



UNIVERSITY of ST. THOMAS

**BUSH FOUNDATION PROGRAM GRANT:
COLLABORATIVE INQUIRY**

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

Abstracts

**Vol. 5
May 5, 2005**

Introduction

The abstracts published in this volume reflect the value we at the University of St. Thomas place on faculty/student collaboration.

Students who have recently done collaborative work with a faculty member present that work in these abstracts and at this poster session for purposes of dissemination and scrutiny by their peers, their professors, and the academic public.

The University of St. Thomas expresses its deep gratitude to the Bush Foundation, who funded this event through a three-year Program Grant. The grant seeks to increase the use of inquiry-based teaching methods, so that students experience the real work of the professions, working on real problems often taken from outside the university, in the ways they will be called upon to employ their disciplines after they leave the university.

A second theme of the Bush Program Grant is to increase faculty/student collaboration. We believe that one of the very best ways to teach is to have professors work with students collaboratively. Students see how work is really accomplished in their chosen professions, and professors have the chance to share their work as it is being created.

We hope this event and this volume gives visibility and credibility to the ideas represented in our Bush grant



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May 2005

I am both pleased and proud to introduce the Spring poster session devoted to faculty/student collaboration projects developed as part of our three-year grant from the Bush Foundation, *Focus on Inquiry: Faculty/Student Collaboration at the University of St. Thomas*.

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. This 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,

A handwritten signature in black ink that reads "Dennis Dease".

Reverend Dennis Dease
President

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Molly Andreason, Michael Cook, Eric Duclos, Ben Reasoner, Melissa Sawyer

BLACKJACK CLIENT-SERVER NETWORK

Faculty Collaborator: Dr. Patrick Jarvis

Client-server is a method of providing computing services in which resources are provided by one machine (the server) for use by other machines (the clients). File servers and print servers are examples of common client-server applications. In our introductory programming class we developed a client-server model that implemented the blackjack card game. The game rules reside on the server (the dealer) which interacts with the clients (the players) through simple yes or no questions.

Bryce Beckman

KINEMATICS OF THE SPRINT START IN COLLEGIATE SPRINTERS

Faculty Collaborator: Dr. Bridget A. Duoos

The initial steps of a sprint race are critical in achieving optimal kinematics that will produce faster sprint results. This study was designed to determine if trunk and lower extremity joint angles are significantly different between a group of highly skilled and skilled athletes during the acceleration phase of a sprint start.

Subjects included ten Division III male track sprint athletes (ages 20 ± 2 years) with an average of seven years of experience. Subjects were split into a highly skilled group ($6.71 \pm .15$ sec) and skilled group ($7.022 \pm .23$ sec) based on their 55-meter dash personal records. Subjects performed six trials of 20-meter sprint starts on a 166-meter indoor track. A recovery of three minutes was allowed between trials. Data was collected using a Digital Sony HandyCam DCR-TRV17 stabilized on a tripod. The following phases were digitized and analyzed for each trial: maximum hip rise, first trunk rise, second trunk rise, and trunk stabilization. Within these phases, trunk, lead hip, trail hip, left knee, and right knee joint angles were measured using a goniometer. Paired t-tests were used to determine if there was a significant difference between the joint angles of the highly skilled and skilled athlete groups.

No significant difference was found in the maximum hip rise, second trunk rise, or the trunk stabilization phases. A significant difference was found in the trunk angle ($P=0.033$) as well as the lead hip angle ($P=0.049$) during the first rise phase of the sprint start.

These results indicate that coaches and athletes should focus on achieving a trunk angle of 24° - 25° , and a lead hip angle of 63° - 64° during the first trunk rise phase of the sprint start in order to maximize sprint performance.

Diane E. Burse

KNEE FLEXION AND MAXIMAL VERTICAL JUMP HEIGHT IN EXPERIENCED VOLLEYBALL PLAYERS

Faculty Collaborator: Dr. Bridget A. Duoos

Vertical jump is a skill that is highly applicable to sport-related performance, particularly in volleyball. This skill is especially important to a team's ability to effectively block the opposing team's attacks. Many coaches stress the importance of attaining 90° of knee flexion to maximize jump height. This study was designed to determine if 90° knee flexion at take-off maximizes a volleyball player's vertical jump height.

Seven female (23.14 ± 4.89 yrs) and 8 male (26.25 ± 4.89) experienced adult volleyball players (male 8.38 ± 4.03 yrs; female 9.14 ± 3.29 yrs) performed two trials of maximal vertical jumps at 70° , 90° , and 110° of knee flexion. A goniometer was initially used to establish each degree of knee flexion. A brightly colored sticker was placed on the wall the subjects faced to serve as a visual cue during jump execution. Subjects placed a labeled circular sticker on the wall at the peak of each jump. Sticker height for each degree of flexion was measured and collected data was used in research analysis. Paired t-tests were used to determine if there was a significant difference in jump heights reached with each knee angle.

No significant difference was found between knee flexion angles and jump heights for the females. A significant difference was found between 90° and 110° knee flexion for the male population ($p=0.022$). Due to inconclusive results, this study implies that coaches need not be concerned with their players' degree of knee flexion, but rather should look to alternate methods for improving vertical jump height. Further research is needed to determine additional factors, such as muscular strength, muscular power, and joint movement speed, which will improve maximal vertical jump height.

Christina Bye

SYNTHESIS OF PEROXYFLUOR-1 FOR COUPLING WITH ALCOHOL OXIDASE AS A NOVEL FLUORESCENT INDICATOR SYSTEM

Faculty Collaborators: Dr. J. Thomas Ippoliti, Dr. Kathy Olson

Alcohol oxidase is an enzyme isolated from the yeast *Pichia pastoris* that reacts with primary alcohols forming hydrogen peroxide as a by-product. In this study, the organic synthesis of a compound (Peroxyfluor-1 also known as PF1) that reacts with hydrogen peroxide to produce a fluorescent product (fluorescein) was performed. Thus, the coupling of the enzymatic alcohol oxidase reaction with PF1 represents a novel reaction scheme to produce a fluorescent indicator. A two-step reaction scheme was used to first generate 3', 6'-diiodofluoran by acid-catalyzed condensation of 3-iodophenol and phthalic anhydride. In the second reaction, 3', 6'-diiodofluoran reacted with bis(pinacolato)diboron and a palladium catalyst to form PF1. The synthesis of PF1 appeared successful but the purification of the product was difficult and no pure product was isolated.

Eric Chapman

IDENTIFICATION OF SERINE/THREONINE PHOSPHATASES IN SYNECHOCOCCUS ELONGATUS PCC 7942 TO DETERMINE THEIR ROLE IN REGULATION OF KaiC PHOSPHORYLATION

Faculty Collaborator: Dr. Jayna Ditty

It has been shown that the phosphorylation state of KaiC, a central serine/threonine autokinase in the *Synechococcus elongatus* PCC 7942 circadian clock, is important for the cyanobacterial timing mechanism. The goal of this research was to determine if serine/threonine phosphatases are important for the regulation of KaiC phosphorylation in circadian rhythm activity in the cyanobacterial cell. Previous research by Bork et al. has shown that there are conserved motifs that are characteristic of serine/threonine phosphatases in bacteria². I identified a phosphorylase in *Synechococcus elongatus* PCC 6803, and determined its 2,535 Nucleotide length sequence and location on contig 52 of the *Synechococcus elongatus* PCC 7942 genome. Further work can be done to generate mutant

cyanobacterial strains to determine whether this phosphorylase plays a role in the regulation of KaiC phosphorylation in *Synechococcus elongatus* PCC 7942.

Mary Dienhart

SEQUOYAH: THE POWER OF THE CHEROKEE SYLLABARY

Faculty Collaborator: Dr. Mark Neuzil

As white settlers in search of more room and more riches forced their way onto Cherokee lands in present-day Virginia and the Carolinas in the late 1700s, the powerful tribe became besieged and divided. Sequoyah (1770?-1843), a Cherokee leader of mixed descent, worried that his culture was being destroyed.

As a private under Gen. Andrew Jackson in the War of 1812, Sequoyah witnessed the utility of a written language, which the Cherokee did not use. Sequoyah, who was an ingenious silversmith (and thus able to make metal type), thought that a written language would help the Cherokee preserve their culture in the advent of white domination and perhaps be of military use to the scattered tribe.

Sequoyah had begun work on a syllabary as early as 1809; his wartime experiences spurred him to finish it 12 years later, enduring ridicule, menace, and discouragement from friend and foe. The final system contained 86 symbols and “consisted of nine modes, 15 tenses, and three numbers, singular, dual, and plural. No prepositions or auxiliary verbs were employed, these adjuncts being in the verbs themselves, and pronouns were seldom used; instead, the nouns were repeated.”¹ His only full-length biographer, writing in 1938, said: “Sequoyah is the only man in recorded history to conceive and perfect an alphabet in its entirety.”²

Sequoyah’s syllabary led to journalistic achievements, including the first Native American newspaper in North America, and paved the way for a print culture for all American Indians. Sequoyah gave American Indians a written voice and a system of communication capable of better overcoming physical separation. But as with any communication revolution, something was gained (the printed word) while something was lessened (the oral tradition). Some criticism of Sequoyah by Native Americans continued into the 20th century.

¹ Foreman, Grant. (1938) *Sequoyah* (Norman, Oklahoma: University of Oklahoma Press): 10.

² Foreman. *Sequoyah*: 3.

Nicole M. Duxbury

ECOLOGICAL STOICHIOMETRY OF SPITTLEBUGS: ARBOREAL XYLEM-FEEDERS CONTAIN EXTRAORDINARILY HIGH PHOSPHORUS AND RNA CONCENTRATIONS

Faculty Collaborator: Dr. Adam D. Kay

Ecological stoichiometry, the study of the balance of elements in ecological systems, provides a framework for linking the chemical composition of organisms to traits impinging on ecological interactions. A central concept in ecological stoichiometry is the growth rate hypothesis, which predicts a positive causal relationship between whole body phosphorus (P) content and growth rate in organisms due to the dependence of protein synthesis rate on the concentration of P-rich ribosomal RNA. While direct links between elemental concentrations and biochemicals such as RNA have been found in aquatic invertebrates, this connection remains largely unstudied in terrestrial invertebrates. Here, we describe P and RNA concentrations in larvae of four species of spittlebugs, terrestrial insects that feed

on the xylem of plants. In two species (*Aphrophora parallela* and *Clastoptera proteus*), larvae contained extraordinarily high amounts of P (7-10% dry mass): these levels are almost an order of magnitude higher than amounts reported for other insects. They are also higher than values reported for some vertebrates (fish), and approach the ~12% P content of bone material. Two other species (*Philaneus spumarius* and *Lepyronia gibbosa*) contained P concentrations typical of larval invertebrates (~1% dry mass). *Aphrophora parallela* and *C. proteus* larvae also contained RNA levels (15-23% dry mass) that are substantially higher than the few reported values for invertebrates. These levels are also considerably higher than levels in *P. spumarius* and *L. gibbosa* (3-10% dry mass), suggesting that differential investment in RNA accounts for some of the variation in P content among species. Our results indicate P and RNA concentrations can differ substantially even within ecologically similar species, and suggest that a focus on P in terrestrial insects may reveal linkages among composition, biological functions, and life history strategies.

Matthew Gogola

COMPARING NOTES: RESOLVING INCONSISTENCIES BETWEEN PRINT AND BRAILLE MUSIC NOTATION

Faculty Collaborator: Dr. Shersten Johnson

The popularity of the current blockbuster film, *Ray*, reminds us that we all have enjoyed the music of blind musicians and marveled at their accomplishments against great odds. Although talented blind musicians have made great strides as performers in popular and classical genres alike, barriers still exist for musicians wishing to pursue formal academic studies in music. Core courses such as music theory, history, and conducting require that students learn certain skills above and beyond playing an instrument or singing with facility and artistry; and all of these skills involve challenges to the blind student. Music theory in particular is, at many levels, a study that is all about notation — the visual representation of audible sounds. Moreover, this representation consists of specialized symbols. Blind students depend on Braille representation of these symbols to communicate with other musicians, and thus they have to navigate a three-part interaction between audible music, traditional print notation, and Braille. Unfortunately, Braille music notation not only communicates very different information about music than does traditional notation, but also Braille notation styles differ from one engraver to another, causing many difficulties for the blind musician. This inquiry centers on finding ways to overcome these discrepancies in order to improve musicianship skills, and furthermore, on making those findings available to other students and teachers of music.

Britt Hammerberg, Robert Kennedy, Cory Tranby, Ben Werner.

UST UNATTENDED GROUND VEHICLE PROJECT

Faculty Collaborator: Dr. Thomas Sturm

Four senior computer science students under the supervision of Dr. Sturm, designed and built an unattended ground vehicle. This project was part of a competition sponsored by General Dynamics that involved the University of St. Thomas and a similar team from St. Cloud State. The goal of this project was to build a remotely controlled vehicle from off the shelf components that could be operated from a remote station out of the line of sight of the operator. The operator would also be able to remotely aim and fire a paintball gun mounted on the vehicle. This project was started in the Artificial Intelligence

and Robotics course taught by Dr. Sturm and continued until the competition between the robots built by the two teams on April 29, 2005.

Anna Hoefs

FAMILY RITUALS: NEGOTIATING THE NEW AND THE OLD

Faculty Collaborator: Dr. Carol Bruess

The purpose of this study was to understand ritual negotiation in couples and families. In particular, we examined ritual development and enactment in newly formed families, specifically the types of rituals couples have in their current marriages and/or families and how or if couples have imported or adapted rituals from their families of origin. Six married couples were interviewed; all participants filled out demographic questionnaires. Using a qualitative/interpretive method, we analyzed 60 single spaced pages of interview transcripts from 6 couples. Data was organized into the following Supracategories: 1) Rituals brought forward unchanged from couples' families of origin, 2) Rituals brought forward and modified from couples' families of origin, 3) Rituals started new in couples' new family, unrelated to a family of origin ritual, 4) Rituals not brought forward from couples' family of origin, 5) Rituals brought forward from family of origin but failed/ended, 6) Conversations and/or negotiations about ritual adoption, adaptation, or abandonment 7) Plans for ritual adoption, adaptation, or abandonment some time in the future. These seven supracategories or themes, although in part guided by Braithwaite, Baxter, and Harper's findings (1997), each emerged during the data analysis process.

Julie M. Hughes

EXERCISE AND ENDOTHELIAL FUNCTION IN POSTMENOPAUSAL WOMEN

Faculty Collaborator: Dr. Bridget A. Duoos

Flow-mediated dilation (FMD) of the brachial artery is a noninvasive measurement of endothelial function. FMD is a homeostatic response to an increase in local shear stress induced by forearm cuff occlusion and release. Endothelial dysfunction is a key event in the pathogenesis of atherosclerosis. FMD has been shown to improve with regular exercise training in a number of high-risk populations including those with hypertension (Higashi, et al, 1999), chronic heart failure (Hambrecht, et al, 1998), and polymetabolic syndrome (Lavrencic, et al, 2000). The purpose of this study was to acquire pilot data determining the relationship between aerobic exercise and endothelial function in another high-risk population, postmenopausal women.

FMD was measured in four postmenopausal women (52.3 ± 2.9 yr) prior to and following eight weeks of aerobic exercise. Participants completed five, forty-five minute supervised training sessions each week. Each participant wore a Polar heart rate monitor and maintained a heart rate between 60 and 80% of her measured maximum during each exercise session. A high-resolution ultrasound probe was used to obtain images of the brachial artery. After recording baseline brachial diameter, a blood pressure cuff on the arm was inflated to 50 mmHg above measured systolic blood pressure. Following five minutes of occlusion, the cuff was released, inducing reactive hyperemia, and FMD was determined as the peak dilation within one minute of cuff release. Data were analyzed using a paired t-test.

No significant difference was observed in FMD following eight weeks of aerobic exercise ($-0.82 \pm 1.6\%$, $P = 0.647$). It is possible that increased duration and/or intensity may be needed to show a marked improvement in endothelial function. This study should be replicated using a larger sample size in order

to accurately assess the relationship between exercise and endothelial function in postmenopausal women.

Ingrid Johnsen

FRAMING THE ISSUES: THE AUTHORITARIAN REPUBLICAN VS. THE NURTURANT DEMOCRAT

Faculty Collaborator: Dr. Greg Robinson-Riegler

Since the 2004 presidential election, there has been much speculation about why Republican candidates seem to be increasingly popular, and are winning more elections. Is the general public simply becoming more conservative? Or are Republicans just better at “selling” their message and attracting voters? According to cognitive scientist and linguist George Lakoff it is difficult to tell, since these two variables—ideology and the effectiveness of “the sell”—tend to be confounded. According to Lakoff, Republicans are simply better at framing issues and as a result, their view resonates with the public. For example, Republicans have framed tax cuts as tax relief. By using the word relief, there is an automatic assumption that some type of burden exists. Democrats have not framed the issue in their own way—instead, they use the same term: tax relief. But, importantly, it might be the “frame” rather than the particular issue stances that are resonating. The present study attempted to separate issue stances and framing in order to investigate their relative impact on preferences for political candidates. Participants in this study were undergraduate students at the University of St. Thomas who were asked to rate their own political attitudes. They were then given a description of two fictional candidates, one liberal and one conservative, with either framed or unframed issue positions. Dependent measures included ratings of agreement with the candidates on issues, personality ratings of the candidates, and likelihood of voting for each candidate. Results showed that overall, conservative participants were more affected by the presence of a frame and seemed to respond more positively to the frames than did liberal participants. The effectiveness of framing an issue varied with the particular issue in question.

Maggie Kendall & Craig Hill

SEDIMENTARY AND MINERALOGICAL INDICATORS OF LATE HOLOCENE PALEOCLIMATE IN SOUTHER PATAGONIA FROM LAGUNA AMARGA

Faculty Collaborator: Dr. Kevin Theissen

Laguna Amarga (51° 00' S, 72° 45' W), a small, shallow (~2 m max. depth), low elevation (~148 m.a.s.l) lake, is located just outside of the spectacular Torres del Paine National Park in Chilean Patagonia (figure 1). This lake is unique for the area in that it is a closed basin lake shut off by ridges and glacial moraines. The lake is supersaturated with salts and evaporite minerals and is bordered by fossilized algal bioherms and mineral springs near its shore. Since Laguna Amarga is not connected to an outside water source, it is very responsive to changes in the regional moisture balance and we suspect that its sediment record accurately reflects past conditions in the region where few paleoclimate records have been collected and published. During January of 2005 we recovered two nearly identical one meter-long sediment cores from Laguna Amarga. Here, we present preliminary results of our sedimentary and mineralogical analysis of Laguna Amarga Core 2 to provide insight into the climatic and environmental changes taking place during the late Holocene in the Torres del Paine region. Initial observations of the core reveal an intriguing sedimentary history within the lake basin. The sediments exhibit millimeter- to centimeter-

thick laminations. Powdered X-Ray Diffraction results indicate cyclic dry and wet periods, indicated by aragonite and quartz dominance, respectively. Smear slide compositions provide similar interpretations, indicating similar cyclic dominance by the carbonate mineral, aragonite. The significant changes in the composition of the sediments suggests sharp fluctuations in the lake water balance which is strongly linked to the intensity of the westerly winds providing moisture to the region. Approximately 35 cm down core is a 2-3 cm thick granular deposit we suspect might be an ash deposit. Further examination and dating of the layer will provide an excellent age estimate for the Laguna Amarga Core 2.

Sarah Kohn, Cyndi Jo McCormick

SOCIAL AND MORAL RELATED VARIABLES MAY PREDICT DEPRESSION

Faculty Collaborator: Dr. Tonia Bock

The extent to which the several social- and moral-related variables predict depression was investigated in this study. One hundred fifty three college students were surveyed using a set of scales measuring consideration for others, community bonding, school ethical identity, family support, hopefulness, relational commitment to family, school bonding, home ethical identity, spirituality, attitudes toward human rights, delinquency, insecure adult attachment and humanitarian liberalism. Of the thirteen variables included in a regression equation, depression was predicted by family support, hopefulness, insecure adult attachment and school ethical identity. These results suggest that assessment of the variables may aide professionals in the identification of individuals at risk for depression.

Sarah Larson

EFFECT OF ATRAZINE ON ORGAN MASS AND ENDOCRINE HORMONES OF MALE CD-1 MICE

Faculty Collaborator: Dr. Susan B. Chaplin

Atrazine is one of the most commonly used herbicides in the country; in Minnesota alone, three million pounds were purchased for use last year. The negative impact of atrazine on animal and human health has been reported in many published studies. In this study, the effect of varied doses of atrazine administered in drinking water for 10 days was measured on male CD-1 mice. Thymus, spleen, liver, and testes weights were significantly higher at the lowest doses of atrazine and significantly lower at the highest doses of atrazine, compared to control animals. However, the dose that significantly decreased organ weight in this study (20 ppm) was 3 times less than that reported to decrease testosterone levels in rats (Friedmann 2002). There was no significant effect of atrazine on thyroid hormone or testosterone levels, but hormone levels decreased linearly throughout the range of 2, 10, and 20 ppm exposure.

Yumi Nagato

UNCONVENTIONAL ENERGY SOURCES AND THE ENVIRONMENT IN MOLDOVA: UESEM

Faculty Collaborator: Dr. Greg Mowry

The United Nations Framework Convention on Climate Change (UNFCCC) recognizes that there is a problem, which is a major achievement of UNFCCC in a general and adaptable character. Although the UNFCCC understands the complex and difficult nature of global warming and climate change, it has the ultimate goal of balancing the greenhouse gas emissions “at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system.” It also claims that such a level needs to be reached in a time-period that is suitable for ecosystems to acclimate, to avoid damage on food production, and to precede sustainable economic development.

The Kyoto Protocol greatly strengthens the Convention by committing Annex I Parties to “individual, legally-binding targets” to limit or reduce their greenhouse gas emission. The six targeted gases of the Protocol are listed on Annex A, while the individual targets for Annex I Parties are listed in the Annex B. With the individual commitments for Annex I Parties, the goal is to reduce greenhouse-gas emissions by at least 5 percent from the 1990 levels in the first target period of 2008 – 2012. The Kyoto Protocol holds three flexible mechanisms that lower the overall costs for Annex I Parties to meet their targets.

The Moldovan carbon project’s goal is to improve energy efficiency in public buildings, and thus mitigate emissions of greenhouse gases, which is implemented by the WB Moldova Energy II Project. This project also contributes to sustainable development of Moldova by replacing and upgrading the deteriorated heating systems of public buildings. With the benefit of lower cost to reduce emissions compared to in many developed countries, the project’s final goal is to be sold to a nation with a Kyoto Protocol target through Clean Development Mechanism, which is one of the Kyoto mechanism.

Susan Pribyl

THE SYNTHESIS OF VARIABLE THERMOCHROMIC POLYMERS

Faculty Collaborator: Dr. J. Thomas Ippoliti

Polydiacetylenes (PDAs) are organic molecules known for their reversible, visual properties. One such property is the ability to change color in the presence of heat. This type of molecule is called a thermochrome. Three thermochromic polydiacetylenes, with varying structures, were synthesized (R-groups: 6-Bromo- naphthalen-2-ol, naphthalen-1-ol, and amino-naphthalene) by varying the structure new information about the chromic transition temperature and colors were obtained. It was discovered that both the 6-Bromo- naphthalen-2-ol and amino-naphthalene derivatives produced viable thermochromes, the naphthalen-1-ol derivative did not. The 6-Bromo- naphthalen-2-ol derivative is dark blue in color and transitions to red at 66oC. The amino-naphthalene derivative is very light blue in color and transitions to red at 68oC.

Adam Rennaker

STEGANOGRAPHY

Faculty Collaborator: Dr. Patrick Jarvis

Steganography is an area of cryptography in which messages are hidden inside other documents. The message is stored by making subtle changes to the document under the direction of an algorithm. When done correctly, these changes are not noticeable by the casual observer. They can, however, be detected by computer software. Theoretically, three things are needed to decrypt (extract) the message: the document, the encryption algorithm, and the key. However, by using powerful computers and sophisticated software, many steganographic codes can be broken by analyzing only the changes made to the document. Knowledge of the key and encryption algorithm is unnecessary.

I propose to develop a steganographic code in which the document is not modified from its original form. This code would, therefore, be unbreakable without having all three decryption components. Knowledge of any two of the three components would not be sufficient. I developed a software system written in Java that uses string matching techniques to build a key whose contents describe paths through the document that, when followed, will produce the hidden message. A uniform modeling language description of the object oriented system was created as well as an implementation in Java classes.

Benjamin Roby, Benjamin Struthers, Christopher Emerson

CARGILL TIME TRACKER

Faculty Collaborator: Dr. Patrick Jarvis

The Cargill finance department help desk wanted a system to track their staff's billable time and invoice the appropriate department each month. Billable time includes answering questions, project time, and fixing problems that users do not have authority to take care of themselves.

A MySQL relational database was designed and implemented to store the collected information and included tables for time entered, user accounts, tasks, and departments. User interface with the system was done via a web browser. PHP, XHTML, and CSS were used to connect the database to the browser via the web server. All the user passwords were hashed for security using the MD5 cryptographic hash function.

Krista Sandford

SUPERIMPOSING BARRIERS: IMAGINING ISRAELI SECURITY FENCES IN THE TWIN CITIES

Faculty Collaborator: Dr. Robert Werner

Due to political conflict and strife in Israel over the occupied territories, which include the West Bank, there have been a variety of security fences and barriers set up by the Israeli government to prevent Palestinian terrorist attacks on the Israeli citizens. The uses of the security fences are an extreme solution, which causes greatest harm to the local population.

These fences cause great disruptions in the lives of people living and working in the West Bank. The Israeli government only allows people with permits to use certain roads or to even leave the West Bank.

Even with permits, Palestinians are often not allowed to leave and many are not granted movement permits at all, which greatly damages the lives of the local people. There are also long lines that Palestinians must wait in to even pass through the security fences to leave the West Bank. Palestinians are subject to searches and detainment at these gates that are controlled by the Israeli Army. Due to this, many Palestinians have a hard time getting out of the West Bank, separating them from adequate medical care, educational opportunities and often their own farmlands.

The goal of this project is to show how these fences would disrupt the lives of the Twin Cities residents if the fences and barriers were installed in the Twin Cities. This model has Jerusalem centered over St. Paul, consequently splitting St. Paul into two parts and separating the eastern suburbs from the western suburbs. This would cause serious issues for the residents in the Twin Cities, whom may work and live in the areas that are on either side of the fence.

Krista Sandford, Anya Yaroch

THE BURMA PROJECT

Faculty Collaborator: Dr. Robert Werner

In February, a St. Thomas law professor and two of his law students agreed to represent the case of two Burmese Karen Christians. The Burmese have overstayed their U.S. tourist visa. The two appeared before a U.S. immigration judge, in Bloomington, Minnesota, on April 11th. The case was made to the judge that they will be persecuted or killed by the Burmese army if they are deported. The law professor enlisted the help of the St. Thomas Geography Department. The problem is to make a judge understand the confusing array of names in the affidavits of the clients. It would be difficult for the judge to separate the place names from people's names, because those given in the affidavits are in Burmese, Karen, and Thai.

A St. Thomas geography professor and a GIS lab assistant attempted to identify the locations of the place names, via study at the U of M Borchart Map Library. While this library is the best local resource, the books of place names and maps identified only one of the 18 place names that needed to be located. Identification of the other place names was obtained with a half-day meeting among the law students, the two Burmese, the St. Thomas geography professor, and a St. Thomas history student. The GIS lab assistant and the professor were then able to produce a map of the places. The history student was enlisted to construct family relationships in the affidavits. She constructed a genealogy, including records of each member of the two Burmese families. Most individuals in the families were killed by the Burmese army, for example, by land mines, or in one case, the machine-gunning of a whole parish while in church.

The court heard the case on April 11th, and our exhibits were included in the files of both the attorneys and judge. The result of the day was that the judge suspended the case for four months while the government tries to determine more clearly the citizenship of the clients.

SYNTHESIS OF AN OLIGOPHENYLENE FOR USE AS A HOLE-TRANSPORTING AGENT IN ORGANIC LIGHT EMITTING DIODES

Faculty Collaborator: Dr. J. Thomas Ippoliti

Progress has been made on a convergent synthesis to form a unique hole-transporting molecule from two components. One of the components to be coupled was formed through a five-step synthesis. Cycloheptanone was converted to 2,6-cycloheptadienone in 4 steps. The dienone was then reacted with 4-bromoaniline by the double Michael addition to form a bicyclic dialkyl monoaryl amine containing an aryl bromide. The second component, an aryl boronic acid was made by a two-step synthesis that coupled diphenylamine and dibromobiphenyl followed by trimethyl borate to form 4-(diphenylamino) biphenyl-4'-boronic acid. Coupling of the aryl bromide of the bicyclic amine and the boronic acid will occur by use of a palladium-catalyzed reaction under mild conditions. The resulting hole-transporter should have properties that will allow it to easily transport electrons, while being highly resistant to oxidative decay, making it a good candidate for integration into an organic light emitting diode (OLED).

Jonathan M. Smieja, Heather M. Sexe

MOLECULAR PACKING DIFFERENCES IN SOME SOLID ISOMERIC BENZYLIDENEANILINES

Faculty Collaborator: Dr. William H. Ojala

Two unreported benzylideneaniline derivatives were prepared and the crystal structures were determined using single-crystal X-ray diffraction. For each of these two derivatives, the bridge-flipped isomer had already been prepared and the crystal structure determined. The hope was that co-crystallization between bridge-flipped isomers could be achieved in order to study the properties of the products. In order for co-crystallization to occur the two isomers must display the same packing arrangement in a crystal structure. The isomers studied here failed to do so. The difference in packing is due to conformational disparities where some benzylidene anilines are flat and some are not. The isomers could have different geometric arrangements due to steric hindrance or for various other reasons addressed here. In this research comparisons are drawn between the individual isomers in the two bridge-flipped pairs.

We describe isomeric benzylideneanilines as “bridge-flipped” isomers if they differ only in the orientation of the bridge connecting the aryl groups (Ar-CH=N-Ar' vs. Ar-N=CH-Ar'). The similarity in size between $-\text{CH=}$ and $=\text{N-}$ might allow bridge-flipped benzylideneanilines to be co-crystallized, producing new solid-state materials, if the individual isomers have the same molecular packing arrangement. Two features that might facilitate isostructuralism between bridge-flipped isomers are similar molecular conformations and similar intermolecular H-bonding motifs. We have determined the X-ray crystal structures of two benzylideneanilines in which these features might play a role in determining the molecular packing. One is the bridge-flipped isomer of a published structure in which the molecule is reported to be nearly planar; the other is the bridge-flipped isomer of a structure we had determined earlier in which intermolecular H-bonding occurs in the solid state. Here we describe the solid-state structural features that render both pairs of isomers non-isostructural.

Shiela Stegora

CONSTRUCTION OF A KAI A LUCIFERASE REPORTER FUSION

Faculty Collaborator: Dr. Jayna Ditty

Organisms base their daily behaviors on the amount of light and darkness to which they are exposed throughout a 24h period, and have evolved a circadian clock to regulate these behaviors, which are known as circadian rhythms. Study of the circadian clock and genetic components and their functions is beneficial for understanding the roles of growth, metabolism, and gene expression in organisms. The cyanobacterium *Synechococcus elongatus* PCC 7942 is a single-celled prokaryote that is the model system for the study of the circadian clock in bacteria. *S. elongatus* has a circadian clock composed of the *kaiA*, *kaiB*, and *kaiC* genes and their subsequent proteins. The *kai* locus is expressed from two promoters, one upstream of *kaiA* (monocistronic message) and one upstream of *kaiB* (dicistronic *kaiBC* message), that are expressed in the same circadian phase in wild-type cells. Previous work has shown that KaiA protein is required for expression from the *kaiBC* promoter, and that overexpression of *kaiA* enhances expression from *kaiBC*, suggesting that KaiA is a positive activator of the *kaiBC* promoter. Therefore, qualitatively determining the role and function of the *kaiA* promoter (*PkaiA*) will be informative in the understanding of its role in *kai* gene expression and protein production for the circadian clock of cyanobacteria. To do so, a *kaiA* reporter fusion was designed to fuse the promoterless *luxAB* genes from *Vibrio harvei* to *PkaiA* in order to easily measure *kaiA* promoter activity by bioluminescence. *PkaiA::luxAB*, when expressed in cyanobacteria, will be used as an efficient way of measuring *kaiA* activity and its role in the cyanobacterial circadian clock.

Jay Vlaminck

NOVEL CHEMILUMINESCENT POLYMERS FOR ANTIGEN DETECTION

Faculty Collaborator: Dr. J. Thomas Ippoliti

As improvements in disease detection methods are continually being sought, determination of estradiol in women is gaining increasing attention. Testing of estradiol is very important in the area of clinical endocrinology. Sensitive determination of the quantity of estradiol in a woman is important for diagnosing debilitating diseases such as osteoporosis in its early stages. This research involves the synthesis of a poly-anhydride via Ring-Opening Metathesis Polymerization (ROMP). This polymer was then combined with a chemiluminescent molecule and estradiol. By changing the ratios of these three reagents, more sensitive results for estradiol assays presumably will be achieved. Increased sensitivity could possibly lead to earlier diagnosis and better treatments. Test results for the sensitivity of this novel polymer are pending.

Dan Vosbell

DETERMINANTS OF INDIANA CHARITABLE GAMBLING

Faculty Collaborator: Dr. John Spry

Charitable Gambling is a significant business in Indiana. Over \$585 million was spent on charitable gambling in 2000 in Indiana. Charitable gambling gross revenue was even larger than the approximately \$548 million spent on the Hoosier Lottery in 2000. In Indiana, charitable gambling can

be operated only by not-for-profit organizations, such as veterans' or religious groups, and is regulated and taxed by the state. There has been almost no research on the economics of charitable gambling. This research will be useful to public policymakers in Indiana and other states.

What Dr. Spry and I have done is examine which socioeconomic factors influence charitable gambling. We have used research methods similar to the numerous studies on the determinants of state lottery sales. With this data we created Lorenz Curves and Suits Indices, and eventually regressions which helped us determine the explanatory variables. We also attempt to estimate the amount of charitable gambling revenue lost by the presence of riverboat casinos.

Kaija Wilson

ENERGY EXCHANGE BETWEEN TERRESTRIAL AND MARINE ECOSYSTEMS VIA LEATHERBACK SEA TURTLES, *DERMOCHELYS CORIACEA*, AT PLAYA GRANDE, COSTA RICA

Faculty Collaborator: Dr. Anthony Steyermark

All seven species of sea turtles are either endangered or threatened, though some species are in more trouble than others. The Pacific population of leatherback sea turtles Costa Rica is dramatically declining, which may have many implications for marine and terrestrial ecosystems. Through nesting, leatherback sea turtles, *Dermochelys coriacea*, transfer energy obtained from distant marine foraging grounds to terrestrial beach ecosystems. This study quantified the amount of energy introduced into a 3.6 km beach by nesting leatherbacks in one season. Four pathways of energy were determined and quantified: energy lost as metabolic heat and gas during embryonic development, energy ingested through predation, energy remaining on the beach for decomposition and energy returning to the marine ecosystem via hatchlings. Human activities including beach development, illegal egg harvesting, and fishing practices, such as shrimp trawling, long lining, and drift netting are negatively impacting sea turtle populations worldwide. This study will allow us to understand the implications of the declining sea turtle population on beach ecosystems.

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