. © Peter Foley/Corbis*

The conservative approach to governance requires a strict father figure, which is predicated on a respect for hierarchy and traditional gender roles.<sup>4</sup> Several self-identified Republicans expressed sentiments similar to Jim’s with regard to Sarah Palin. I found that many men expressed this sentiment, all of whom were Republicans; they indicated that men were entitled to leadership positions by God and that women could not fulfill this role.

In contrast, Maggie, a 69-year-old retired businesswoman, defended her identification as a progressive with the following:

“I mean, a thinking person has to know that our own population has to be cared for healthwise, education-wise, before we get involved in other nations. We can’t keep treating our own people like ‘the other.’ It’s just so hard to believe that we are not educating our people. Having lived abroad and traveled a lot in Europe,

anecdotes.

For example, commenting on McCain’s not knowing how many houses he owned, Rachel, a 68-year-old retired schoolteacher, stated, “I remember when George Bush senior didn’t know how much a gallon of milk cost... Now that sorta got to me ’cause I gotta buy milk [chuckles]. Now that affected me a lot more than [McCain’s] not knowing how many houses [he owned].”

Because she had encountered “out of touch” politicians in previous elections, Rachel found McCain’s gaffe to be less consequential. The younger respondents were not so forgiving. For example, a younger voter, Angela, stated, “That bothers me that he didn’t know how many [houses] he had when some people out there don’t even have one house right now. ... It makes me upset.”

Younger respondents were more likely to be swayed by the ideological views of their parents. This is im-

portant when one considers the increased voter turnout among youth during the 2008 election.<sup>5</sup> Many white college students spoke of how their parents' political views influenced theirs.

Krystal, a 21-year-old college student, described her parents' political views as the "really conservative Christian type." When I asked her how her views resembled her parents', she stated, "I am not really a big fan of abortion, and I think it would be okay for, like, homosexuals to have similar uses, but I think marriage has, like, religious ties to it. So I think it should be saved for, like, what the Bible says."

Interestingly, Krystal was an avid supporter of Obama, which her parents did not quite approve of. Although she supported the Democratic nominee, she reflected the ideological sentiments of her parents regarding abortion and gay marriage. Because "new voters" have little or no experience to draw on, they rely on secondhand knowledge provided by their parents. In this way, many young voters "rationally choose to employ parental experience to help orient themselves to politics."<sup>6</sup>

#### *Views toward the Media*

Regardless of political orientation, age, gender, and other demographic indicators, respondents displayed a widespread distrust of the news media.

The respondents viewed the media as biased toward their opponent's party. For example, Barb, a 55-year-old Obama supporter, claimed that "all the big networks are owned by Republicans." On the flip side, Lindsay, a 21-year-old McCain supporter, quipped that "CNN and MSNBC are just pushing a liberal agenda."

The respondents were critical toward the news media but unreflective about their own sources of political news. No respondents admitted that their source of political information had a political bias. All respondents saw themselves as "above the influence" of political framing.

#### *Race*

Despite the media glamorization of Obama's racial

heritage, most respondents "did not see race" at all. Liberals and conservatives alike saw Obama through a lens of racial exceptionalism. These respondents consciously or unconsciously chose to minimize Obama's identity as an African American and categorized him as an "honorary white."<sup>7</sup>

For example, one young McCain supporter stated, "Well, I don't think the media have really portrayed him as an African American. ... [They] have portrayed him as basically white." Many white voters shared this sentiment, which propagated in the mainstream media.

Some respondents, rather than ignoring Obama's racial heritage, made it the focal point of their political views. For instance, Jenna, a 21-year-old McCain supporter, stated, "And to me, I just wish that we could move beyond, like, *truly move beyond* looking at the color of a person's skin. Like if somebody is trying to get admitted into college, look at their scores; don't look at their skin."

Jenna's arguments reflect the minimizing strategies that many whites use when dealing with racial issues today. Central to these strategies is a belief that affirmative action legislation provides an unjust advantage to otherwise unqualified individuals on the basis of their racial heritage. This argument has even been leveled against Obama regarding his victory in the 2008 presidential election.<sup>8</sup>

## **Above the Influence**

*The respondents were critical toward the news media but unreflective about their own sources of political news... All respondents saw themselves as "above the influence" of political framing.*

#### *Political Framing*

Conservative framing toward Obama's racial heritage was strong. Most respondents retained some uneasiness toward Obama's ethnic or religious background.

When asked whether it would be a problem if Obama had been a Muslim, Krystal, a supporter of Obama, stated, "Well, it depends what kind of Muslim. If he was, like, an Osama bin Laden, then there would be a problem. But if he was a moderate Muslim,

I don't think that would be a problem 'cause I know some Muslims and they say, like, 'Yeah, those people are crazy and they are just taking it [to an] extreme.'"

In this ethnocentric targeting of people of color and non-Christians, both groups have been portrayed as dangerous, foreign, and "unlike us." Years of conservative framing, epitomized in President Bush's "war on terror," have created a powerful distrust toward Muslims and people of Middle Eastern descent. White voters from both political parties shared this conservative framing toward Muslims.

Obama's conservative opponents sought to elevate a narrative of fear in order to reach the electorate's "gut instincts." In doing so, conservative political strategists showed a keen understanding of American voters.<sup>4</sup>

### Conclusion: The Importance of Framing

The importance of narrative for the success of a political campaign rests in its ability to resonate with the public.<sup>1,4</sup> The 2008 election marked a determined step for the Democratic party, which trumped the GOP's narrative of fear.

With the collapse of the economy in mid-October 2008, voters' rational interests were pushed to the forefront of their minds. This left Republican nominee McCain unable to capitalize on his foreign policy experience and "maverick" narrative. And with his selection of Governor Sarah Palin as vice-presidential candidate, he alienated many of his supporters and interrupted his desired "experience" frame. On the other hand, Obama came to be seen as the steady hand at the wheel.<sup>9</sup> The Obama campaign successfully framed its candidate as the harbinger of hope and change, a narrative that resonated with both young people and those exasperated with eight years of Republican leadership.

Obama's campaign also galvanized broad swaths of the voting public to make it to the polls on Election Day. His campaign's ability to frame the debate left people not fearful, cynical, and distressed, but rather inspired, uplifted, and ready for change. His use of new technology broke new ground and reached college students across the nation; his message of change inspired those whom America's political system had long marginalized. In short, he reached the heart of the voting public who were ready for a new direction. He called for change, and America answered.

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## FLAME RETARDANTS IN TEXAS CLIFF SWALLOWS

*Flame retardants accumulate in animals, producing biochemical changes. Cliff swallows, as model indicators of local pollution, were compared from three sites to estimate the relative geographical extent of contamination and possible effects as a result of the industrial production and use of flame retardants.*

Catherine Baxter

**P**olybrominated diphenyl ethers (PBDEs) are flame retardants used throughout the world on such products as upholstery, circuit boards, foams, and rubber. Over time, PBDEs break free from these products and enter the environment. Since the 1970s PBDEs have been found in many natural media, from sediments to human breast milk. This prevalence of PBDEs is a concern because of their known toxicity. PBDEs have been linked to hormonal, developmental, and enzymatic ab-

normalities, some of which pose substantial threats to the welfare and reproductive capabilities of affected organisms. This article discusses and compares the types and concentrations of PBDEs found in cliff swallows (*Petrochelidon pyrrhonota*) from Laredo, El Paso, and Somerville, Texas, in an effort to illustrate not only the geographic variation of contamination but also

**Continued on page 18...**

# About

## the Authors

*The contributors of this issue include Texas A&M undergraduate students with a wide range of majors, from biomedical engineering to international studies to geophysics. Some have since graduated in the Class of 2009.*

### David Paul Strohecker

Sociology, Class of 2009

David Paul Strohecker, a class of 2009 former student from Plano, Texas, graduated with a B.A. in Sociology. He currently attends the University of Maryland and is pursuing his Ph.D. in Sociology. He was inspired to write his article by his mentor, Dr. Feagin, who encouraged David to stake a claim on the 2008 election season and develop a research project addressing it.



### Tahni Joy Candelaria

International Studies, Class of 2009

Tahni Joy Candelaria is a 2009 International Studies graduate with a special emphasis on Africa and the Middle East. Tahni spent 2008 in Senegal studying the culture of the Senegalese people. Her article shows Tahni's personal fascination with the subject and presents insights on how people shape their cultural identity.



### Julianne E. Larson

Aerospace Engineering, Class of 2010

Julianne Larson is a senior Aerospace Engineering major from Houston, Texas. After graduation, she hopes to join NASA and continue working on projects related to the exploration of space. Julianne has been working on this project at the Space Engineering Institute since her freshman year and hopes that her article will inspire other Aggies to consider a research experience at Texas A&M.



## Catherine Baxter

Chemistry, Class of 2009

Catherine Baxter is a 2009 graduate with a B.S. in Chemistry. Catherine hopes to work as an environmental scientist and naturalist focusing chiefly on toxicological and chemical studies. Under the guidance of her advisor, Dr. Mora, Catherine funneled her love of both chemistry and wildlife into this article. This work complements another study on which she and Dr. Mora collaborated.



## Jenny Russell

International Studies, Class of 2012

Jenny Russell is a sophomore International Studies major from Baton Rouge, Louisiana. After graduation, she plans to pursue a career as a Foreign Service Officer. Because *Wuthering Heights* is Jenny's favorite gothic novel, she wanted to articulate the qualities that have made this convoluted tale of love and revenge one of the classics of English literature.



## Rebecca Rulla

Biomedical Engineering, Class of 2011

Rebecca Rulla is a junior Biomedical Engineering major from Sherman, Texas. After graduation, Rebecca hopes to continue researching and designing cutting-edge technologies and devices to be used as medical treatments inside the body. Rebecca's inspiration for this article came from her human physiology professor, Dr. Wasser, who assigned a project to design a nanosized mechanism to treat a disease of the brain and/or spinal cord.

## Andrew Muñoz

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Andrew Muñoz is a senior Geophysics major from Houston, Texas. He plans to intern with an oil and gas company this summer and then continue to graduate school in 2010. Andrew's article was inspired by the work of his advisor, Dr. Everett, on crater impact sites. His goal was to learn how to process and interpret data to answer important scientific questions.



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the industrial origins of the PBDEs concerned. Because swallows are considered good indicators of local pollution, it is also possible to infer the relative extent to which other organisms, including human inhabitants of these three locations, are exposed to PBDEs.

## Introduction

The use of flame retardants, though conferring fire resistance in many important products, has caused an unnatural influx of chemicals into the environment. These flame-retardant chemicals accumulate in living organisms, sometimes producing substantial biological and biochemical changes.<sup>1</sup> Much effort has been devoted to examining wildlife for flame-retardant contamination, in order to estimate the toxicological and ecological effect of the industrial production and use of flame retardants.

We analyzed cliff swallows (*Petrochelidon pyrrhonota*) from El Paso, Laredo, and Somerville, Texas, for concentrations of a class of toxic flame retardants called polybrominated diphenyl ethers (PBDEs). To help assess the environmental health and extent of pollution at the three sites, we determined the types and concentrations of PBDEs present in these birds and

## Birds of a Feather

*Cliff swallows are considered good indicators of local pollution because of their propensity for exposure and tendency to stay near their nests.*

considered them in the context of toxicological studies of PBDEs. Exposure of cliff swallows may be used to infer that of other organisms living in the same areas.

## Background

PBDEs are a class of chemicals commonly manufactured for use as flame retardants in products such as upholstery, circuit boards, foams, and rubber. Many types of PBDEs exist, each of which is called a congener and is denoted by a different number.<sup>2</sup> There are

also several industrial mixtures of specific congeners; the three most common are the so-called deca-, octa- and penta- mixtures, which make up 80%, 6%, and 12%, respectively, of industrial production.<sup>1</sup>

## PBDE Toxicology

As PBDE-treated products break down, they release PBDEs into the environment.<sup>3</sup> PBDEs are rather mobile in both living materials (such as tissues) and nonliving materials (such as sediments and water), and they tend to migrate through ecosystems and accumulate in organisms that sit higher on the food chain, such as birds of prey.<sup>4,5</sup> Experiments in which birds and rats have been dosed with PBDEs showed that exposure causes immediate and long-term problems such as developmental delays, organ damage, cancer, and death,<sup>1</sup> as well as hormonal, developmental, and enzymatic abnormalities.<sup>6</sup>

## Use of Cliff Swallows as Study Subjects

Many studies have focused on the levels of PBDEs in birds, mainly because birds are found throughout the world in various habitats and so offer many opportunities for site-specific analyses of PBDEs. Also, because birds are vertebrates with body processes somewhat similar to those of humans, they can conceivably act as indicators of PBDE toxicity to people. Cliff swallows are considered good indicators of local pollution

because of their propensity for exposure and tendency to stay near their nests. Their main modes of exposure are probably their diet of insects and their habit of collecting sediment for nest construction;

both the water in which the insect eggs are laid and the sediment can be environmental reservoirs of PBDEs.<sup>7</sup> There is particular interest in the exposure of cliff swallows from the Texas–Mexico border because this area is so agriculturally and industrially active; many pesticides, herbicides, organic solvents, metals, and hazardous wastes are either inadvertently washed or intentionally dumped into the Rio Grande, where they pollute the immediate ecosystem and sites downstream.<sup>7</sup> Thus, cliff swallows, many of which live along the Rio Grande, are apt indicators of local environmental health and pollution.



*Collecting swallows with a mist net at the Rio Grande canal by R. Bustamante wastewater treatment plant, southeast El Paso, TX.*

## Results

### *Geographic Differences in PBDE Levels*

A total of 20 cliff swallows—eight each from Laredo and El Paso (both of which are on the Rio Grande) and four from Somerville (which served largely as a control group)—were tested for types and concentrations of PBDEs present in their bodies. After capture by net, the birds were killed and ultimately their heads, tails, wings, feet, feathers, and stomach contents were removed, leaving torsos with associated tissues and organs as the subjects of analysis. Four birds were taken from El Paso in 1999, and four more were taken from the same site in 2005. The birds from Laredo were taken in 2003, and those from Somerville were taken in 2004. Figure 1 shows the average total PBDE concentrations in birds from each site. The birds from El Paso had by far the highest average concentrations of PBDEs.

### *Concentrations of Congeners by Site*

Figure 2 shows the average concentration of each congener in birds from each site. Again, El Paso birds had the highest load of PBDEs. Some congeners were much more common across all sites than others.

## Discussion/Conclusion

As shown in Figures 1 and 2, El Paso had cliff swallows with the highest levels of PBDEs. This finding suggests that the environment in which these birds live in El Paso is much more contaminated with PBDEs than those in Laredo and Somerville. Given that the El Paso birds were collected at the Roberto Bustamante Wastewater Treatment Plant, we think they might have picked up PBDEs either from the plant's discharge or from the adjoining Rio Grande. Indeed, heavier congeners in wastewater accumulate in the particulate runoff from treatment plants.<sup>8</sup> Also, as noted, water (especially

that flowing through or near urban areas) commonly is contaminated with PBDEs through direct dumping and runoff from contaminated land.<sup>3,7</sup>

The finding of high concentrations of PBDEs in cliff swallows from El Paso is especially important ecologically because of El Paso's position upstream on the Rio Grande. Perhaps the PBDEs the swallows are exposed to could be transferred downstream to other sites and organisms. However, the levels in Laredo birds (which were collected at Manadas Creek, which sits in an industrial zone near the Rio Grande) were much lower. Laredo's lower levels suggest that direct-point PBDE pollution is more environmentally relevant than migration of PBDEs over long distances via waterways, which has been demonstrated only for smaller, more volatile congeners, such as PBDE-47 and PBDE-99.<sup>8</sup> Somerville was included for comparison with the two border towns, and PBDE levels in cliff swallows there were notably lower than those in cliff swallows living alongside the Rio Grande. This difference could indicate the importance of the Rio Grande as a PBDE reservoir. It could also reflect the influence of urbanization on contamination, since Somerville is more rural than Laredo and El Paso.<sup>8</sup>

Looking at the relative concentrations of congeners found at each site (Figure 2) helps us discern the industrial source of the contaminating PBDEs. The relative concentrations of congeners at all sites indicate contamination by the industrially produced penta-mixture, which consists of approximately 37% PBDE-47, 35% PBDE-99, 6.8% PBDE-100, 3.9% PBDE-153, 2.5% PBDE-154, and 1.6% PBDE-85 (along with trace amounts of other PBDEs).<sup>9</sup> The percentages that we

found were not identical, but they were close, and discrepancies can be explained by the tendency of some PBDE congeners to break down into additional congeners and other chemicals in the environment and in the bodies of organisms.<sup>10</sup> Also, some other mixtures that may be present contain the same congeners in different percentages. Although the penta-mixture is not produced as much as the deca-mixture, it is indeed used as a commercial flame retardant.

Our findings indicate that all three sample sites

**Average Total PBDE Concentrations by Location**

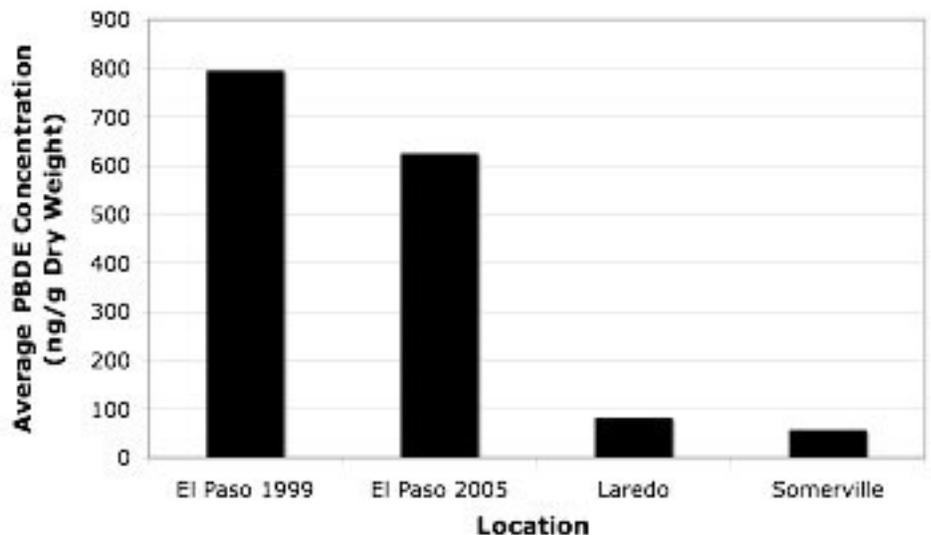


Figure 1

**Average Congener Concentration by Location**

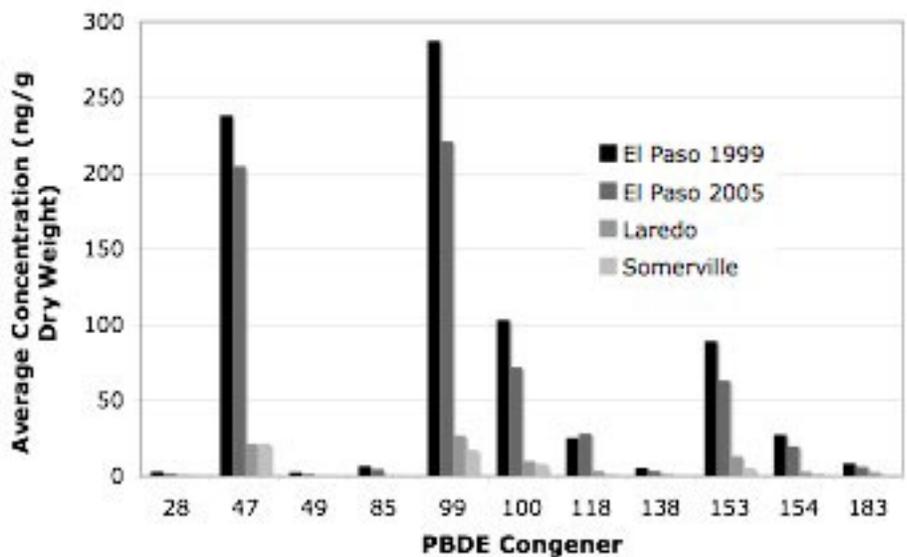


Figure 2

have some industrial (probably penta-mixture) PBDE contamination, with El Paso having the most contamination. Although what effects these levels may have on the birds is unclear, the mere presence of PBDEs is reason for further investigation because of their known toxicological potential. Many other organisms live in the same habitat as cliff swallows and probably accumulate PBDEs as well, although the degree of accumulation and thus toxicological effect may differ among species and even among individuals of the same species. Drawing conclusions about specific PBDE risks at the sites is difficult without directly examining several groups of organisms and their environments; apparently no comprehensive such studies have been published.

Many people living near the Texas–Mexico border probably experience the same sort of PBDE exposure that cliff swallows in this study did. Likelihood of exposure is particularly high for those who lack access to municipal water supplies (for example, those who reside in the so-called colonias) and those who eat animals that live in the river. However, no substantial medical problems are currently known to be associated with environmental PBDE exposure in humans or wild animals. Further study is warranted on the sources of PBDEs at these three sites, the presence of PBDEs throughout the local food chains (including in humans), and the toxicological implications of the levels found. Such studies can help in determining the extent of PBDE pollution, identifying any resulting damage to organisms, deciding whether industrial PBDE production should be limited or stopped, and assessing the need to clean up contaminated areas and reduce future pollution.

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## *WUTHERING HEIGHTS*: A STUDY IN LITERARY FILTERS

*Emily Brontë emotionally distorts the main characters and obscures their motives by using literary mechanisms, including filters between the reality in the story and the reader outside the story. This technique is a driving force behind the novel's ability to hook readers.*

Jenny Russell

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Emily Brontë's *Wuthering Heights* requires emotional stamina from the reader. The novel features characters who are often in states of mental anguish and who possess passions so extreme that the characters appear distorted. In addition, the motives of the characters—especially those of Catherine Earnshaw and Heathcliff—are obscured. This piece will explore the literary mechanisms Brontë used to achieve these distorting and obscuring effects. Particular attention will

be given to how Brontë layers “filters,” such as Nelly and Lockwood, between the reality in the story and the reader outside the story; the significance of these filters and their specific effect on a reader's perceptions of the novel will be discussed. Finally, this literary analysis will use these observations to support an argument that Brontë's deliberate obscurity is one of the driving forces behind the novel, and that to establish a single “right” answer to the unanswered questions is neither



possible nor necessary—and may in fact be counter-productive.

## Background

Since its first publication in 1847, *Wuthering Heights* has puzzled and intrigued readers and literary scholars. Many theories have been proposed to explain the novel's twists and turns. Perspectives ranging from modern feminist to Marxist to critiques of British imperialism have been applied to the novel, with varied degrees of success.<sup>1</sup> Although useful, these types of analyses limit themselves by imposing a narrow focus and external criteria upon their inquiries. Inherent in these approaches is the danger of using a work of literature as a means to an end instead of appreciating the work for its own sake. Such approaches also bear the risk of reading too much into a particular passage or phrasing. My analysis will take a different tack and approach the novel strictly on its own merit, with no assumptions about the author's political or social agenda. Although by necessity limited, the goal of this approach is to uncover what, if anything, has given the novel intrinsic appeal to readers from a vast array of backgrounds.

## Results/Discussion

Before delving into an analysis of the novel, one must understand the type of distortion most often encountered in it. This is not the sort of distortion one would see by looking in a cracked mirror. Instead, it is more the effect produced by looking at an insect through a magnifying glass. The insect's features remain proportionate, but the insect is magnified several-fold and thus is distorted. Here, the purpose of a magnifying glass is to focus more closely or exclusively on something. Such is the type of distortion featured in the novel: a focus so sharp it is nearly surreal. Although the novel is not strictly realistic, it retains trappings of realism, like the insect under the glass that still has all its features, though at many times their natural size.

One of the simplest means of distortion Brontë uses is the setting. The chief aspects of the novel take place entirely within the sphere provided by *Wuthering*

Heights and The Grange. Isolation itself is not unrealistic, but in this case the reader is given to understand that there are other humans flitting around the edge of this sphere. Although the reader eventually discerns that there is a village nearby, people in the village have no part in or control of the events transpiring within the sphere—an uncomfortable fact shown when Heathcliff advises his captive Catherine Linton that no one can or will come to her aid. This vague presence of an excluded outside world is what makes the setting of the novel distorted. The occupants of the two houses reign as sovereigns over a microcosm.

The characters are also subjected to distorting techniques. Heathcliff is one prominent example, having been twisted to the point of grotesqueness. As the novel progresses, his pure evilness—his “blackness of

soul”—becomes more and more apparent. This concentration of evil is unnatural to most readers, and it is emphasized by his juxtaposition with characters like Hare-

ton who possess a more realistic blend of good and evil. Catherine Earnshaw also exhibits a character flaw in the form of a curious concentration of passion, a willfulness so strong it is self-destructive. Her character is also distorted by being placed alongside characters with lack of passion, like Edgar Linton and his sister. The direct effect of this distortion is the emphasis of the characters' ambiguous motivations. Their passions are at once thrown into sharp relief while their causes are clouded.

The chief tool used to achieve this obscuring effect is a sort of literary filter. In general, when applied to literature, the term *filter* means anything that exists between the reality within a work of literature and the reader's perception. A filter controls what reaches the reader through the medium of the text. For example, if a story is narrated by one of its characters, that character may be considered a filter in the story. The authorial voice is another type of filter—the author has obvious control over what does and does not reach the reader. *Wuthering Heights* has three important filters: the author, Nelly Dean, and Mr. Lockwood.

When attempting to ascertain the obscure motives

*When applied to literature, the term filter means anything that exists between the reality within a work of literature and the reader's perception.*

of the novel's characters, one must know that it is beyond human power to fully understand the minds of other humans. Only a creator can hold that power; as author, Brontë played the role of creator and could have revealed the mystery. However, she chose to negate her authorial power by interposing other filters between her understanding of the characters and the reader and telling the story from a limited third-person perspective. In doing this, she has placed the first filter of authorial voice over the story.

Nelly Dean is the character entrusted with most of the responsibility for relaying the story to the reader. She is a down-to-earth, observant, and, above all, believable character in the novel. Yet these very attributes are what cause her to act as another filter. She can observe and describe many things in sharp detail: the characters' temperaments, their relationships, and their erratic behavior. She can be a trustworthy eyewitness of all these. At the same time, her humanity prevents her from knowing what the reader most wants to know—*why* the characters are the way they are and what is driving them.

The third and most curious filter is that of Mr. Lockwood. Although the novel begins with the first-person perspective of Lockwood, he takes no hand in the action. In fact, after Nelly begins her narrative, he is almost never mentioned, except for occasionally encouraging her to continue. He is of little consequence to any of the focal characters such as Heathcliff, the Earnshaws, or the Lintons. He does not affect the events narrated in the novel in the least. However, he can and does affect the *narration* of the events—a subtle and important distinction. Lockwood functions as an agent of the reader and is responsible for instigating the investigation. Everything the reader can observe in the book is a direct result of Lockwood's presence, and the reader cannot see anything unless Lockwood sees it first.

Lockwood's role allows him to wield remarkable power over the reader's perceptions of the novel. He has control over Nelly's narrative, with the power to ask questions or leave them unasked. Thus, because of Lockwood, what Nelly tells is not necessarily the sum

of all her experiences and observations of the drama but rather what Lockwood has prompted her to tell. One might wonder whether the reader might be on guard and suspicious of Lockwood on this account, lest his character try to influence the reader. Yet, as an outsider looking in, Lockwood has no vested interests in how any of the characters are portrayed; therefore, the reader tends to perceive him as an impartial and truth-

## Puzzle with a Missing Piece

*Brontë has created a masterpiece of unforgettable characters plagued by unanswerable questions that draw readers back over and over again.*

ful narrator—and even as the reader's personal agent. In fact, he is in many ways not merely an agent, but an extension of the reader. He is an anyman, and his shoes will fit the feet of any reader who wishes to slip into them and walk among the characters of *Wuthering Heights*. In the thrill of this realization, it is easy to forget that these shoes tread a predestined track from which they cannot veer.

Thus the layering of the filters is quite clear: There is the authorial voice, over which the filter of Nelly is placed, and the filter of Lockwood is placed over Nelly. These three combine to severely, yet plausibly, limit the reader's ability to peer into the psyches of the other characters. After all, it is necessary for the realistic humanity of Nelly and Lockwood that they be unable to fully disclose the psyches of other characters. Brontë has sharpened the focus of the novel on its characters to a high degree and at the same time used filters to obscure the most intriguing parts.

### Conclusion

To what end is this distortion and obscurity? The reader is repeatedly invited to guess the motives of the characters, yet the author seems to have rigged the game. The simplest answer is that there is no answer and that this is what has made the novel great. When a piece is missing from an otherwise completed puzzle, the human mind inevitably marks its absence and focuses on it more than the rest of the puzzle. When an object is pressed into wax, the most prominent jut-

ting features of the object make the deepest impression. *Wuthering Heights* has a similar effect upon the reader's mind. The missing piece of the characters teases and intrigues every reader, while the characters who have been thrown into sharp relief leave a lasting mark when pressed into the wax of the mind. Brontë has created a masterpiece of unforgettable characters plagued by unanswerable questions that draw readers back over and over again. If there were a formula or an answer to the riddle, the allure of the novel would fade instantly. The reader would answer the questions and, having been satisfied, set the book aside, perhaps never to return to it. *Wuthering Heights* would be deprived of its timeless appeal.

### **Acknowledgments**

I thank Dr. Bruce McMenemy of Scholars Online for both his wisdom and his formative guidance as I have begun to study great literature. He has taught me how to turn a critical eye over even the most untouchable works.

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## WATER RECLAMATION IN SPACE

*One way to supply enough water for astronauts on long-duration missions is to recover water from urine by using the cascade distillation system. The goal of this research is to identify a compatible nontoxic pretreatment agent that prevents clogging of the collection system.*

Julianne E. Larson, Moriah S. Thompson, Marco A. Cienega Jr., Elizabeth G. Joachim,  
Blesson A. John, David G. Moore Jr., and Sandhya Ramesh

NASA has set a goal of returning to the moon by 2020. The Constellation program involves developing a vehicle and other hardware necessary to meet this goal. The Orion crew module will hold four to six crew members, and each mission to the moon will help to construct a lunar colony, which will allow preparations for human exploration of Mars. Urine will be collected in the crew module and water will be recovered using the cascade distillation system. Urine is a complex fluid that supports bacterial metabolism and quickly creates solid precipitants if left untreated. The constraints of a reduced-gravity environment require the collection system to be composed of small-diameter tubes. To prevent the tubes from clogging, one must pretreat urine with a chemical agent composed of sulfuric acid and Oxone<sup>®</sup>. However, Oxone<sup>®</sup> can create toxic gases and could be detrimental to astronaut health over extended periods. This article will describe our efforts to identify a nontoxic pretreatment agent that prevents clogging of the collection system and is compatible with a cascade distillation system. Our work consists of laboratory tests to assess potential chemicals.

### Introduction

The National Aeronautics and Space Administration (NASA) has set the goal of returning to the moon by 2020. Thus far, space exploration missions have not

been long enough to require water reclamation: Missions take a crew to the International Space Station and return to Earth. In these cases, water is launched in the space shuttle, and wastewater is returned to Earth or dumped into space. The new Constellation program involves developing a vehicle and other hardware necessary to return to the moon. The Orion crew module, which will transport four to six crew members to the moon for long-duration missions, will require a water reclamation system to supply enough water for the astronauts.

*The current plan is to collect urine in the crew module and to recover water by using the cascade distillation system.*

The current plan is to collect urine in the crew module and to recover water by using the cascade distillation system. However, urine is a highly

complex fluid that supports bacterial growth and quickly creates solid precipitates if left untreated. In space, the urine collection system consists of small-diameter tubes susceptible to clogging. To prevent clogging of the system, one must pretreat urine upon discharge with a chemical agent that inhibits growth of bacteria and precipitation of solids. The current pretreatment method, which astronauts call the “string of pearls,” uses a combination of sulfuric acid and Oxone<sup>®</sup>. A “string of pearls” (row of tablets) is inserted into the urine collection hose, as shown in Figures 1 and 2, and the tablets dissolve upon urination. Oxone<sup>®</sup> is a highly reactive oxidizing compound that destroys microorganisms by oxidation, forming chlorine and other toxic gases.<sup>1</sup> It

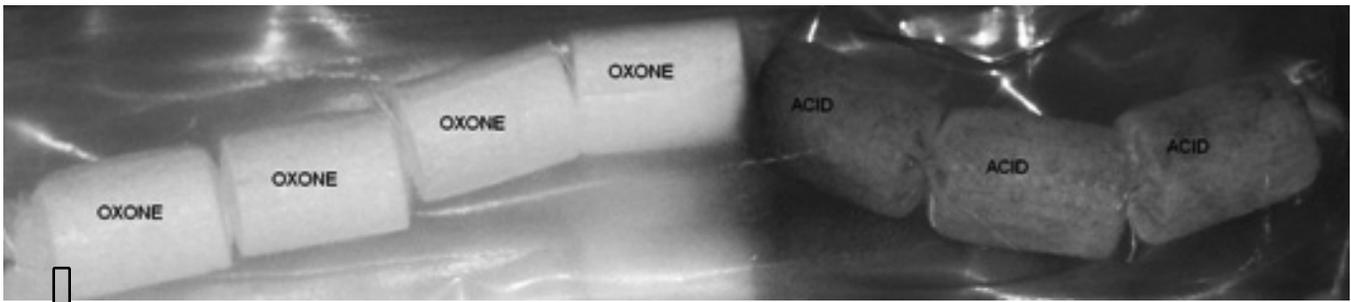


Figure 1. "String of Pearls"



Figure 2. Hose

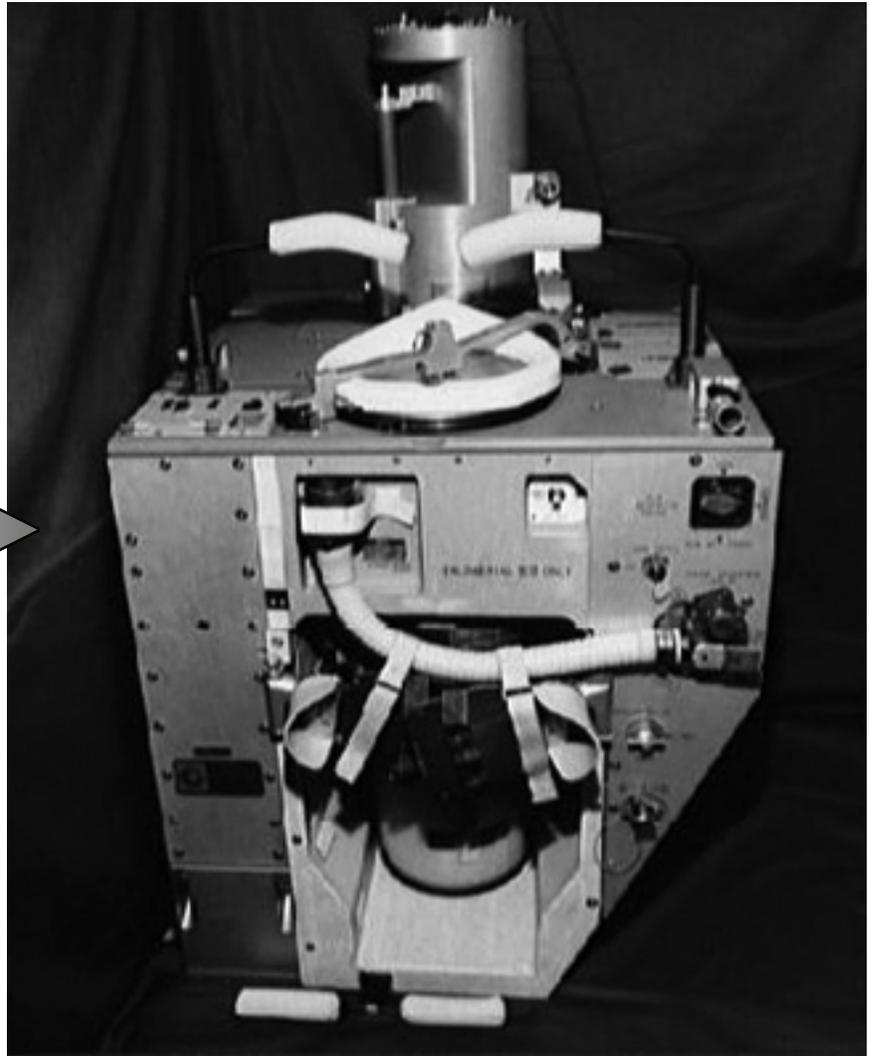


Figure 3. Urine Collection Unit

*Figures 1, 2, and 3*

*A "string of pearls" (row of tablets) is inserted into the urine collection hose, as shown in Figures 1 and 2, and the tablets dissolve upon urination. This current pretreatment method utilized by the U.S. urine collection system in the International Space Station uses a combination of sulfuric acid and Oxone®. The toxicological effects of Oxone® have not been fully investigated, nor have the maximum allowable concentrations in potable drinking water determined. This method is not compatible with the water reclamation system.*

is hazardous to human health and cannot be used if the urine will be recycled.

Our multidisciplinary team of undergraduate engineering students has been researching this topic since Fall 2005. Previous work related to water recovery in space, as well as NASA's latest plans, led us to our Fall 2008–Spring 2009 objective: to identify a nontoxic pretreatment agent that prevents clogging of the collection system and is compatible with a cascade distillation system.

## Possible Pretreatment Chemicals

*An acceptable urine pretreatment agent should preserve the biological, chemical, and physical characteristics of fresh urine.*

### Background

#### *Selection of Pretreatment Agents*

We established criteria for selecting pretreatment candidates to consider for laboratory testing. These criteria ensured that the pretreatment candidates would not be detrimental to an astronaut's health and would comply with NASA safety guidelines. The current pretreatment agents, Oxone<sup>®</sup> and sulfuric acid, do not meet this requirement. The candidates must also be compatible with the cascade distillation system.

We identified chemicals with low toxicity by using the Hazardous Materials Identification System as well as data on acidity, toxicity, volatility, and solubility. (The delivery system for solid chemicals requires solubility.) The pretreatment chemicals chosen for testing were boric acid, lactic acid, phthalic acid, sorbic acid, and fumaric acid. These chemicals are less hazardous than Oxone<sup>®</sup>. We tested boric acid, sorbic acid, and fumaric acid in Fall 2008 and lactic acid and phthalic acid in Spring 2009.

### Laboratory Tests

We tested pretreatment chemicals by using urine collected from eight students. The urine was stored at 4°C before testing, in keeping with NASA Urine Collection Procedures.<sup>2</sup> At the start of the experiments, the urine from the eight students was mixed in a large bottle. Portions of the mixed urine were placed in smaller

bottles and treated with the respective chemicals. Experiments were carried out in triplicate in continuously stirred capped bottles. Each experiment lasted 1 week. Samples were collected and analyzed at 0, 20, 40, 60, and 120 minutes the first day and at 24-hour intervals for days 2–7.

An acceptable urine pretreatment agent should preserve the biological, chemical, and physical characteristics of fresh urine. Therefore, we monitored biological, chemical, and physical changes in the urine after pretreatment. Biological conditions were monitored by protein assay, ammonia concentration measurement, and use of a dissolved oxygen concentration probe. Biochemical changes were monitored by determining changes in acidity (pH). Physical changes, specifically the formation of precipitates, were quantified by measuring turbidity and the concentration of total suspended solids.

### Results

The pH, concentration of total suspended solids, and turbidity increased with time in the treated samples, indicating that all the chemicals stabilized urine for short-term but not long-term storage. Likewise, data on concentrations of protein and ammonia indicated that the tested chemicals effectively stabilized urine in the short term but not the long term. Data on the concentration of dissolved oxygen indicate that some biological activity occurred in the first 2 hours.

### Conclusion

Our results indicate that the chemicals that we tested meet pretreatment requirements for short-term but not long-term storage. During short-term storage for the Constellation program, the pretreated urine will travel to the wastewater collection tank to begin the distillation process. Pretreatment must eliminate precipitation and bacterial growth for the first 2 hours.

Our team plans to test ultraviolet-light disinfection as a pretreatment method. Ultraviolet light would damage the DNA of any bacteria growing in urine, preventing them from producing harmful proteins. This approach would prevent accumulation of bacteria and

precipitates. Although some preliminary research has been carried out, the optimum intensity, distance from light source, and exposure time still must be determined. We will design experiments to determine these conditions. The Space Engineering Institute team at Texas A&M–Commerce will assist our team once we develop the experimental design.

### **Acknowledgments**

We thank the Space Engineering Institute at Texas A&M University for providing the funding, facilities, and mentorship needed to complete this research. We also thank Dr. Karen Pickering at the Johnson Space Center for her continued involvement and guidance.

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## NANOROBOTS: A NEW TREATMENT FOR BRAIN TUMORS?

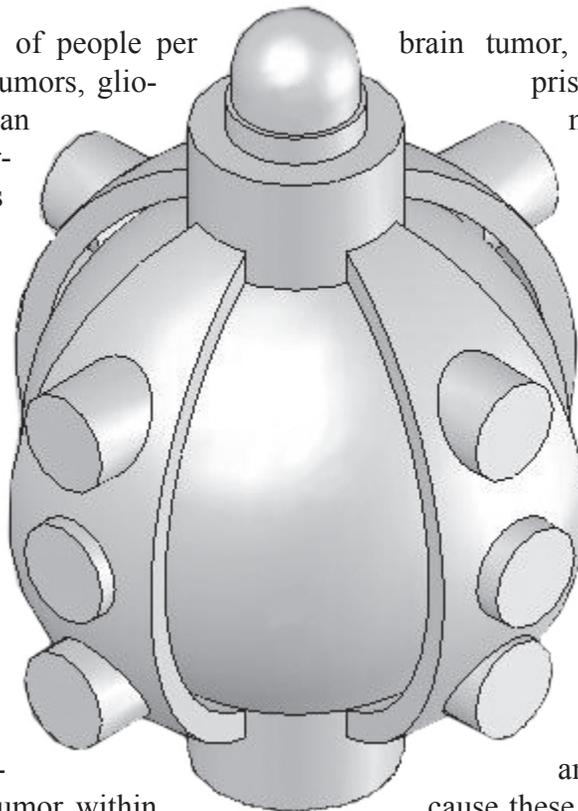
*A radiation-emitting nanosized robot could provide an alternative, relatively noninvasive treatment for brain tumors, specifically the most malignant, glioblastoma multiforme.*

Rebecca Rulla, Amy Oliver, Lauren Neuburger,  
Andrew Moorman, Shawn Schepel, Jeffrey McFarland, Jeremy Rogers

**B**rain cancers kill thousands of people per year. The most malignant tumors, glioblastomas, account for more than half of brain cancer deaths. Current treatments for these tumors include surgery, radiotherapy, and chemotherapy, all of which kill thousands of healthy cells and may fail to kill cancerous ones. My team has designed a futuristic radiation-emitting nanosized robot that is intended to be injected by the thousands into the bloodstream in order to target brain cancer cells. We envision it as part of a three-step treatment that will be administered intravenously during two short hospital stays. The treatment is relatively noninvasive, can easily target the tumor within the brain, and uses less radiation—yet it is more accurate than conventional radiotherapy. The treatment avoids irradiating healthy tissues, and the robots are readily eliminated from the body. This article describes our treatment approach and explains how we envision it will limit the death of healthy cells, kill all cancerous cells, reduce the length of hospital stay, and increase the survival rate.

### The Cancer

The most common and aggressive type of solid



brain tumor, glioblastoma multiforme, comprises more than half of all brain tumors in humans and causes most of the deaths in children with brain cancer. These glioblastomas have fingerlike projections weaving around large clusters of blood vessels that supply them with the nutrients they need in order to grow and spread. The projec-

*Nanorobot closed—does not sense quantum dots and does not release radiation.*

tions are difficult to remove surgically without extracting a large amount of healthy brain tissue. Because these tumors are so difficult to remove completely, they tend to return or regrow, leading to death. In addition to surgery, radiotherapy and chemotherapy are used to treat these tumors; however, they commonly kill many healthy cells, fail to kill some of the cancerous cells, or both. Even combinations of the three treatments yield a median survival time of less than 1.5 years.<sup>1</sup>

### Our Proposed Treatment

We have designed a nonsurgical treatment that is administered via three intravenous injections. One dif-

difficulty in attacking tumor cells in the brain is the blood-brain barrier, in which tightly adjoined cells keep harmful substances out of the brain tissue. By destroying the vessels that provide blood and nutrients to the tumor, our treatment will avoid the obstacle that the blood-brain barrier poses. Our treatment targets only cancerous cells and their blood supply and so minimizes the death of healthy cells in the brain.

### Step 1

The first injection, which will be given in the arm, will contain *alkylphosphocholine erucylphosphocholine* (ErPC). ErPC induces apoptosis, or programmed cell death, in several lines of glioblastoma cells and makes them more sensitive to radioactivity.<sup>2</sup> This treatment will not damage the blood vessels needed for the movement of our nanorobots.

### Step 2

The second injection, administered in the arm 1 week after

Nanorobot open—detects light from quantum dots and releases radiation stored within.

the first, will contain a mixture of salt solution and quantum dots. Quantum dots are only nanometers in size (one strand of hair is about 100,000 nanometers wide); they illuminate (light up) when activated. The dots that we chose will travel through the blood; pass through the blood-brain barrier; and, similar to keys in locks, attach only to cells growing at uncontrolled rates, such as brain cancer cells. These dots are self-illuminating, meaning they need not be activated by an external light source.<sup>3</sup> After the dots flow through the system and attach to a brain tumor, they will illuminate the cancerous cells by emitting red light, about twice as bright as sunlight, from their surface. The dots will reach their peak light intensity about 6 hours after the injection, at which point the third step of the treatment begins.

### Step 3

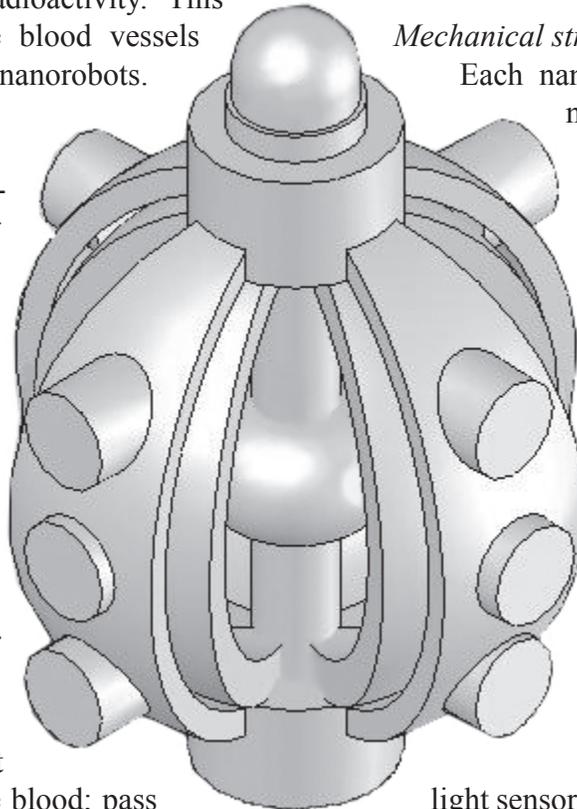
The third injection will contain our nanosized robots. These nanorobots contain radiation, which they have been programmed to release once they come near the glowing cancer cells. The injection, containing about 100,000 nanorobots, will take place via the carotid artery, in the neck. The heart will pump the nanorobots through the blood vessels in the brain tumor, which contains the quantum dots; then the spleen will filter out the nanorobots. Because the nanorobots will travel through the bloodstream, the radiation they emit will damage the blood vessels supplying the tumor, thereby killing existing cancer cells and inhibiting tumor recurrence.

### Mechanical structure

Each nanorobot, which will be about 20 nanometers in diameter, will consist of two spheres of Plexiglas and will be topped with a motor that rotates the outer sphere to release radiation when activated. Both spheres will contain longitudinal holes that will align when stimulated, thereby allowing the radiation to be emitted. The nanorobots will float freely through the blood vessels of the body until the spleen removes them. They will not release their radiation until activated.

### Sensors

Each nanorobot will contain 13 light sensors on its surface to detect light from the quantum dots. The sensors that we chose detect only red light and will open the doors housing the radioisotope only at an intensity of at least twice that of everyday sunlight. This measure will ensure that the radiation will be released only in the presence of cancer cells. As a safeguard, the sensors on the nanorobots will keep the radiation-shielding doors closed until at least two sensors detect light that is of adequate intensity and occurs at the appropriate time. These safety measures will minimize the loss of healthy tissues.



## Radiation

The source of the radiation to be delivered to the tumor is lutetium-177. Its half-life is relatively long for a radioisotope used in medicine. It will last long enough to irradiate the tumor cells but will be gone from the body about 2 months after injection. It is an excellent choice for radiation because it has a maximum range

## COMPARISON WITH OTHER TREATMENT MODALITIES

Our design will be considered a success if it severely damages the tumor's blood supply, kills an appreciable amount of the cancerous mass, and extends the patient's survival to at least 5 years with a relatively high quality of life. The following compares our proposed treatment with current treatments:

**SURGERY.** To succeed as the sole treatment, surgery must remove the tumor completely. After surgery, there are high likelihoods of infection, fluid buildup in the skull, and regrowth of the tumor. Each of these can be painful and will require return to the hospital for further treatment.

**RADIATION THERAPY.** Many types of radiation therapy can hinder the spread of cancer cells; however, this treatment is not successful when used alone. Current types of radiotherapy damage large portions of healthy tissue and have serious side effects.

**CHEMOTHERAPY.** a standard tactic used to battle brain cancer, is usually coupled with surgery, radiation therapy, or both. Throughout the months of treatment, chemotherapy commonly causes nausea, weakness, hair loss, and other distressing side effects.

**OUR METHOD.** Ideally, our nanorobot method will largely avoid the side effects of other treatments and will ultimately produce a much higher survival rate. If our method does not destroy all the cancer cells directly, it will promote the destruction of the tumor's blood supply and thus greatly decrease the possibility of tumor regrowth. Our treatment will be precise, will be relatively noninvasive, will use low doses of radiation, and will damage little healthy tissue.

of 1.6 centimeters (about 0.6 inches) in living tissue. Because the radiation will localize at the site of the tumor and its nutrient-supplying blood vessels, it will destroy the tumor cells but damage few surrounding healthy cells. This radioisotope also is acceptable because we can shield against its harmful waves until they are needed. We will line the inside of our nanorobot with a low-density material, *Demron*, that blocks radiation. This fabriclike material, which is lightweight and flexible, will allow our nanorobot to flow through the bloodstream without irradiating the entire body. Finally, this type of radiation can be detected by CT (computed tomography) scans. Therefore, physicians can monitor the work of the nanorobots and determine how much radiation is reaching the tumor.

### Potential Problems

Our design has the potential to cause a few problems, which I discuss in the following. However, in each case the nanorobot will have a safeguard.

- Because the nanorobots will emit radiation, a few healthy cells in the brain and elsewhere may be harmed. However, each nanorobot will emit only a small amount of radiation, and the devices are designed to target the tumor precisely.
- The nanorobots will be too large for the kidneys to filter out and will therefore remain in the bloodstream or be removed by the spleen. They may eventually cause complications, perhaps including allergic reactions. If necessary, however, they can be filtered out of the blood via hemodialysis or the spleen can be removed.
- Individual nanorobots may experience mechanical failures such as malfunction of their doors or light sensors. The failure rate per nanorobot cannot be determined without substantial testing, but this possibility merits further study. The large number of nanorobots injected into the body will compensate for this problem.
- The blood, containing the quantum dots and the nanorobots, flows through the lymph nodes, which might filter them out. The quantum dots could accumulate in the lymph nodes. This development could be dangerous, because the nanorobots, which contain radiation for 2 months, would be triggered to open their doors and emit radiation when near the quantum dots. To minimize this risk, the sen-

sors we chose for the outer casing of our nanorobot will trigger the release of the radiation only when the light from the quantum dots is at its peak intensity.

- After the cancerous cells are killed, a small possibility exists that they will break off from the solid mass, enter a blood vessel, and thereby cause a stroke. This outcome is highly unlikely because the cells that undergo apoptosis and necrosis (cell death) probably will remain in place.
- A minuscule risk will exist of a nanorobot's being ingested by the body's white blood cells. If a nanorobot were somehow ingested, it would simply remain in one of the white blood cell's lysosomes (storage units). The nanorobot's Plexiglas covering would protect it from the lysosome's digestive enzymes and thus prevent release of the radioisotope.

### Future Steps

The next steps in such research would usually be animal testing and, if the results are promising, clinical trials. However, our nanorobot cannot be tested immediately because not all the materials to create it are available with sufficient quality at the nanosized level. We hope that eventually this treatment will be a good option for brain cancer patients.

### Acknowledgments

Special thanks to Dr. J. Wasser for giving this assignment and for sharing his expertise in human physiology, including brain physiology. I also thank my peers who took part in the research, design, and writing processes: J. McFarland, A. Moorman, L. Neuburger, A. Oliver, J. Rogers, and S. Schepel.

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