



UNIVERSITY *of* ST. THOMAS

UNDERGRADUATE RESEARCH AND COLLABORATIVE
SCHOLARSHIP (URCS) PROGRAM:
COLLABORATIVE INQUIRY

Inquiry at UST:
A Poster Session with the Results of
Faculty/Student Collaboration
at the University of St. Thomas

Abstracts

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Introduction

The abstracts published here summarize some of the sustained research and creative inquiry carried out in recent months across many disciplines by undergraduate students at the University of St. Thomas. In all cases, the student researchers have worked in close collaboration with faculty mentors who have contributed their time and talent to help our students dig more deeply into topics of the students' choosing and design.

Funded by the University of St. Thomas through its Undergraduate Research and Collaborative Scholarship (URCS) Program, this poster session allows our dedicated scholars an opportunity to share their work with larger audiences and receive the critical scrutiny of their peers, professors, and the general public.

We hope that you enjoy this event and invite you to engage our scholars in ways that will both challenge them and encourage them to continue their journey of the mind.



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September 2008

As president of the University of St. Thomas, I am both pleased and proud to introduce the twelfth annual poster session devoted to faculty/student collaborative projects, sponsored by the Undergraduate Research and Collaborative Scholarship (URCS) Program.

I believe that one of the most effective ways for students to learn is through collaborative inquiry: students and faculty working together on research that can have real-world consequences. In fact, this was one of the major themes of my 2008 Academic Convocation address to our faculty. Active learning of this kind is completely in keeping with our mission as a Catholic university grounded in the liberal arts tradition. We strive to provide a high degree of personal attention in a challenging campus environment that is engaged with the complexities of our urban community and the world beyond.

Collaborative inquiry gives our students the opportunity to experience first-hand how their professors approach research questions in a given discipline. It also gives our faculty a better opportunity to understand how our students think, and helps them develop new ways of looking at research problems. Collaborative inquiry enables our students and faculty to experience their disciplines in action, deepening students' academic experience while simultaneously increasing career competency.

I heartily endorse this effort, and I hope this presentation of work accomplished to date will illustrate the importance of collaborative inquiry at St. Thomas.

Sincerely,

Reverend Dennis Dease
President

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Ellyar Barazesb

MARKOV CHAIN MONTE CARLO: ESTIMATING THE PARAMETERS OF BETA DISTRIBUTION

Faculty Collaborator: Dr. Arkady Shemyakin

The statistical techniques of Markov Chain Monte Carlo method can be used to estimate statistical parameters in a variety of situations. In this project, the parameters of beta distribution were estimated by these techniques. In “Mathematica,” a program was created that uses the Metropolis-Hastings algorithm to simulate a random sample from beta distribution. Various Alpha and Beta values were entered into the program and random data were generated. This data were used to initiate a Markov Chain producing the simulated parameter values. The estimate of parameters (posterior mean) was obtained through the Markov Chain Monte Carlo process and compared to the theoretical value calculated analytically. The computation time and the error in relation to the theoretical value were recorded. The Beta value was then changed and the effect on the results were examined.

Jake Becker

FIELD-EFFECT TRANSISTORS BASED ON CDSE NANOCRYSTAL FILM

Faculty Collaborator: Dr. Tom Marsh

The unique size tunable properties of semiconductor nanocrystals (SC NCs) make them a promising material in the application of future electronics and optoelectronics, where thin film of semiconductor layer is necessary. However, the insulating nature of NCs, especially due to their organic ligand shell, inhibit charge conduction through the film; limiting the application. The goal of this research is to first address this issue and obtain highly conductive NC films and second to understand the electrical properties of the film. Specifically, a film of CdSe NC doped with Ag in a field-effect transistor (FET) configuration will be used in order to amplify charge carrier concentration. Also, the ability to control the semiconductor charge carrier concentration in a FET will best allow us to understand the film’s electrical properties.

Michael Blissenbach

IS HUMAN SUFFERING COMPATIBLE WITH THE EXISTENCE OF GOD?

Faculty Collaborator: Dr. Catherine Deavel

The problem of evil is an objection to the existence of an omnipotent, perfectly good God based on the existence of evil in the world. According to the problem of evil argument, if God is all-powerful and all-good, then He wouldn’t allow evil to exist in the world. Since God allows evil to exist, God cannot be omnipotent and perfectly good. A supporter of the problem of evil argument, such as Scottish philosopher David Hume, would state that God and evil existing concurrently means either one of two things: either God can eliminate all evil, but chooses not to (in which case He cannot be perfectly good), or God would like to eliminate evil, but cannot (in which case He cannot be omnipotent). Hume utilizes the problem of evil in his work *Dialogues Concerning Natural Religion*, in which he claims that God cannot exist due to the existence of meaningless human suffering. For philosophers and theologians who affirm both God’s omnipotence and perfect goodness, as I do, the problem of evil is a major challenge that needs to be addressed; otherwise, upholding God’s omnipotence and perfect goodness alongside the existence of evil appears problematic. In this paper I do this by showing that goodness flows from instances of human suffering, thus discrediting the notion of meaningless suffering. I do this by demonstrating three possible meanings behind human suffering: natural goods, moral goods, and redemptive suffering, all of which I will describe and then support with subsequent passages. Having demonstrated that it is likely that at least one of the possible meanings to human

suffering is applicable to each instance of human suffering, I will then conclude that Hume's argument cannot hold, and thus uphold the claim that God exists and that the Roman Catholic notion of God is reasonable.

Logan Bodnia

ANALYSIS OF ATRAZINE IN SHALLOW LAKES USING LC-MS-MS

Faculty Collaborator: Dr. Tony Borgerding

Atrazine is one of the most common herbicides used agriculturally in the United States. Atrazine has been known to cause various problems if it is retained in water. The goal of this project is to selectively detect atrazine in shallow lakes using LC-MS-MS coupled with solid phase extraction (SPE) to quantitatively measure its amounts. SPE allows for further concentration of atrazine allowing for five times concentration. SPE was done using specialized cartridges for atrazine and were eluted with a 50/50 mixture of methanol and dichloromethane. LC-MS-MS allows for the detection of atrazine based on its molecular weight and fragmentation pattern, which are unique to atrazine. Using LC-MS-MS with a column also allows for the separation of any similar compounds, which will elute from the C-18 column at a different time than atrazine. The chromatographs given from the instrument can then be integrated and compared to a known standard to calculate the concentration.

Chelsea Botten

LITHUANIAN CHARITY AUCTIONS

Faculty Collaborators: Dr. David Bernotas and Dr. Craig Marcott

Auctions are a popular method to raise money for charities. This paper examines the properties of a charity auction, which has been used at Lithuanian weddings to raise money for newlywed couples. The auction format is a pay-as-you-go type, where each time a bidder bids they pay a predetermined amount of money. In this auction each bidder's utility depends on their valuation of the item on the auction block and on the size of the monetary gift to the bride and groom (revenue generated by the auction) both from their own contributions and the contributions of others. The Lithuanian auction was investigated, by way of computer simulation, to find the optimal properties for the maximum revenue generation. Results from the analysis show that, with a proper bid increment and item value, the auction does indeed generate enough revenue to compensate for the item for sale and a direct donation to the charity hosting the auction. Also, the revenue generated is comparable, and sometimes significantly more, than what is generated by more traditional methods of fundraising. This, in conjunction with its affordability and simplicity, makes the Lithuanian auction is an ideal choice for charity and public good fundraising.

Madison Bruber

WAR AND SOCIETY: AN ADRIATIC ISLAND IN LATE ANTIQUITY

Faculty Collaborator: Dr. Ivancica Schrunk

The goal of this project was to investigate how the militarization of the Adriatic region in the 5th century and the Gothic-Byzantine Wars in the 6th century affected an island settlement, using historical and archaeological evidence. During Late Antiquity there was an increase of instability throughout the Mediterranean due to the decline of the imperial political order and the rise of warfare. The Adriatic islands were central to military events, but historical sources are scarce. In order to fully understand the effects of the war on socio-economical and cultural issues, archaeological fieldwork was carried out to see what remains could help us better understand life during the war. The

project was centered around a Roman villa settlement in Soline Bay on the island of St. Clement in Croatia. Through survey and excavation we saw how cultures are intertwined in trade and sale of goods—pottery being a main indicator and how a once wealthy Roman villa was transformed into a naval port for war.

Scott Dillon

UNDERSTANDING MALES' PERCEPTION OF PHYSICAL ATTRACTIVE ATTRIBUTES IN WOMEN

Faculty Collaborator: Dr. Tonia Bock

Evolution can help explain many human behaviors. Mating has been one of the most important aspects of evolution in that mating is the process that leads to reproduction, and in turn, the survival of a species. One important aspect of mating is attracting a potential mate. Many studies of human attraction from an evolutionary perspective have analyzed what each sex searches for in a mate. The purpose of this project was to examine how varying body types of U.S. college males affect what they perceive as being physically attractive in females and then to also compare this perception of attractiveness to the body types of their past mates. Male participants were categorized according to their physical qualities (e.g., waist-to-chest ratio). They also indicated the body type of their previous mate(s) and rated the attractiveness of several images of women who varied in body mass index and waist-to-hip-ratio. The results illustrated that men with less appealing body types tended to rate less appealing women as more attractive. It was also found that females' waist-to-hip ratio compared to their body mass index tended to play a stronger role in males' attractiveness ratings for the females.

Benjamin Essington

THE LIFE OF ANTONY AND THE FORTH CENTURY NOTION OF THE ACTIVE AND CONTEMPLATIVE LIFE

Faculty Collaborator: Dr. Pavel L. Gavriluk

According to the Center for Applied Research in the Apostolate (CARA) the total number of priests in the U.S. has been declining since 1975, from 58,909 priests that year to 40,580 in 2008. What's even more alarming is the decline in religious brothers, from 12,271 in 1965 to 5,001 in 2008. These declines have puzzled many in the Catholic Church, and no doubt it has come across many a Catholic's mind that maybe the life devoted to serving Christ that includes taking vows of poverty and celibacy is losing its significance in our country. In the fourth century there was quite a different phenomenon happening with the religious life. St. Antony- a Christian who left all of his ties behind him to live a life of strictly solitary contemplation- became famous for his firm faith and asceticism, spiritual guidance, mediation to God on behalf of others, wisdom, spiritual battles with demons, and other traits. Through his own example he inspired a multitude of men and women to become contemplatives, and today he is known as the founder and father of Christian monasticism.

What I wanted to find out, through analysis of the work *The Life of St. Antony* and research of the fourth century Christian theological setting is what exactly it was that made monasticism and the figure of St. Antony so popular in the fourth century and after. After I found out these reasons I argued that if some of them were applied today (like reading *The Life of Antony* in our schools) there would be more interest in the contemplative life by Christians, and that there may be then more growth in the numbers of those who choose to live a life dedicated to serving God.

CROP INSURANCE

Faculty Collaborators: Dr. Heekyung Youn and Dr. Arkady Shemyakin

For this research project, our main goal was to develop a crop insurance plan to insure maize farmers in Kakamega, Kenya. Because of the various degrees of moral hazard, it was discovered that weather-indexed crop insurance would be the most efficient type of insurance. We had received data containing daily rainfall amount in Kakamega for each day from 1970-2007 and we wanted to use that data to find the probability of crop failure due to lack of rain. The first planting season normally starts during the first week of March. Although this is the standard range, we wondered if farmers would benefit from a delayed start date. The ultimate goal was to find expected payout for various start times of the first planting season and to develop an affordable insurance plan that provides a safety net for farmers in seasons of total crop failure due to inadequate rainfall. We researched the amount of rainfall needed for successful maize growth and also stress and failure levels of rain fall amount for the crop. After finding this information, we needed to determine what type of crop insurance plan best fit the needs of the Kenyan farmers.

After the rainfall data was organized into a manageable set, it was analyzed using the different growth periods as the possible payout periods. The results showed high expected payouts that would result in an insurance premium unfeasible for the client. In order that one may find a lower expected payout, future endeavors should be targeted at a moving start date, rather than a fixed date. For instance, start the planting of maize after there has been 30mm of rain in a 10-day period.

Matt Farmer

THE AFFECT OF CORE STRENGTH ON CLUB HEAD SPEED IN GOLF

Faculty Collaborator: Dr. Bridget Duoos

The purpose of this study was to explore the relationship between core strength and club head speed in golf. Determining this relationship can give us insight on how to help athletes achieve maximal levels of performance through appropriately designed training and conditioning programs.

Six male Division Three collegiate golfers (age = 20 yr. \pm 0.75; ht = 187.33cm \pm 0.5; wt = 80.91kg \pm 3.39) volunteered to participate in this study. Maximum voluntary contractions (MVC) of the rectus abdominis and external obliques were recorded on two separate occasions for each subject using the BIOPAC MP 35 surface electromyography (SEMG). The subjects performed maximal contractions of the two isolated muscles on a StairMaster Ab/Torso/Oblique weight machine. The second MVC was used for analysis, with the first serving as a practice session. During a final third session, the subjects performed five drive shots at a designated target from a distance of 15 feet. Club head speed on the third and fourth shots were measured using a Costar Imaging Camera and Prografix Software.

Jaclyn M. Fermanich

INTERMOLECULAR INTERACTIONS IN CRYSTALLINE BENZYLIDENEANILINES: PACKING MOTIFS DIFFERENTIATING SOME FLUORO/CYANO AND BROMO/CYANO DERIVATIVES

Faculty Collaborator: Dr. William H. Ojala

We use single-crystal X-ray diffraction to examine molecules we have designated *bridge-flipped isomers*, molecules differing only in the orientation of a bridge of atoms connecting two major molecular fragments. Among the benzylideneanilines this isomerism is Ar-CH=N-Ar' vs. Ar-N=CH-Ar', where Ar = aryl. Different isomers assuming the same solid-state packing arrangement might readily co-crystallize to form new materials, so we examine intermolecular interactions that might occur in both crystalline isomers and favor this isostructuralism. Here we describe the crystal structures of two bridge-flipped isomeric benzylideneaniline pairs in which halogen-nitrile, hydrogen-nitrile, or halogen-halogen contacts might define the packing arrangement. In both cases, we find that the isomers are not isostructural and are differentiated from each other by packing motifs occurring in only one isomer of each pair.

Lucy E. Ganseboom

SYNTHESIS OF A NOVEL OXAZOLIDINONE ANTIBIOTIC

Faculty Collaborators: Dr. Jayna L. Ditty and Dr. J. Thomas Ippoliti

The ongoing antimicrobial resistance is becoming a major concern in the field of medicine. A new class of antimicrobials, known as oxazolidinones, is showing promising effects against multi-drug resistant bacteria. The synthesis of an oxazolidinone containing a 1,3,4-thiadiazole ring is reported to show even more success against gram-positive and gram-negative bacteria. As of now, steps 1, 2, & 3 have been synthesized, with 4, 5, & 6 yet to be completed. Once the sixth step synthesis is completed, the compound will be tested against gram-positive bacteria in the Ditty Lab.

Thomas D. Garske

APPROXIMATION OF THE ISING MODEL

Faculty Collaborator: Dr. Richard A. Thomas

I developed an approximate solution to the Ising Model. Our solution models groups of spins as chemical species. How a group changes from one state to another is modeled as a chemical reaction that proceeds at a certain rate determined by the Van't Hoff rule. At equilibrium, we find the fraction of spins up, and the magnetization. With this method, we can determine the Curie temperature in any lattice structure, even in 3 dimensions. The Ising and Onsager results give us exact solutions for the Ising Model only in 1 and 2 dimensional square lattices. We have an approximate method that can be applied to any lattice structure or other situations, such as spin glasses, incomplete lattices, lattices with spins that can point more than 2 directions, anti-ferromagnetic lattices, etc. Our solution compares well to the Bethe-Peierls approximation, but it is more straightforward and can be easily applied to more systems.

Annie Gatto

HOW FAMILIES COMMUNICATE AND MAKE DECISIONS AS PARENTS' AGE

Faculty Collaborator: Dr. Mary Anne Chalkley

This study looked at multiple facets of the individual and the family which are affected by the challenges created by aging. There is very little in the literature addressing the impact of the parents' aging process on the communication and decision making responsibilities on the family members, not to mention their own personal relationship with one another and their siblings or other children. The participants included five mother-child pairs. The ten participants were given parallel oral interviews that discussed topics in decision making, communication, emotional closeness, boundaries, and changes in their daily living and life adaptations. In addition to the interview itself both the parent and the child filled out two questionnaires. The first questionnaire measured availability of the child interviewed in their parents' daily activities and then a parallel questionnaire was given to the parent to measure their independence when doing certain daily tasks. The second questionnaire was given to both the parent and the adult child to measure their emotional closeness.

Each mother-child family set varied in their responses but they all seemed to have common themes underlying in their responses. From these interviews, important issues for maintaining healthy relationships in the areas of communication, change, decision making, and boundaries all seem to include positive attitudes, recognizing and respecting appropriate boundaries, maintaining regular contact between parent and child, and making decisions in a consensual way. All of these common themes seem to be important strategies that form healthy communication skills between family members and positive coping skills in regard to change, decision making and boundaries.

Anthony L. Gerten

TOWARD ISOSTRUCTURAL ISOMERIC BENZYLIDENEANILINES: A SEVERELY NONPLANAR CONFORMATION FORCED BY 2,6-DISUBSTITUTION

Faculty Collaborator: Dr. William H. Ojala

Molecules we have designated *bridge-flipped isomers* differ only in the orientation of a bridge of atoms connecting two major molecular fragments. Among the benzylideneanilines, this isomerism is Ar-CH=N-Ar' vs. Ar-N=CH-Ar' , where Ar = aryl. *Isostructural* (same solid-state molecular packing) isomers might be readily co-crystallized to form new materials, so we are using single-crystal X-ray diffraction to identify such pairs. Conformational differences will cause isomeric benzylideneanilines to assume different packing arrangements, so previously we identified planar benzylideneanilines in the literature and examined their isomers in the hope that *both* isomers would be planar, yielding isostructural crystals. We propose here a new strategy: forcing both isomers to assume a severely *nonplanar* conformation by 2,6-disubstitution on the rings. This conformation exists in the benzylideneaniline obtained from 2,6-dimethylaniline described here.

Amy Gosselin

THE RELATIONSHIP BETWEEN PERSONALITY AND AUTOBIOGRAPHICAL MEMORY

Faculty Collaborator: Dr. Greg Robinson-Riegler

Previous research has shown that many aspects of a person play a role in autobiographical memory. Personality is one of these aspects. The present study investigates possible personality differences in autobiographical memory, and examines whether the encoding or retrieval stage of remembering might be the most important in producing these

differences. Thirty-five participants completed the Big Five Inventory and provided autobiographical memories in response to four cue words after being primed into one of three conditions: openness to experience, not open to experience, and control. Results showed little to no effect of priming on autobiographical memory, indicating that personality differences in autobiographical memory relate to encoding, rather than retrieval. An investigation of the phenomenological qualities of remembering revealed that those higher in openness to experience produced significantly different ratings on the memory measures of participant, vividness, and recollection. Links between phenomenological characteristics of memories and personality domains were examined as well.

Kevin Graden

CHEMOTACTIC RESPONSE OF *PSEUDOMONAS PUTIDA* STRAINS TO FURAN MOLECULES

Faculty Collaborator: Dr. Jayna Ditty

Bacterial chemotaxis is the process that allows bacteria to respond to environmental stimuli. Sensory signals are processed by *Pseudomonas putida* (strains Fu-1 and A3) triggering rotary flagellar movement toward a stimulus. Typical attractants are molecules that the organism uses as a form of carbon and energy. Carbon sources used for this particular study were 2-furoic acid and 5-hydroxymethyl furfural. There was interest in determining if the *Pseudomonas putida* strains that degrade furan compounds can also detect and respond to these industrially important compounds in the environment because these compounds form and act as fermentation inhibitors when crops (such as grapes) are pretreated with acid and heat to release fermentable sugars. To study the chemotactic response to furan carbon sources, qualitative observations were made by analyzing swarm plates and performing agarose plug assays. Swarm plate results showed that the strains were attracted to either the furan molecules themselves or a metabolic intermediate. Whereas the agarose plug assays were used to ensure that the strains were attracted to the furan molecule itself, and not a metabolic intermediate. Based upon the Pseudomonads behavioral response over a short period of time (~10 minutes), a definitive ring of cells was visible in each of the assays for both strains, showing that the bacterial cells were attracted to the furan molecule as it diffused from the plug.

Joseph Anthony Grundtner

THE INFLUENCE OF GENDER, CLASS YEAR, AND EXPECTED GRADE ON THE CHANGE OF MORAL REASONING AND SELF-PERCEPTION FROM TAKING AN INTRODUCTORY ETHICS COURSE

Faculty Collaborator: Dr. Tonia Bock

My paper is part of a larger project examining whether student's moral motivations and moral knowledge change due to knowledge received from taking a required Philosophy course on ethics. Within the confines of the larger project, I explored three variables that may influence moral motivation and knowledge. Specifically, I examined the extent to which gender, class year, and expected grade influenced students' moral reasoning and self-perception. A pre-post design was employed, whereby students in the required ethics courses completed questionnaires before the course began and at the end of the course. Results showed that gender, class year, and expected grade have little, if any, influence on students' moral reasoning and self-perception.

Mary Gustafson

USING FOSSILS AS A GUIDE TO PALEOCLIMATE

Faculty Collaborator: Dr. Melissa Lamb

This project has several purposes: to characterize the rock layers that make up the Bitterspring Quadrangle in Nevada, to aid in defining these units of rock so as to make mapping possible, and to further our knowledge of the paleoclimate in the BSQ, all by identifying fossils found within Paleozoic rocks there. Fossils were collected in periodic trips to Nevada by various students of the Geology department from January 2007 through May 2008. The fossils were identified by the making of thin sections which were studied under the microscope. The fossils studied were all from Paleozoic age rocks, meaning they are between 544 and 245 million years old. Based on the type of fossils found and their manner of preservation, the climate in the Bitterspring area during the Paleozoic was mostly a shallow marine environment.

Kirsten Halstead

MATHEMATICAL MODELING OF GROWING TISSUES

Faculty Collaborator: Dr. Magdalena Stolarska

Trying to find an explanation of how tumors grow has been an issue people have been trying to find for many years. Many scientists look into the biology of a tumor to find the answer but there are some that have instead thought about the mechanical movements of a tumor. An article written by Gabriel Helmlinger, explains an experiment he performed on seeing how a tumor grows in a controlled environment. Helmlinger and his colleagues placed a tumor of spherical geometry into a capillary tube of oblong shape, small in the axial direction when compared to the length. While inside the capillary tube, the tumor began to grow. However, instead of growing proportionally to its original spherical geometry, it grew more vertically following the length of the tube and less in the axial direction. The researchers showed that the symmetry breaking was from mechanical effects and not from effects of nutrient distribution, and as a result they concluded that mechanical stresses affect tumor growth.

From reading this research article, I gained an interest in wanting to understand why tumors grow the way they do. I took a mechanical point of view in trying to find this explanation since many scientists have not yet taken this approach. In the model, I treat the tumor and the surrounding tissue as a collection of points that are connected by springs. In this setting, one can determine the displacements of the tumor as it grows by balancing forces at each node. My goal was to see an expansion of the original tumor and determine the forces that result from tumor growth. From the research I did over the summer, I was able to investigate the forces that result as a tumor grows uniformly from its original position in an enclosed square shaped system.

Mary Hammer

ESI HIGH RESOLUTION MS ANALYSIS OF COMMON COMMERCIAL PRODUCTS

Faculty Collaborator: Dr. Tony Borgerding

The goal of this project is to identify any perfluorinated compounds and their intermediates in the environment using mass spectrometry. Many of the molecules in this poster were selected for their similar properties. These molecules were studied to become comfortable with the instrument and identifying unknown peaks. All molecules were studied using the Micromass QTOF 2 instrument. Perfluorinated compounds (PFCs) were extracted from Scotchguard and Crest Glide dental floss and were analyzed using MS and MSMS. The Scotchguard peaks show the C8 (498.9012), C6 (398.8983), and C4 (298.9321) sulfonates. The dental floss was shown to have the C6 acid (312.9723). MPS was

analyzed using MSMS and fragment peaks were found at 186.9789, 208.9575, 152.9832, 121.0169, and 176.9895. Triclosan was analyzed using MS and a peak was found at 286.9438. Surfactants and optical brighteners were analyzed from Tide laundry detergent. Surfactant peaks were found at 325.2035, 311.1883, 297.1697, 339.2194, and 353.2234. Optical brighteners were extracted and concentrated. The largest peak was found at 154.9541. MSMS analysis was performed and peaks at 135.9274, 150.9570, 152.9327, and 194.9422 were found.

Kate Hattenberger

THE INVISIBLE WOMAN: GENDER AND SPECTRALITY IN *FRANKENSTEIN* AND THE VICTORIAN GHOST STORY

Faculty Collaborator: Dr. Alexis Easley

During the nineteenth-century, women in England were essentially ghosts, specters occupying what Vanessa Dickerson calls a “shadow realm of powerlessness and potential power that ultimately skews their identity.” The spectrality of women throughout this century made them unable to have substantial roles in both the domestic and private realms. For things to change, the woman had to confront her own ghostliness in order to gain a substantial self who could hold true power and influence.

There is probably no other setting where this confrontation took place more than in the ghost story. Within this medium, women writers could present the marginal position of women very literally through ghostly female characters. However, the real beginning of feminine spectrality that would continue in many ghost stories by women came in the summer of 1816 when Mary Shelley wrote her novel, *Frankenstein*. Mary Shelley’s marginal, yet carefully calculated treatment of her female characters makes *Frankenstein* a central text in the examination of women’s spectrality. By creating her women characters as ghostly presences using specific strategies, Mary Shelley was able to examine conflicting ideas about being a woman and a writer, as well as her beliefs about a woman’s identity and her role within the family.

Mary Shelley’s conventions would be replicated throughout the century in the ghost stories of women writers, including Mary Elizabeth Braddon. Braddon’s short story, “The Shadow in the Corner,” displays how Braddon adapted motifs from *Frankenstein* and employed Mary Shelley’s ghost-constructing strategies to create her own female ghosts. These strategies allowed Braddon to examine the ghostly position of a single, educated woman forced into servitude.

Both authors shed light on women’s marginalization for their own purposes, but in similar ways and for a similar end: to call for significant positive change in women’s position.

Patrick Hawk

THIOL PLACE EXCHANGE OF FLUORESCENTLY LABELED THIOL-DECORATED AU NANOPARTICLES AND DISULFIDES IN A HETEROGENEOUS ENVIRONMENT COMPOSED OF AQUEOUS AND ORGANIC LAYERS

Faculty Collaborator: Dr. Thomas C. Marsh

The well known thiol place exchange reaction on gold nanoparticles is a very good way to create a variety of functional surfaces on the nanoparticles for use in any number of chemical or biological processes. Despite its widespread use, the fundamental chemistry of thiol place exchange has not been extensively investigated until recently. A new method of determining the rate and quantity of place exchange was developed that utilizes fluorescently labeled thiols attached to gold nanoparticles. The fluorescence of most dyes is effectively blocked (quenched) when they are bound to a gold nanoparticle. Upon release from the nanoparticle, the photons emitted from an excited fluorescent thiol can

be measured. A place exchange reaction may be observed in real time when a free thiol in solution displaces a fluorescent thiol on a gold nanoparticle. Place exchange reactions are typically performed in a homogeneous environment or with the aid of a mediating surfactant. In this study we utilized fluorophore tagged gold nanoparticles to examine the efficacy of interfacial place exchange reactions across an aqueous/organic phases. A variety of amphipathic thiols and disulfides were tested and all demonstrated interfacial place exchange to vary extents. The rates of place exchange for some disulfides were comparable to those found in a heterogeneous environment. This new methodology may be applied to decorating molecular scaffolds in an aqueous phase with gold nanoparticles in an organic phase.

Jaryd Heyer

EXTRACTION AND ANALYSIS OF PERFLUORINATED COMPOUNDS (PFCS IN AN AQUEOUS ENVIRONMENT

Faculty Collaborator: Dr. Tony Borgerding

Method development was performed to support future work on a food-web study. We have used solid-phase extraction (SPE) coupled with LC-MS/MS to analyze aqueous solutions with known concentrations of PFCs to compare and determine linearity between C18 and XAD-7 solid phases. Signal strength increases linearly with volume of sample in both solid phases. Both C18 and XAD-7 were able to concentrate one liter of sample without breakthrough for a range of perfluorinated alkyl sulfonates and carboxylic acids. We have determined that the detection limit prior to extraction is approximately 1 ppt although it varies slightly for each compound. We are also studying concentration of samples directly into the HPLC column after large volume injection.

Maria Hindt

PROMOTER CHARACTERIZATION OF *RAP1*, A POSSIBLE TUMOR SUPPRESSOR GENE

Faculty Collaborator: Dr. Jennifer Cruise

Ras is a GTPase involved in signal transduction (including cell proliferation) and is an oncogene commonly mutated in human cancers. Rap1 is also a member of this family and has been shown to antagonize Ras, suggesting that Rap1 may be a tumor suppressor gene. Defining its promoter region is critical for further understanding of how Rap1 functions, but it has yet to be studied. In this study, we begin to characterize the three *rap1* promoters (*rap1A* short and long transcripts and *rap1B*), using a step-wise process. Putative promoter fragments are synthesized, cloned into a reporter vector, transfected into mammalian cells, and analyzed by fluorescence microscopy, western blotting, and flow cytometry. By this method, we have identified three functioning promoter constructs for the short transcript of *rap1A*.

Kevin Hoffman

INTERNET CARTOGRAPHY WITH THE UNITED STATES FOREST SERVICE

Faculty Collaborator: Dr. Catherine Hansen

Within the past decade, a new dimension of communication has been added to the function and purpose of the internet: sharing geospatial information. Many websites (MSN, Google, etc.) have dedicated major outlays of webspace and financial resources into providing reliable access to valuable spatial information. The technology

required to develop these webpages has become remarkably accessible, enabling any organization to develop their own powerful, internet-ready cartographic computer application.

With the help of the University of St. Thomas geography students, the United States Department of Agriculture and the United States Forest Service have developed several internet mapping applications that provide data to hundreds of environmental scientists throughout the world. Of course, there are several factors involved in the development of a cartographic webpage. Data storage, updates, performance, and appearance are just a few of the considerations related to the development of a public cartographic website. With consideration to these and other factors, the University of St. Thomas and the USDA have developed user-friendly webpages that provide information related to forest health, government environmental programs, and demographics, with several future websites planned.

Leandra Hubka

TRANSCRIPTION OF SONATA IN A MINOR FOR ARPEGGIONE AND PIANO, D. 821 BY FRANZ SCHUBERT FOR GUITAR AND STRING QUINTET

Faculty collaborator: Dr. Christopher Kachian

The *Sonata in A minor for Arpeggione and Piano (Sonata Arpeggione)* was composed by Franz Schubert in 1824. The now obscure arpeggione (a cross between cello and guitar) received only a limited popularity after its debut in 1823. Since then, *Sonata Arpeggione* has been arranged for a wide variety of instrumental combinations, the most common being cello and piano. However, the arpeggione is strikingly similar to the classical guitar, as they both have an equal number of strings which are identically tuned. The main difference is that the arpeggione is bowed while the guitar is plucked. Thus, *Sonata Arpeggione* is a natural choice when choosing a piece to transcribe for the modern classical guitar. Unlike instruments such as violin and piano, the classical guitar has a very limited repertoire dating from the Romantic era. Thus, I transcribed *Sonata Arpeggione* for guitar and string quintet (two violins, viola, cello, and double bass), increasing not only the classical guitar's repertoire but also adding to the relatively limited selection of music for guitar paired with string orchestra. The string ensemble was a staple of the Romantic period and is sonically more complementary to the guitar than the piano. To aid my transcription, I first researched many facets of orchestration and musical techniques of the Romantic era. I additionally analyzed the original sonata, providing me with a better understanding of the piece's underlying musical structure. I then transcribed the arpeggione part for guitar and apportioned the piano's notes to the string quintet. I organized a string quintet to read through my transcription, allowing my faculty collaborator and me to receive feedback from the musicians and hear if further alterations were necessary. Lastly, I also adapted the string quintet score for guitar ensemble, further expanding performance options of this sonata for classical guitarists.

Will Huepfel

RAPID PHOTOMETRIC TEST FOR DETERMINING FREE AMINO NITROGEN IN FERMENTING TANKS

Faculty collaborator: Dr. J.T. Ippoliti

The recent emphasis placed on the use of alternative fuels has led to an increase in the production of biofuels. In order to produce these plant-based fuels, sugars are converted into ethanol through fermentation. In order to ensure efficient fuel production, the yeast has specific nutritional requirements that must be maintained. Of the nutrients needed, one of the most significant is the amount of free amino nitrogen, or FAN, present in the fermenting tanks. It thus advantageous to monitor and maintain desired levels of FAN throughout the fermentation process.

A photometric, ninhydrin-based method to measure free amino nitrogen has been developed. Ninhydrin reacts with primary amines to form a colored product known as Ruhemann's purple. This product absorbs at a known wavelength of 570 nm. The peak height at this wavelength provides an efficient and accurate way to measure the amount of product in solution. Ninhydrin-based methods to measure FAN have been around since the early part of the 20th century, with many still in use today. The test developed this summer is unique in both in reaction time, and heating source. While other tests require the reactants to be boiled for as long as 20 minutes, our test requires a heating period of only 30 seconds in a conventional microwave. Both the reduced reaction period and inexpensive equipment greatly improves the test's practicality for on-site testing.

Adam Johannsen

NATURAL REGIME SHIFTS IN MINNESOTA SHALLOW LAKES

Faculty Collaborator: Dr. Kyle Zimmer

Shallow lakes commonly exist in either a phytoplankton dominated, turbid-water regime, or a macrophyte dominated, clear-water regime. Research in Minnesota has documented shifts between regimes, but only in response to human manipulation of fish communities. Thus, it's unknown whether natural changes in fish communities also induce regime shifts. We documented ecosystem responses to serendipitous changes in black bullhead abundance in three shallow Minnesota lakes from 2005-2008. Lake 8 Mile shifted turbid to clear following 99% reduction in bullhead abundance between 2005 and 2006, as chlorophyll a declined from 243 to 3 ug/L and macrophytes increased from 0 to 0.7 kg/sample. In 2008, Lake 8-Mile maintained a high abundance of macrophytes and low chlorophyll a despite a rise in benthivore abundance. Concurrently, Lake Sweet shifted clear to turbid following bullhead colonization, with chlorophyll a increasing from 8 to 50 ug/L and macrophytes decreasing from 4.7 to 0.2 kg/sample. No changes were detected in a third lake with stable benthivore abundance between 2005 and 2008. These results suggest that natural changes in benthivore abundance may induce regime shifts in Minnesota shallow lakes.

Kyle Johnson

U.S. CENTRAL BANKING: THE CREATION OF THE FEDERAL RESERVE

Faculty Collaborator: Dr. William Walsh

The compiled research of the 2008 summer was conducted to understand the political and intellectual progression in United States history that resulted in the creation of the Federal Reserve Bank system. The resulting paper begins with a brief history of the role of banking in ancient times, state-monopolized money, and the rise of state power. It continues by discussing the origins of central banking within the United States beginning in 1791 with the First and Second Banks of the United States, skips over a brief period of unregulated banking in the 1830s, moves to the national banking era circa the Civil War, and finally overviews the creation of the Federal Reserve in 1913.

The views of sound money, free markets, the U.S. constitution, and non-state intervention are followed throughout the nearly 150-year era of which the paper covers. Trends of deficit spending and the ancient use of fiat and over inflated currencies are identified as constant parallels to state intervention in banking and markets.

As current debate in economic systems escalate in the United States, a solid background in the nation's financial history may be useful when attempting to progress. The paper offers a jargon-free medium for understanding the often-lofty discussion of economics. This research is intended to be used as a basic historical guide for a nation facing an uncertain economic future.

Melissa Joyce

A COMPUTATIONAL STUDY OF TiH_5^+ AND CH_5^+

Faculty Collaborator: Dr. Joseph Brom

Interest in three-center-two electron bonds leads to a study of CH_5^+ and TiH_5^+ . The electronic structure of CH_5^+ and TiH_5^+ was examined using GAMESS (General Atomic Molecular Electronic Structure System). MCSCF (Multiconfiguration Self Consistent Field) calculations with basis sets of 6-311G(d) for CH_5^+ and a triple zeta basis set with polarization and diffuse functions for TiH_5^+ have been completed. For both molecules, the C_s point group leads to a structure where the H_2 moiety can either be perpendicular to or parallel to the mirror plane. One of these conformations is a transition state structure and the other one is a minimum on the potential energy surface. The CH_5^+ molecule exhibits three-center-two-electron bonding while this particular type of bonding is not seen in the TiH_5^+ species.

Albert Kertho, Godino Kalungi and Jaryd Heyer

EXTRACTION AND ANALYSIS OF PERLUORINATED COMPOUNDS (PFCs) IN AN AQUEOUS ENVIRONMENT

Faculty Collaborator: Dr. Tony Borgerding

Method development was performed to support future work on a food-web study. We have used solid-phase extraction (SPE) coupled with LC-MS/MS to analyze aqueous solutions with known concentrations of PFCs to compare and determine linearity between C18 and XAD-7 solid phases. Signal strength increases linearly with volume of sample in both solid phases. Both C18 and XAD-7 were able to concentrate one liter of sample without breakthrough for a range of perfluorinated alkyl sulfonates and carboxylic acids. We have determined that the detection limit prior to extraction is approximately 1 ppt although it varies slightly for each compound. We are also studying concentration of samples directly into the HPLC column after large volume injection. This technique has been used to analyze samples from Lake Johanna.

Andrew Robert Knoff

SYNTHESIS OF FUNCTIONALIZED ISOLUMINOL DERIVATIVE

Faculty Collaborator: Dr. J.T. Ippolitii

Recently, our lab synthesized a new isoluminol derivative with a pyrrolidine ring substituent increasing both chemiluminescent intensity and lifetime. Although, this new derivative has been effectively synthesized and shows better characteristics, the introduction of the ring system has decreased its solubility and made it difficult to use in water based biological systems. Our goal was to synthesize an isoluminol derivative with a functionalizable group. We have attempted three different schemes in order to synthesize a functional isoluminol derivative. This functionalization will allow for polymerization and greater water solubility, while maintaining chemiluminescent intensity. Thus far, the greatest yield obtained is 30% by NMR integration. We hope to increase the yield of our desired product through new reaction schemes.

Andrew Korte

ENVIRONMENTAL PHOTOCHEMISTRY AND PHOTOPRODUCTS OF THREE FLUOROQUINOLONE ANTIBIOTICS

Faculty Collaborator: Dr. Kristine Wammer

The fate of three fluoroquinolone antibiotics (norfloxacin, ofloxacin, and enrofloxacin) was examined under environmentally-relevant conditions. Photodegradation has been previously shown to be a major environmental path for these compounds, with degradation rate being significantly affected by water pH. For this reason, photodegradation quantum yields were calculated for three protonation species of each compound based upon experimentally derived pKa, absorption, and degradation rate data. For all three drugs, quantum yields were found to be highest for the species predominant in most natural waters, moderately lower for the anionic form, and nearly zero for the cationic form. Additionally, structures were proposed for several norfloxacin and enrofloxacin photoproducts based upon LC-MS and high-resolution MS data. Future work will focus on isolation and identification of biologically active enrofloxacin photoproducts.

Andrew Kraemer

THE EFFECT OF INVASIVE SHRUB *RHAMNUS CATHARTICA* ON MICROARTHROPOD LEAF LITTER DIVERSITY

Faculty Collaborator: Dr. Chester Wilson

One of the problems often associated with introduced species is a loss of native biodiversity. Common buckthorn (*Rhamnus cathartica*) is an introduced shrub that has established itself and become a noxious invasive in North America. In order to quantify any change in biodiversity associated with the presence of buckthorn I sampled leaf litter microarthropods in transects of varying buckthorn density and calculated levels of diversity via Shannon-Weaver indices. There was no statistical change in leaf litter microarthropod diversity with increasing buckthorn density, suggesting that although buckthorn may change other biotic and abiotic factors in new environments, it may not have any overall effect on the biodiversity of leaf litter fauna. However, variation in microarthropod diversity between the samples of each transect did vary significantly between transects, with a trend toward lower variation with increasing buckthorn density. This suggests that although overall microarthropod diversity did not vary between transects, the homogeneity of microarthropod diversity within a given transect increased with buckthorn density. This study demonstrates that even though ecological changes due to a shifting environment may not be immediately apparent, more subtle changes may be occurring with potentially larger downstream effects.

Jeremy D. Leavell

STRUCTURE-DEFINING INTERACTIONS INVOLVING THE NITRO GROUP IN CRYSTALLINE “BRIDGE-FLIPPED” ISOMERIC PHENYLHYDRAZONE

Faculty Collaborator: Dr. William H. Ojala

We designate as *bridge-flipped isomers* molecules that differ only in the orientation of a bridge of atoms connecting two major molecular fragments. Among phenylhydrazones, this isomerism is Ar-NH-N=CH-Ar' vs. Ar-CH=N-NH-Ar' where Ar = aryl. Because isostructural isomers (those having identical crystal structures) might readily co-crystallize to form new materials, we use single-crystal X-ray diffraction to identify isostructural pairs. Similar intermolecular interactions in different isomers might encourage isostructuralism, so we examine packing motifs common in phenylhydrazones. In the 4-nitrobenzaldehyde-4'-chlorophenylhydrazone structure described here, one nitro group oxygen atom contacts both the C-H and N-H hydrogen atoms of a neighboring bridge. If no significant H-bonding

distinction exists between those hydrogen atoms, bridge reversal may leave the crystal structure unaffected and allow formation of an isostructural bridge-flipped isomer.

Lindsey Lee

TOPOGRAPHIC SEM EXPLORATION OF BITTER RIDGE CARBONATES

Faculty Coordinators: Melissa Lamb and Thomas Hickson

Through SEM exploration we hoped to determine how well microbial structures are preserved in the rock record; what is preserved, versus what is replaced by secondary processes or weathering; and what can the preserved structures or organisms reveal about the environment in which the rocks were deposited? The accurate identification of microbial laminae in the carbonates of Bitter Ridge Limestone can reveal characteristics such as salinity, temperature, depth and mineralogy of the lake at time of deposition. Microbial material, ooids and oncolites were found preserved in the samples. Ooids and oncolites are spherical coated grains of algal or microbial origin requiring high- energy settings in lacustrine or marine environments. The growth of carbonate cements and chert replacement were evidence for secondary processes, showing what processes were active on the rocks after lithification. Dogtooth calcite replacement suggests either shallow- burial or hydrothermic conditions in diagenesis. In the freshwater zone below the water table, pores are filled with water and large calcite crystals can grow on all surfaces. The growth of carbonate cements is favored by high pH and higher temperature; quartz or chert replacement is favored by the opposite.

Nick Leininger and Kyle Braun

VISIBLE AND ULTRAVIOLET IMAGING POLARIMETRY OF BUTTERFLY WINGS

Faculty Collaborator: Dr. Adam Green

Recent research shows that certain butterflies reflect linearly polarized light from their wings, and some species use this effect to attract mates. The degree of polarization of visible light reflected from butterflies living in forested areas is often about 25%, whereas butterflies living in open meadows reflect very little polarized light in the visible spectrum. We have recently discovered that polarization degrees can be much higher—25-100% in many cases—for ultraviolet light between 300 and 400 nm, even for species that display little effect with visible light. These results are significant because many insects, particularly butterflies, can see quite well in the UV spectrum. We have also found that butterflies (and some other insects) with wings that are transparent in the visible range (e.g., “glass wing” butterflies) reflect polarized UV light strongly, which might allow them to detect each other but remain hidden to animals that cannot see polarized light of these wavelengths. To measure the polarization characteristics of these insects, we have built an imaging system that acquires complete polarization information. It uses linear polarizers, quarter-wave plates, and CCD cameras that can operate in the 300-800 nm range.

Molly Leonard

MATHEMATICS AND ARCHITECTURE OF THE INCAS

Faculty Collaborator: Dr. Cheri Shakiban

Can you imagine what it would be like trying to make calculations on a stone tablet instead of using your TI-89? Or recording numbers with knots instead of using pen and paper? Just as the “Mathematics of the Incas” is a topic so broad and convoluted, my research project is just as multi-faceted. The first aspect of the project is to build a model of the archaeological wonder Machu Picchu, and use architectural programs in Matlab to calculate the stability of the structure. We would then have quantitative results that could be compared to other modern structures. The other key

component of my research is to further develop the coursework for the J-Term class. The development and investigation has led to many sub-topics that can be submitted for publication as separate papers. The ultimate goal is to compile all of the math-related topics and applications into a more comprehensive book about the mathematics that the Incas used. This book would essentially be a textbook that would include background information on the region and the people, the mathematical concepts and how they were applied, and exercises to test the students' knowledge. Up to date we have made significant advances in our understanding of the mathematics related to the Incan knot-tying system (el quipu), the Incan abacus (la yupana), the Incan cross (la chakana), and the Incan chess game (la taptana).

Nick Lesmeister

NOVEL BIOCOMPATIBLE PHOSPHORYLCHOLINE POLYMERS FROM NORBORNENE DERIVATIVES

Faculty Collaborator: Dr. J.T. Ippoliti

Many biocompatible materials that are used to make or coat implantable devices such as arterial stents are based off the structure of the red blood cell's outer membrane. The external portion of this membrane is comprised of fatty acid chains with a zwitter-ionic headgroup known as a phosphorylcholine (PC). This group's strong affinity to water creates a large hydration sphere inhibiting the binding of proteins and macromolecules in biotic systems. The focus of the research was to synthesize a novel biocompatible polymer from a norbornene derivative. Two monomers were made with the phosphorylcholine functionality and work on polymerizing these monomers is in progress.

Amanda E. Louiselle

AN IMPROVED METHOD FOR THE DETECTION OF 17B- ESTRADIOL IN AN ELISA

Faculty Collaborator: Dr. J. Thomas Ippoliti

An improved method for the detection of 17b- Estradiol in an ELISA was found. New Alcohol Oxidase and a new synthetic method were used to improve the rate of the results to under 30 minutes. Previous work had shown results in one to two hours. Also, a commonly used catalyst, Horsradish Peroxidase was found to inhibit the speed of the reaction of converting a substrate to a chromogen.

Sally Mahmood and Alfred Fernandez

UPTAKE OF PHENYLALANINE BY *SACCHAROMYCES CEREVISIAE* IN THE PRESENCE OF METABOLIC INHIBITORS

Faculty Collaborator: Dr. Anthony W. Lewno

Phenylalanine is a nonessential amino acid for *Saccharomyces cerevisiae* (common baker's yeast). This means that yeast cannot manufacture it, but must consume it as part of their nutrients. We set out to determine if yeast use passive transport, facilitated diffusion, or active transport to bring phenylalanine into their cells. Sodium azide is a metabolic poison that inhibits a key part in a cell's process of making adenosine triphosphate (ATP), one form of cellular energy. Dinitrophenol (DNP) is a known uncoupler of the proton gradient in the mitochondria of eukaryotic cells. Ion gradients are also a form of cellular energy. Without either ATP or this proton gradient, yeast may not be able to do the things that need that energy. If yeast actively transport phenylalanine, and are subsequently exposed to either sodium azide or DNP, then that transport will be disrupted. We found that after yeast were exposed to sodium azide,

more phenylalanine was left outside the cell compared to no treatment. This means that phenylalanine is actively transported into yeast cells, and that less was actively transported in the presence of this poison. However, when yeast were exposed to DNP, a lot more phenylalanine transport was disrupted. Consequently, we think that *Saccharomyces cerevisiae* use the energy contained in their mitochondria's proton gradient to actively transport phenylalanine into their cells. Using additional metabolic poisons, especially those that disrupt cellular energy production in different ways, would be helpful in determining exactly how yeast transport phenylalanine.

Ryan Markwardt

XILINX SYSTEM GENERATOR

Faculty Collaborator: Dr. Chris Greene

The purpose of the engineering research work that I did this summer centered around the new Xilinx 10 software that was released this year. Dr. Greene needed a student to explore the capabilities of this software and thoroughly learn how to use it. The main component of this software that I was working on was the Xilinx System Generator, which allows the user to create complex circuit and system designs using block diagrams. Design using block diagrams greatly simplifies and accelerates the process in comparison to conventional design methods. The System Generator also automatically generates VHDL code for your design which would have previously been done by hand. Compatibility exists between System Generator and the main Xilinx ISE program which is used for simulating/synthesizing/implementing designs and then programming them onto actual circuit boards. My overall goal was to create a design and get it through the full process of System Generator to ISE to successful programming onto a circuit board. By the end of the summer I was able to achieve this and gave a presentation on the accomplishments of my research.

My poster includes a written overview of my objectives, descriptions of the different programs and components that I used, visual examples of the different steps in the design process, and a listing of the applications/purposes my research could be used for as well as future directions that the research could go in.

Anna Meyer, Jennifer Woychik, and Megan Frericks

ANALYSIS OF HIV/AIDS MORTALITY DATA IN MINNESOTA

Faculty Collaborators: Dr. Arkady Shemyakin and Dr. Palahela Dayananda

Our research is based on a data set collected by the Minnesota Department of Health, which contains information about those people who have been diagnosed with HIV in Minnesota during the last 25 years. Using the given dates of HIV diagnosis, AIDS diagnosis, and death, we computed the length of time between HIV and AIDS diagnosis (called the incubation period), and AIDS diagnosis and death in days. We used time series analysis to analyze patterns in the mortality data that occur over time. In particular, we are interested in determining the affect of the medical treatment change for HIV/AIDS patients that occurred in 1998. Additionally, we used the multiple regression method to build statistical models describing the relationships between the variables given in the data set. Our work is directed at determining the dependence of the incubation period on a person's age at the time of HIV detection and the time in the last 25 years that HIV detection took place. These models may be used to forecast future patterns of HIV/AIDS mortality.

William Montes

PRINTING NON-POLAR POLYMERS USING THE BIOFORCE NANO ENABLERÄ OPEN CHANNEL MICRO-PATTERNING TOOL

Faculty Collaborator: Dr. Thomas C. Marsh

The Nano eNablerä (NeN) is a versatile micro/nano-scale printing tool for creating arrays of materials with high precision and accuracy. An open channel microfluidic device is used to deliver very small volumes of solution to a surface. The majority of current applications for the NeN are focused on creating patterns of water-soluble polymers, biomolecules, viral particles and living cells on various surfaces. In order to use the NeN for creating arrays of non-polar molecules, a suitable solvent with low vapor pressure is required. This work describes the development of a sample preparation method and instrument parameters that enable printing arrays of polystyrene (PS) and polymethylmethacrylate (PMMA) onto substrates such as SiO₂, Au, Mica and Indium Tin Oxide.

Luyen T. Nguyen

TITLE: SYNTHESIS OF AN OXAZOLIDINONE ANTIMICROBIAL

Faculty Collaborator: Dr. J. Thomas Ippoliti

Oxazolidinones, a recent class of antimicrobials, have potent activity against gram positive bacterial pathogens. A novel oxazolidinone antimicrobial containing a thiadiazole functional group has been successfully synthesized and tested against gram positive and gram negative bacterial strains. The six-step synthesis of this compound starts with the formation of a carbamate and then transformed to an oxazolidinone ring with an alcohol functionality by reaction with optically pure glycidyl butyrate. The alcohol is then converted to a mesylate and displaced by an azide which is reduced to an amine. The amine is converted to an acetamide in the final step. The conditions for each step were optimized so that no columns were necessary for purification of any intermediate. Its effectiveness against bacterial pathogens was tested against *Staphylococcus aureus* and *Escherichia coli* and compared to the marketed antibiotic, Zyvox.

Scott O'Donnell

CAMPUS MARKETING

Faculty Collaborator: Dr. Catherine Hansen

This project is done for John Hersey, the neighborhood liaison at St. Thomas. The purpose is to map off-campus student housing. Mr. Hershey has compiled a list of houses and apartments over the years that have traditionally been occupied by students in Merriam Park and the Macalester-Groveland area. He has divided the housing units into groups and they are mapped by classes including: non-UST housing, duplex rentals, apartments, family owned houses, single family rentals, student's permanent residence, and UST rental conversion.

Each time that somebody does the project over again, to update it, Mr. Hersey gives us a list of updated housing results to add to the others. Because this is such a useful map for Mr. Hersey and the University of St. Thomas, a former student, Stacie Rominski, designed a model for this project so that we didn't have to start from scratch every time we wanted to redo the project. Now all that we have to do is update the results in excel, add the excel file to the model, and press run. The new map with the updated features is made and ready to use, after making it look nice.

I was the first one to test out this model to see if it works and if it will continue to work in the future. While there were a few snags in trying to get it to run, Ms. Rominski and myself got it to work. This will be a project that will continue to be improved upon and used over the years. And by way of adding a model to it, the map will be easy to remake in the future.

James Omlie and Meghan Black

EXPLORING THE ROLE OF RAP1 IN THE CELL CYCLE

Faculty Collaborator: Dr. Jennifer Cruise

Ras is one of the key proteins involved in stimulating cell proliferation. The small G-protein Rap1 is a member of the Ras superfamily, and is thought to act downstream of Ras in signaling cascades. While its exact role is unknown, it may serve as a possible alternative or antagonist to Ras. Some studies suggest that Rap1 is capable of stimulating cell proliferation, while others indicate the opposite effect, identifying Rap1 as a possible tumor suppressor. Cell proliferation was investigated in several cell lines expressing Rap1 constructs, using a BrdU DNA labeling index assay. Untransfected cells (MRC-5, MDCK, NIH-3T3) were used as a baseline. Transfected cells expressing active Rap1, dominant-negative, or empty vector were observed. A significant effect of Rap1 was observed in stably transfected cells. This indicates the possible proliferative role of active Rap1 in fibroblastic cells. Other studies have suggested that the phospho-Akt cellular signaling pathway is involved in the observed proliferation in cells containing active Rap1.

Bethany Rhein and Kelly Delaney

THE EFFECT OF DIFFERING PHOTOPERIODS ON THE OUTPUT GENES, *PSBA1* AND *PURF* OF THE CYANOBACTERIUM *SYNECHOCOCCUS ELONGATUS*

Faculty Collaborator: Dr. Jayna L. Ditty

Cyanobacteria are single-celled prokaryotes that exist and thrive in most habitats on earth and use a circadian clock to efficiently regulate their cellular activity. The oscillator genes *kaiA*, *kaiB*, and *kaiC* are responsible for the circadian mechanism and therefore regulate output gene activity. Genes such as *psbA1* (important for photosynthesis) and *purF* (important for purine biosynthesis) are examples of two output genes that are expressed in the cyanobacterium *Synechococcus elongatus* PCC 7942 due to the circadian clock.

Photoperiods have been shown to have considerable impacts on circadian clocks in other model systems; however, the effect of photoperiod on the cyanobacterium *Synechococcus elongatus* is not well understood. To determine the effects of photoperiod on cellular activities, *S. elongatus* reporter strains AMC408 (*purF::luxAB*), AMC669 (*psbA1::luxAB*) and the wild-type AMC462 were exposed to 12L:12D (12-hours of light and 12 hours of dark), 6L:18D & 18L:6D photoperiods. The wild-type *S. elongatus* results showed a 4-hour phase delay during the 18L: 6D photoperiod and a 4-hour phase advance in the 6L:18D photoperiod when compared to the 12L:12D phenotype. Preliminary results suggest that the AMC408 strain showed little difference in circadian oscillation in response to the different photoperiods, while AMC669 demonstrated a phase advance when exposed to either an 18L:6D or 6L:18D photoperiod compared to 12L:12D. These preliminary results suggest that the different photoperiods differentially effect the circadian expression of the wild-type *S. elongatus* and the different *S. elongatus* output genes, *purF* and *psbA1*.

Senta Riley, Hoang Bui, Idy Akpan, Tony Andrade, and Peter Ibrke

UNDERWATER ROBOTICS

Faculty Collaborators: Dr. Chris Greene and Dr. AnnMarie Thomas

Student Collaborator: Paul Rocznik

Over the summer, we had the opportunity to work with Dr. Greene, Dr. Thomas, and Paul Rocznik in order to create a remotely operated vehicle (or R.O.V.). In order to do so, we brainstormed on several ideas regarding the hull design,

other aesthetic and mechanical aspects that were necessary to build this machine. We determined that our robot's main purpose was to see what life is like underwater and also collect water for Geologist, Kevin Theissen.

In order to make this a reality, we bought a waterproof camera, and attached it to the R.O.V. To make sure that the camera worked, we tested it in our lab by turning all of the lights off and pointing it into the darkest corners of the room. Not only that, but when we tested the R.O.V outside the lab at Long Lake and Dr. Greene's pool, we made sure that the camera was one of the first working parts on our test run.

For our robot to be able to move, we attached five motors and propellers on various locations so that our robot has four different degrees of freedom: x, y, z and yaw. One difficulty for this portion of the project was determining whether or not the motors are powerful enough. After testing the R.O.V for the first time, we determined that our motors were not powerful enough, this made us consider two possibilities; should we add another motor or should we flip the direction of the motor. In the end our solution was to add another motor.

The last aspect of our project was to make sure that our robot was remotely operated. In order to do so, we had two-team members focus on building a control box, which connected to the robot itself.

Andrew Rischall

INCREASING SENSITIVITY OF GAS PHASE MICRODIALYSIS PROBES USING A CARBON NANOTUBE COATED TRAP

Faculty Collaborator: Dr. Tony Borgerding

Gas phase micro-dialysis extraction (GPME) probes are used to extract volatile organic compounds (VOCs) from aqueous solutions. Current GPME probe research has been successful in monitoring reactions and analyzing analytes in diverse environments. A major constraint while using GPME probes is their lack of sensitivity to small concentrations of analytes (~1-20mM). Sensitivity of GPME has been increased by cryofocusing analytes with a carbon nanotube (CNT) coated column. Analyte is rapidly desorbed off the column through resistive heating. The CNT coated column is able to trap ethanol at 40 °C and toluene at temperatures above 60 °C. Solutions of 100 nM ethanol and 10 nM toluene have been detected with GPME probes and our cryofocusing technique.

Paul Rocznik

UNDERWATER REMOTE OPERATED VEHICLE PROJECT FOR LAKE RESEARCH

Faculty Collaborators: Dr. AnnMarie Thomas and Dr. Christopher Greene

Underwater remote operated vehicles, or ROV's, can be used to reach places that are undesirable or unsafe for humans to operate or do research in. This project involved designing and building an underwater ROV capable of being deployed into a lake, from shoreline or boat side, to take a variety of measurements at a variety of depths and locations. Such measurements include temperature levels, dissolved oxygen levels, visibility, water samples, and depth. The measurement data would be relayed to a user through visual feedback or an electronic file. Using an ROV to take these measurements would decrease time spent collecting and documenting research. To begin this project, research was conducted about the previously existing underwater ROV's and sensor equipment. A prototype design was created that could move forward/backward, up/down, and left/right. A control system was then designed, with sensor integration, to measure and direct the depth of the vehicle. Currently, feedback from the ROV allows a user to receive and record the depth of the craft, and temperature of the water, among other information including a real time visual via the underwater camera. Further work could be done to make the vehicle autonomous and collect a wider selection of data for research.

Jonathan Rylander

MEANINGFUL WORK IN ADVANCING ECONOMIES: WILLIAM MORRIS, OSCAR WILDE, AND THE ANARCHIST MOVEMENT

Faculty Collaborator: Dr. Alexis Easley

In the early 1890's Britain was on the verge of economic crisis. Global competition, industrial decline, and adverse climate conditions led to a tense economic situation and increased social anxieties. At this time the middle class and conservative government felt threatened by activists who supported working-class concerns—particularly the decline in meaningful work—and who challenged the status quo. As a result, the anarchist movement, which fought to improve working-class hardships, was greatly feared and often stereotyped as purely violent and subversive. William Morris and Oscar Wilde similarly responded to the economic situation, particularly the consequent volatility of working-class politics. I will argue that in the aftermath of “Bloody Sunday” in 1887, a day that confirmed revolution was brewing in Britain, both writers became more politically active, dedicating themselves to promoting change through their literary efforts. Morris’ *News from Nowhere* and Wilde’s “The Soul of Man under Socialism” similarly redefined the utopian essay as a pacifist-anarchist genre. In these works, both men attempted to alter the negative image and widespread fear of the anarchist movement and to promote a non-violent response to injustice from the working classes. In addition to encouraging the working classes to articulate their needs non-violently, they called upon them to self-educate and to develop aesthetic aspirations beyond immediate economic necessities. In this manner both men worked to change current patterns of thinking, to re-educate society, and to self-empower the working classes. Their philosophical approach to revolution, I argue, ultimately contributed toward improvement in the economic situation and transformation of the workplace.

Jillian Schleicher

A STRATIGRAPHIC AND ISOTOPIC ANALYSIS OF THE RAINBOW GARDENS MEMBER, HORSE SPRING FORMATION, SOUTHERN NEVADA

Faculty Collaborator: Dr. Thomas Hickson

My project is an ongoing in-depth basin analysis of the Rainbow Gardens Member (RBG) of the Horse Spring Formation in Southeast Nevada, specifically looking at the stratigraphy of this unit and the isotopes found in its carbonates. The Southwestern United States and Northern Mexico are experiencing extension of the crust, occurring since the late Oligocene (33.7-23.8 Ma). RBG was formed during the onset of this extension, and by studying the lithology today we can try to piece together the environment in which they were deposited and later deformed. This can help us to get a better understanding of past extension in the region, which also allows us to study and predict the effects of current and future extension. The stratigraphic results of this study show the depositional environment of the RBG was an alluvial system flowing into a shallow, freshwater lake. The isotopic analysis confirms this, giving more specific information on the lake, including its deepening as well as an increase in microbial activity.

Danielle Scotti

THE FEMALE ARMY NURSE: HER TRANSFORMATION SINCE WWII

Faculty Collaborator: Dr. Joseph Fitzharris

Analyzing the changing societal gender stereotypes and actual roles and duties of female nurses from World War II to the present day was the goal I achieved in this project. Secondary sources provide a broad general view of how society views women's war efforts and military nursing, both positively and negatively. My research focused on the changes in these stereotypes and the various experiences of the women nurses during WWII, the Vietnam War, and present day operations in Iraq and Afghanistan. Primary sources such as letters, interviews, and oral history transcripts, diary entries, and contemporary magazine articles and newspapers directly assist in revealing how women army nurses view themselves and how they are perceived. This allows us to examine how society's views of women and their war efforts correlate with how the women themselves viewed their duties. Studying the three war periods reveals variations in the number of women involved, their work conditions, the reasons women joined the military at the time of their service, but most importantly reveals how the stereotype of women's involvement in war has transformed. Despite all the differences in responses to the variety of questions asked, each nurse interviewed felt satisfied with the work they performed while serving and their experience assisting their country in a time of need.

Allison Seiwert

SENIOR CITIZENS AND THREE RIVERS PARK TRAILS

Faculty Collaborator: Dr. Catherine Hansen

In order to get the local senior citizens active and on the Three Rivers Park District of Hennepin County, Minnesota Trails, they needed to know exactly how many park benches there are and where they are located. After going out in the field and locating the benches on several trails using a GPS, I took the data I collected and put it on a map, comparing the demographics around the trails. After looking through the correlation of points and the demography around them I wanted to determine whether or not there were enough benches to satisfy the older population surrounding the trails.

Louis Sigtermans

SELECTION OF RESISTANT BACTERIA WITHIN AN ENVIRONMENTAL COMMUNITY IN RESPONSE TO LOW-LEVEL EXPOSURE TO AN ANTIBACTERIAL AGENT

Faculty Collaborator: Dr. Kris Wammer

The emergence of antibiotic-resistant bacterial strains is a growing concern worldwide. Because of the possibility of resistance genes transferring between bacterial species, the rise of resistance in environmental bacteria is of interest. This project attempts to determine the effect of exposure to low levels of triclosan (a widely used antibacterial agent that is included in many consumer and personal health-care products) on the selection of resistance in environmental bacterial communities. Bacteria collected from a natural water source were grown in bioreactors known as chemostats, exposed to low concentrations of triclosan, and tested periodically for resistance. The bacteria were also analyzed over time for community composition of a highly variable DNA region. We have observed changes in bacteria exposed to 0.5 and 0.1 M triclosan concentrations. Future studies include isolating resistant populations for further DNA analysis.

Daniel L. Sjolund

THE EFFECTS OF VARIOUS QUENCHER MOLECULES IN PHOTOINDUCED ELECTRON TRANSFER AND TRANSIENT ABSORPTION WITH PYRRROMETHENE DYES

Faculty Collaborator: Dr. Joseph M. Brom

This qualitative and exploratory study investigates the fundamental properties of photoinduced electron transfer in fluorescent organic dyes. More specifically, the project's foremost task is to obtain the absorption spectrum of the Pyrromethene 567 (PM567) radical anion by utilizing assorted quencher molecules with a technique known as transient absorption spectroscopy. When a highly fluorescent dye (such as PM567) is excited by high energy ultraviolet light, the molecule will most likely release the absorbed energy through the emission of a photon of a lower wavelength. In the presence of a quencher molecule, the excited electrons can be transferred to form positive and negative ions. The electrons from the quencher molecule have a natural tendency to position themselves in the most stable configuration and will (theoretically) automatically occupy the lowest unoccupied molecular orbital of the excited PM567. Such a transaction will result in a highly reactive and negatively charged PM567—hence the term radical anion. Effectively, the quencher molecule provides for an alternative energy release pathway, therefore significantly reducing the amount of emitted photons. This project is currently conducting experiments with 135 Trimethoxybenzene and DABCO (1,4-diazabicyclo[2.2.2]octane)—both of which are suitable electron donating quenchers that will theoretically interact with the PM567 to yield the desired radical anions. Upon achieving a comprehensive understanding of such elementary atomic interactions and excited electron energy transfer pathways, it may be possible to apply the knowledge towards more practical applications; this knowledge could then provide advancements for new forms of storable energy as well as aid in the production of solar panels able to absorb a large spectrum of electromagnetic radiation.

Matthew T. Slattery

ANALYSIS OF THE ANTIBACTERIAL PROPERTIES OF TETRACYCLINE AND ITS PHOTOPRODUCTS

Faculty Collaborator: Dr. Kristine H. Wammer

Tetracycline is commonly used in veterinary therapy, culture ponds, and as a human antibiotic and trace amounts of tetracycline have been detected in the environment. In this study the photodegradation of tetracycline, under environmentally-relevant conditions, was examined to determine the fate and behavior of its photoproducts. Tetracycline, by direct photolysis, is known, in varying conditions, to degrade into 7 different photoproducts. Water hardness and pH are two characteristics of a natural environment that can alter the decomposition pathway of tetracycline. Here, the growth of the bacterial strain *E. coli*. DH5 was measured by UV vis spectrophotometry (600 nm) in the presence of varied concentrations of both photolyzed and unphotolyzed tetracycline to determine the potential antibacterial activity of its photoproducts in diverse waters and conditions. The EC50 of the photolyzed and unphotolyzed curves are compared to determine if the photoproducts retain antibacterial activity.

Ryne Smith

MATHEMATICAL MODELING OF CELL MOTILITY

Faculty Collaborator: Dr. Magdalena Stolarska

One-celled organisms move in a variety of different ways. One type of movement is known as chemotaxis, the process by which cells are attracted to a chemical in the cell's surroundings and move towards that chemical. The process of chemotaxis involves various complex biochemical pathways. In this research, the biological pathway of focus is that which leads to extension of the leading edge and the contraction of the rear of our cell of study, *Dictyostelium Discoideum*. The specific purpose of this research project is to model the biological process of extension and contraction in a mathematical way, concentrating more heavily on the contraction phase and the "C-to-spot" formation of the biological species inside the cell known as *myosin*. This species *myosin* works with a number of other intracellular species, which were also modeled. This mathematical model was programmed into the computer program *Mathematica* in order to process calculations more quickly.

Christy Spampinato, Nick Huynh, and Alisha Duffy

SUBSTANCE P MODULATION OF EXPRESSION OF T CELLS ACTIVATION ANTIGENS

Faculty Collaborator: Dr. Jill Manske

Substance P (SP) is a neuropeptide that has been shown to have immunoregulatory properties including effects on mediators involved in anti-tumor immunity. In previous studies we have shown that treatment of mice with SP provides protection against tumor growth. This protection requires both T cells and NK cells, and adoptive transfer of cells from SP-treated animals can transfer tumor protection. These studies suggest a model in which SP treatment prior to tumor challenge primes immune mediators to prevent or delay tumor establishment. In this study we examined the ability of SP to upregulate the activation antigens CD25, CD134 and MHCII on T cells. Mice were implanted with mini osmotic pumps that supplied a continuous supply of either SP or PBS over a 14-day period. During the 14-day period, mice were sacrificed at 5, 10 and 14-day intervals and expression of activation antigens was analyzed by flow cytometry. In vitro ConA proliferation assays were performed to measure T cell antigen expression on activated T cells. The expression of activation markers was measured by specific antibody treatment (CD134, MHCII, and CD25) and analysis by flow cytometry. T cells from mice treated with SP showed increased expression of CD25, CD134, and MHCII activation antigens as compared to T cells from PBS controls. No difference was observed between T cells from SP treated animals and those from the control animals in the in vitro proliferation assays. These results suggest that SP may act in vivo by upregulation of antigens required for T cell activation. These results support a hypothesis in which SP primes T cells so that they are able to readily interact with other cells of the immune system in tumor defense.

Amanda Stemig

ANTIBACTERIAL ACTIVITY OF OXYTETRACYCLINE AND ITS PHOTOPRODUCTS

Faculty Collaborator: Dr. Kristine Wammer

Oxytetracycline, a derivative of tetracycline, is an antibiotic commonly used to treat both humans and animals and has been detected in natural water systems. It is known that oxytetracycline, along with other tetracycline derivatives, photodegrade when exposed to sunlight and recent concerns have emerged that some of its photoproducts may also retain antibacterial activity. The antibacterial activity of oxytetracycline and its photoproducts were studied under various natural water conditions to determine if the photoproducts indeed introduced more antibacterial activity.

Oxytetracycline degrades to very low concentrations at a fairly rapid rate in each of the natural water samples. Although, the photoproducts of oxytetracycline do not retain significant antibacterial activity, different photoproducts are made under different water conditions such as pH and metal ion concentrations. Through the utilization of other analytical techniques, the photoproducts formed in each water sample will be identified and compared.

James Stokman

SYNTHESIS AND TESTING OF A NOVEL ANTIMICROBIAL

Faculty Collaborator: Dr. J. Thomas Ippoliti

As bacteria resistance to current antibiotics continues to increase, new antibiotics must be continually researched and synthesized. My research has been developing and refining a nine step organic synthesis of a novel antimicrobial, modeled off of Zyvox™. The main feature of this first generation class of antimicrobials is the oxazolidinone ring, which targets Gram positive bacteria by blocking the ribosomal 50s subunit, effectively preventing translation of RNA to a polypeptide chain.

As demonstrated by previous research, it is possible to increase the potency of the antimicrobial by changing the aromatic substituent attached to the oxazolidinone ring. My synthesis utilizes an aminoisothiazole aromatic substituent, which has itself been researched for antimicrobial properties, in the hope of increased antimicrobial potency.

Heidi Telste

ZOOPLANKTON DISTRIBUTION AT DIFFERENT DEPTHS IN LAKE ITASCA AND LAKE DEMING

Faculty Collaborator: Dr. Kyle Zimmer

Zooplankton distribution varies dramatically within and between bodies of water, even those that are relatively close together. Many factors such as temperature, dissolved oxygen, food sources, and predation can influence the distribution of zooplankton. We examined zooplankton distribution in two Minnesota lakes that differed in physical and biological properties. Samples were collected in the epilimnion, metalimnion, and hypolimnion of each lake, and we tested whether the proportion of *Daphnia*, calanoids, and cyclopoids in each depth zone differed between lakes, and whether it changed through time. Lake Itasca showed little variation in any invertebrate taxonomic group through time whereas in Lake Deming, *Daphnia* moved to deeper levels and calanoids became more equally distributed over time. We detected no relationship between abiotic factors and zooplankton distribution in Lake Deming. As Lake Deming contains only planktivores, zooplankton distribution was most likely shaped by fish predation effect.

Patrick Tierney

PROGRESS TOWARD MAKING A SIZE-SELECTABLE NANOPORE

Faculty Collaborator: Dr. Gary Mabbott

The focus of this summer research project is to develop a nanopore with a diameter that can be easily manipulated. Nanopores have been used to sequence DNA, characterize particle dimensions, and quantify protein-antigen bonding capabilities. Using a polypyrrole polymer, the diameter of the pore will be electrochemically increased and decreased

to desired size. The nanopore will act as a filter for proteins. The passage of a protein through the pore will be detected by interruption of an electric current. We demonstrate here the first step of creating a supporting structure with a pore with micron dimensions. Progress thus far has been concentrated on creating this pore with micron dimensions in a controllable manner. Silver particles were electrochemically deposited onto a silver foil. A pore diameter of about 10 μm was reached. This makes for optimistic progression toward a size selectable pore.

Jonathan D. Tschiggfrie

A COMPREHENSIVE TECHNICAL, HISTORICAL, AND STYLISTIC ANALYSIS OF THE STEAM CALLIOPE ON THE INLAND WATERWAYS OF THE UNITED STATES

Faculty Collaborator: Dr. Sarah Schmalenberger

Abstract: This study explored three aspects of the steam calliope tradition as it relates to the riverboat culture in the United States, ca. 1851-2008. These aspects are: the technical issues of instrument construction (including its acoustical properties), a verified historical survey of the instrument, and the stylistic technique involved in performing on the instrument. Phase I of this project involved a literature review of existing documents, while Phase II involved personal interviews with modern builders and performers, as well as field observations and analysis of existing instruments. With the goal of creating a summative reference to aid in future research, this study represents the first accurate and thorough inquiry into a musical instrument which is an overlooked part of the culturally significant American riverboat tradition.

Daniel Wadell

HIGH VOLTAGE POWER SUPPLY

Faculty Collaborators: Dr. Chris Greene and Dr. Martin Johnston

My work over the summer was based on the continuation of an ongoing research project that has been around at the University of St. Thomas for over five years. My main goal was to push it further along so it could ultimately be rendered complete. When asked to do the project, there was no previous information about work that had been done in the past, only an existing circuit that was to be tested, documented, and eventually, improved.

The project's basis was to create a high voltage power supply that was able to act as a supply channel to allow a more affective, both through cost and application, voltage source for electron guns. A supply meant for this purpose already exists prior to the voltage supply project; however it exists with much room for improvement. The specification goal consisted of creating a supply that offered an output of a positive and negative voltage of 2000 Volts with an input of twelve, a cost of around \$300, and an easily computer controlled interface.

All of these specifications were met throughout the summer to an extent, but at the same time there still lies room for improvement. The computer controlled interface can still be reworked so that it is more appealing to the user as well as the cost may be able to be reduced slightly which will provide an affective and efficient high voltage power supply in time to come.

Jeff Wiisanen

DEVELOPMENT OF A MICROFLUIDIC DEVICE TO QUANTIFY SMALL AMOUNTS OF A SUBSTANCE BY WAY OF TITRATION

Faculty Collaborator: Dr. Gary Mabbott

Minute quantities play an important role in science, as well as everyday lives. That is why the goal of this project is to research and develop a method that easily quantifies very small amounts of an unknown substance in a precise and reproducible manner. The approach will involve the creation of a simple model system using larger amounts of materials, then scaling it down to a point where very small quantities can be studied. The microscopic work will use a device that can transfer one material to another on a very small scale. The combination of the two substances will create a reaction which can be monitored. From the results of this reaction, the original amount present of the unknown reagent can be calculated. The precision and reproducibility of the quantification techniques will hopefully be applicable to a variety of scientific areas.

Steven J. Winkelman

NIETZSCHE'S CRITIQUE OF KANT

Faculty Collaborator: Dr. John van Ingen

During the late 18th Century Immanuel Kant attempted to establish one of the most intricate systems of morality ever devised in an attempt to clarify what he took to be the moral law within us. Kant's formulation of the moral law centers on his categorical imperative, which he intended to serve as the supreme principle by which to determine moral ends. Kant proceeded to discuss and clarify this supreme principle, as well as other key concepts, in his moral, political, and religious works up to and including the publication of his *Metaphysics of Morals* in 1797. Nearly a century later, Friedrich Nietzsche employed one of the most adamant, albeit unconventional, critiques of the categorical imperative yet seen. With this project I have examined Kant's moral philosophy and the categorical imperative in light of Nietzsche's critique. Specifically, I consider three aspects of Nietzsche's critique of Kant's ethical system: the form of his critique, his conception of human excellence as embodied by the higher man, and his assertion that Kant's moral philosophy inhibits human excellence. I then examine Kant's moral philosophy – as presented by Kant himself, rather than Nietzsche – to determine whether Nietzsche accurately portrays and thus sufficiently critiques Kant's moral philosophy.

Eyerusalem Woldegebreal

AFRICAN AMERICAN WOMEN IN MATHEMATICS

Faculty Collaborator: Dr. Brenda Tiefenbruck

Purpose

As an African American woman studying mathematics I have noticed the lack of other African American woman in my math courses. Even though the number of African American men in these courses is very small as well, it is still significantly larger than that of woman and I am curious and excited to find out why this occurs. Since there continues to be studies that show the same trends of African American students falling behind their peers when it comes to mathematics I believe that there are answers to why this occurs and what can be implemented in the classroom to change these statistics (Ambrose, Levi, & Fennema, 1997). For these reasons I have explored my proposed questions more deeply in the African American Women in Mathematics Project.

Research Questions and Methodology

Over the summer I took the time to explore a research question that really interested me. The question of interest: What factors influence African American woman to shy away from mathematics in college? I thought that it would be very interesting to take a closer look and try to understand why these factors occur. I also had the time to look at a second question that looks at families, friends, and media and their influence on the choice of a college major for African American women.

The African American Women in Mathematics Project uses qualitative methods to examine factors influencing the choice of college major by African American women and family influence of major. I created a list of interview questions that I asked several African American women involved in the REAL Program and Summer Academy. This data heavily supported the literature that I read as well as did interviewing professionals in the math and/or education field.

Taylor Zumbusch

INTERACTIVE EFFECTS OF COMPETITION AND DIET ON SUCCESS OF INVASIVE ARGENTINE ANT SPECIES

Faculty Collaborator: Dr. Adam Kay

Invasive ants often have large ecological and economic impacts. It has been proposed that invasive species competitive success is largely correlated to their distinct nutritional requirements. In this study, we investigated how nutrition influences performance in Argentine ants, a devastating invasive ant species in California. We predicted that Argentine ants with more access to carbohydrates will invest more in metabolically expensive activities (i.e. territorial defense), and will be more likely to thrive in competitive environments. Colonies were fed diets consisting of different protein : carbohydrate ratios; some colonies had to face competition while feeding, others did not. We found that colonies fed protein-rich, carbohydrate-poor diets were less active and had significantly higher weekly worker mortality rates than those colonies given protein-poor (carbohydrate-rich) diets. In addition, competition resulted in lower activity and higher mortality rates. Contrary to our prediction, the negative effect of competition on activity and mortality was particularly large for colonies on carbohydrate-rich (protein-poor) diets, suggesting that access to metabolic fuel may not guarantee success in interference competition.

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