

# **Summer Undergraduate Research Fair**

**Mount Allison University**



**Friday, September 16, 2011**

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## Science Oral Presentations (3:30 – 4:45 pm) Avard Dixon 118:

*Proton Efficiency in the CB-TAPS Set-Up - Chris Sherman*  
Physics - Supervised by Dr. David Hornidge

The spin polarizabilities of the proton have become a hot topic in particle physics over the last few years. These polarizabilities are fundamental structure constants similar to mass or charge, and their discovery would allow physicists to use another testable piece to check current particle physics theories and ideas. We aim to extract the spin polarizabilities of the proton by using the Compton scattering process, which involves bombarding stationary protons with photons and observing the scattered particles. To extract the polarizabilities properly, it is essential that we know how good our equipment is at detecting these scattered particles. My work involves the determination of the proton efficiency - a measure of how efficient the crystal ball and TAPS detectors are at detecting scattered protons.

*Calculating Soft Tissue Thickness Through X-ray Scattering - Sarah Thomas*  
Physics - Supervised by Dr. David Fleming

Soft tissue thickness is a useful quantity to be able to measure and is required for some medical measurements such as when determining strontium concentration in bone. X-ray fluorescence (XRF) photons are a type of secondary x-ray which are increasingly being explored as an elemental detection method for the human body. At this point in time a second device, the ultrasound, is needed to get the soft tissue measurement but ideally the portable XRF could be used for both purposes. This research examines the viability of using the portable XRF system to accurately measure soft tissue thickness. Phantoms will be used in order to ensure reproducibility.

*Muonium Kinetics in Methanol - Ryan Clarke*  
Chemistry - Supervised by Dr. Khashayar Ghandi

It has been well understood that solvent effects influence chemical reactions for a long time. The free radical kinetics of acetone and muonium ( $0.11\text{H}$ ) in water, supercritical carbon dioxide and trihexyl (tetradecyl) phosphonium chloride have been investigated by our group in the past. My current work investigates this reaction in methanol, a fourth, and more traditional organic solvent, as a means of elucidating further solvent effects on this reaction. This solvent has comparatively smaller Arrhenius parameters than all three previously studied solvents; with an activation energy of  $6.5 \pm 1.7$  kJ/mol and a  $\ln A$  of  $24.6 \pm 2.4$ . These small activation parameters lead us to believe that quantum tunneling largely controls the reaction.

Gas phase calculations were carried out on each of the reaction channels as a means to estimate the extent of tunneling on each one.

*Leak-Detection System for a Heavy Gas Cherenkov Detector - Lee MacDonald*  
Physics - Dr. Dave Hornidge

Cerenkov light is produced anytime an incident particle passes through a medium with a velocity exceeding the speed of light in that medium. The detectors of this light are important for a diverse number of functions involving the identification of the incident particles and play a crucial role in an accelerator's detector package. The photons produced can be quite few in number and are susceptible to a number of types of interference including contamination of atmosphere as a function of oxygen content. My project involves the design and implementation of an apparatus for detecting Cerenkov light and measuring the performance of this apparatus when subjected to contaminants.

*Ionic Liquids as Synthetic Mediums - Fraser Burns*  
Chemistry - Supervised by Dr. Khashayar Ghandi

Ionic liquids are gaining interest in the scientific community as a possible replacement for classic organic solvents, due to their high thermal stability, low vapour pressure, low reactivity, recyclability, and tuneability. These properties were desirable for our research into biopolymers and the formation of novel nanoparticles. Our focus, as part of our continuous work on green chemistry, was in particular on green chemistry methods to make metallic nanoparticles, which are metallic material on a nanometer scale, with sizes ranging from 1-100 nm being of special interest. These molecules are being studied due to their potentially differing products from their bulk counterparts. These changing properties are a result of their interaction with the surfactant and stabilizing agent in solution.

## Arts Oral Presentations (3:30 – 4:45 pm) Avard Dixon 111:

*Emerging Forms of Community Engagement in Urban Renewal Projects, New Delhi, India - Rebecca Dixon*  
International Relations - Supervised by Dr. Leslie Kern

Cities in the global south are struggling to improve their urban environments. While governments are increasingly cognizant of the need to include citizens in the urban renewal process, the platforms they have developed for community participation have met with mixed success. In this presentation I will explore emerging forms of

community engagement taking place in New Delhi, India, where architects, planners and community-based organizations are actively developing and promoting solutions to challenges such as urban mobility and housing. I will present examples of such initiatives and situate them within broadening understandings of urban citizenship.

*Restorative Justice in Post-Conflict Northern Uganda - Rachel Gardner  
International Relations - Supervised by Dr. Dave Thomas*

Restorative justice defines crime as a violation of people and relationships, with a focus on the social context from which crimes arise; retributive justice defines the state as the victim, and determines guilt and punishment through utilitarian assumptions that are all equal under the law, regardless of one's social context. This report critiques the effectiveness of retributive justice principles in post-conflict zones, emphasizing the need to include victims and communities in justice processes, and to heal relationships to prevent future conflict. This paper further assesses local restorative justice mechanisms in Northern Uganda prior to colonialism, comparing and contrasting their effectiveness with retributive and restorative national and international justice mechanisms in meeting the immediate, and predicted future, concerns of Northern Ugandan residents

*The Ethics of Goldman Sachs, from the Perspectives of Smith and Friedman - Christina Free  
Philosophy - Supervised by Dr. Majithia*

In April 2010, the Securities and Exchange Commission filed a civil suit against the mega-firm Goldman Sachs, accusing the company of committing securities fraud, in which the bank created and sold an investment "secretly devised to fail". While Goldman protested that it did nothing illegal, the S.E.C. claimed that the firm withheld "material information from investors". I will analyze this incident to provide perspective on the role ethics plays financial institutions. Capitalist corporations will always try to maximize profits, but how far are they willing to go, and what kinds of repercussions are there for the parties involved? This case study will examine the Goldman Sachs controversy from the point of view of Adam Smith and Milton Friedman's economic and moral philosophies.

*The Eldorado of Antiquity: How Gold and Silver shaped Spain's Romanization- Jacob Wood  
Classics - Supervised by Dr. Bruce Robertson*

Following the Punic Wars, Spain became one of, if not the most, important province to the growing Roman empire. But how did Rome bring the Iberian Peninsula into its control? This presentation will aim to show the role of one specific commodity, that of the precious metal trade, in shaping Spain

into a Roman province, as well as asking the role of commodities in the greater idea of cultural diffusion.

*Selling NB Power: The Unrecognized Problem - Melissa O'Rourke  
Business (UNBSJ) - Supervised by Shelley Rinehart*

March 24, 2010, New Brunswick Liberal Premier Shawn Graham announced the proposed sale of NB Power to Hydro-Québec had been canceled. Five months later the Graham government suffered a massive defeat in the September 27th election losing to the Progressive Conservatives 42 to 13, a sixteen seat change from the prior election. In a province where one term governments are unheard of, many people were left questioning... what happened? What caused such an abrupt switch in voter preference? The following is a case study that examines the impact of the proposed NB Power sale on the provinces political landscape. It will highlight the importance of proper government public communication and also how the government failed to adhere to the marketing principals of problem recognition.

### **Geography focus Oral Presentations (4:00 – 4:45 pm) Avard Dixon G12:**

*Dendrochronological Analysis of Nine Tree Species in Canadian Prairie Shelterbelts - Emma Davis  
Geography and Environment- Supervised by Dr. Colin Laroque*

Shelterbelts have been widely used in Saskatchewan since the dry years of the dirty thirties when the Prairie Farm Rehabilitation Association began sending complimentary trees to farmers upon request. These trees can now act as a paleo-climate proxy, allowing, with the use of dendrochronology, to determine radial-tree growth under past climate conditions. To date, no other analysis has been completed on the way shelterbelt tree species have responded to historical climates, and so this became the focus of my summer research. Nine species were analyzed for their ability to share a common growth signal, and for the degree to which they responded to climate variables. My results will aid in deciding which species will be the most useful for planting under various future climate scenarios.

*Evaluating Methods of Determining Spruce Budworm Outbreaks- Sarah Quann  
Geography and Environment - Supervised by Dr. Colin Laroque*

Eastern spruce budworm (*Choristoneura fumiferana*) is an insect known for its destructive impact on coniferous forests across the Maritimes. During spruce budworm outbreaks, trees experience considerable stress as the budworm defoliates forest stands, leading to the reduction or elimination of an individual tree's annual-growth ring. Outbreaks have historically been identified through comparison of the

radial-growth patterns of a species unaffected by the budworm to that of an affected species. However, where no reliable non-host species is available, alternate methods have been developed to identify outbreaks. My research seeks to assess these new methods and to statistically determine if their results are significant through comparison of these results against those produced using the traditional method.

*Odes of joy, or sounds of silence? A dendrochronological investigation of an old violin - Cecilia Jennings*

*Geography - Supervised by Dr. Colin Laroque*

Antonio Stradivari was a well-known instrument-maker in the 18th century, whose instruments, especially his violins, remain famous today for their superior quality and incredible value, both culturally and financially. This summer, the MAD Lab received an old violin labelled with Stradivarius' mark from a client, with the label claiming it had been built in 1734. The goal of my summer's research was to try to date the wood used in the violin to solve this mystery, since any growth past 1734 would prove the instrument was a fake. Traditional dendrochronological methods and new applications of technology with the scanning electron microscope were used as we tried to trace the violin back to its origins and discovered when and where it was made.

## **Poster Viewing and Refreshments (4:45 – 5:05 pm)** **Avard Dixon 1<sup>st</sup> floor:**

### **Posters:**

*Empathy & Conversational Enjoyment in Younger and Older Adults Adults - Sylvia MacNeil Gautreau*

*Psychology - Supervised by Dr. Odette Gould*

Disagreement remains as to the nature and expression of empathy across adulthood. Empathy and self-reported conversation enjoyment with various other people was assessed in 144 young adults (M age = 19.50, SD = 1.69) and 120 older adults (M age = 68.75, SD 7.88). Results indicated age differences across dimensions of empathy: older adults scored higher on the Empathic Concern scale of the Interpersonal Reactivity Index, but lower on the Personal Distress and Fantasy scales. Inter-relationships between the empathy measures were similar across age groups, though the links between conversation enjoyment and empathy were stronger for older adults. The importance of using a multidimensional view of empathy, and the possibility that empathy influences conversational interactions differently across the lifespan are highlighted.

*Transcriptomic Analysis of a Mid-winter Algal Bloom in Lake Erie Provides Insight on Adaptations to Psychrophilic and Low-light Environments and the Role of Pathogenic Oomycetes - Robyn Edgar*  
*Biology (BGSU) - Supervised by Dr. Paul Morris*

In 2009, samples from a mid-winter sub-ice algal bloom were collected with bias to filamentous diatoms using a 153µ vertical net tow to a depth of 15m. cDNA was produced from the samples and sequenced. After assembly (MIRA 3.0), the resulting metagenomic library was 11,576 contigs. BLAST analysis against multiple NCBI databases revealed that ~56% of the assembled contigs had relevant hits (E-value < 1xE<sup>-10</sup>) and ~60% of those had best hits to algal genomes. The assembled library was also blasted against a set of oomycete data sets (both proteins and genes). This analysis identified an additional ~300 sequences with stronger homology to oomycetes than anything in NCBI's databases and ~10% of these hits were secreted proteins. The surprising abundance of organisms known to be major pathogens in terrestrial ecosystems suggests that they may be playing a similar role in the annual decline of this bloom.

*In-situ X-ray diffraction observations of stress within electroless copper films - Colby Brown*

*Physics - Supervised by Dr. Ralf Bruning*

The electroless deposition of copper films from liquid electrolyte solutions is an important step during the industrial manufacturing of printed circuit boards. For most applications, the copper layer serves as a conductive layer on a non-conductive substrate material. Stress, either tensile or compressive, is present in these films.

These stresses influence the quality of the final product. I have used X-ray diffraction techniques to investigate the dependence of the electrolyte bath chemistry on the stress within the resulting copper films.

*Next Generation of Nuclear Reactors - Marisa Smith*

*Chemistry - Supervised by Dr. Khashayar Ghandi*

We are doing research on the chemical reaction of the hydrogen atom with water under sub- and supercritical conditions. Supercritical water is water above the critical point (373.9 C and 220.6 bar). This reaction is one of the most important reactions in the next generation of nuclear reactors called Gen IV, where supercritical water will be used as a coolant. We have been studying this reaction by the SR experimental technique. SR is the only technique that is able to work under these extreme conditions to provide kinetics data and it can be a billion times more sensitive than other techniques. TRIUMF, the particle accelerator in Vancouver is the facility that we used to collect data.

## Science Oral Presentations (5:05 – 6:05 pm) Avard Dixon 118:

*Molecular dynamic simulation of copper film growth - Aaron Martin  
Physics - Supervised by Dr. Ralf Bruning*

using a molecular dynamics simulation to study the effects of temperature, deposition rate and deposition energy on the physical properties of the growing copper film. Using these measurements to compare with the copper films grown in the lab. Physical properties include biaxial stress, crystal size and crystal orientation.

*Compton Scattering: Extracting the Cross Sections from the 08 Data - Ari Silburt  
Physics - Supervised by Dr. Dave Hornidge*

The feasibility of isolating Compton Scattering events from the sea of noise in the 200-300MeV range has only recently been realized. Just over two years ago, Darin Eddy made the first preliminary calculations for the Compton Scattering cross sections, which measure probabilities of an event occurring. It has been my job, over the summer, to refine these results, and determine the sources of discrepancy between theory and experimental values. My thesis work will build on these results by calculating the “sigma 3” beam asymmetries. These asymmetries are a crucial component of the spin polarizabilities, a set of constants fundamental to the proton which Dr. Dave Hornidge has been working on for the last few years.

*Diatom segmentation and measurement using image processing - Greg Legere  
Computer Science - Supervised by Dr. Andrew Irwin, Dr. Dan Vogel*

Images of slides containing diatoms have to be segmented and measured. This is a tedious task that takes a lot of time, and there are many images to process. Under the supervision of Dr. Andrew Irwin, and Dr. Dan Vogel, I have created a small application using C# and an image recognition and processing library to make this task quicker and easier to perform. This program can however be used for many other tasks that require the segmentation of phytoplankton, or other similar species. Within the program you are able to label the segmented items as the appropriate species, cut away and delete junk, and add things that have been missed.

*Kinematic Fitting for Background  $\pi^0$  Removal - Ryan Bennett  
Physics - Supervised by Dr. Dave Hornidge*

This research uses the conservation laws of physics to determine the particles detected when a gamma-proton collision occurs. Kinematic fitting, which uses principles of momentum, energy, and mass conservation particles detected can be used to reconstruct the reaction and determine whether the measured parameters

match the predicted ones. Hopefully, this method of removing background contamination will be more effective than the current 'cut' methods employed which remove all events above or below a certain points of energy or angle. Improving the background removal process will aid in the research determining spin polarizabilities of protons.

## Arts Oral Presentations (5:05 – 6:05 pm) Avard Dixon 111:

*Shakespeare's Desperate Housewives: The Eloquence of Women on Trial for Adultery in Renaissance Drama - Caroline Wong  
English - Supervised by Dr. Karen Bamford*

Feminist approaches to Shakespeare and his contemporaries have repeatedly underscored the masculine anxieties towards female sexuality that pervaded Renaissance England. In this patriarchal society where men feared being cuckolded and having their bloodlines polluted with bastards, female speech was perceived as sign of female sexual appetite and, consequently, met with distrust. How, then, can the modern critic reconcile this scene of misogyny with the Renaissance stage and its female protagonists, who frequently united chastity with moving eloquence? This presentation will explore the tensions surrounding female speech in Renaissance England by examining how women accused of adultery defend themselves in several plays, including Shakespeare's *Much Ado About Nothing*, *Othello*, and *The Winter's Tale*.

*My Dear Cannibal: Portraits from the Nixon Era Dioxide - Becky Martin  
Fine Arts - Dr. Erik Edison*

For my grant project I have created five large scale (30"x 45") portraits of prominent but troublesome figures of Nixon era America. These portraits are intended to be strange inversions of the portraits created by Yousuf Karsh, a photographer known for his depictions public heroes. For each drawing I have created a corresponding sonnet. The sonnets are not written in the traditional sense, but rather 'compiled' from various sources such as magazine articles, obituaries, interviews and other sources related to each figure. The poems are accompanied by 'bibliographies' that reveal the source material and allow the reader, if interested, to view the poems from a different vantage point. Each poem has been printed using the traditional method of letter press. Thank you!

*Executive Functioning: Examining the Relationship between the Iowa Gambling Task and Social Behaviours - Kiera Kent  
Psychology - Supervised by Dr. Garon*

A literature review was conducted examining the relationship between the Iowa Gambling Task (IGT), the emotional understanding of individuals, and prosocial behaviours. The IGT is a hot executive functioning task, which means that individuals need to plan ahead or use goal-oriented behaviour to perform well. A relationship of the IGT and social behaviours (such as prosocial behaviour and emotional understanding) has been an underdeveloped area of research; therefore, the aim of this review was to identify the limitations and examine areas that could link the existing literature. It was found that the ventromedial prefrontal cortex could be a link showing this relationship. I will conduct an experimental study in my Honours study in the upcoming year to further explore this research.

*Rogue Banking: Case Studies - Peter Dargie  
Math/Commerce - Supervised by Dr. Farooqi*

'Rogue Banking' describes any set of institutions or transactions utilized by pariah states in order to circumvent international financial sanctions. Such transactions take the form of monetary transfers, derivatives investments, capital purchases and commodity exchanges. Such a transaction is necessarily brokered and orchestrated by either a complicit or complacent financial intermediary. In either case, rogue banking operations are by nature highly subtle, however their importance to global economic and political regulation is becoming increasingly visible. This analysis seeks to equip the viewer with a foundational understanding of rogue banking practices by examining historic and contemporary examples.

## **Geography focus Oral Presentations (5:20–6:05 pm) AvarD Dixon G12:**

*Aiding the Shelterbelt Decision Making Process through an Internet-Based Program  
- Brian Mood  
Geography and Environment - Supervised by Dr. Colin Laroque*

A PHP: Hypertext Preprocessor (PHP) program was developed as one component of a large shelterbelt project based out of Saskatchewan for the Prairie Provinces. The goal was to develop a computer program that acts as a medium for conveying science to the end user, farmers. The internet-based program will allow users to view past (actual values from AD 1950 to 2010) and future (projected values from AD 2010 to 2100) growth of nine common shelterbelt tree species, in up to six regions, with three future climate scenarios through graphical visualizations. It will aid each individual farmer's decision making process and help them understand which species should be planted for optimal tree growth under differing future climate scenarios within their region of the Prairies.

*Hemlock Holmes: Tree Detective - Creating an Interdisciplinary Educational Resource Based on Tree Rings - Emily Hogan  
Geography and Environment - Supervised by Dr. Colin Laroque*

The "You and Your World" curriculum was developed by New Brunswick educators with the goal of promoting active, student-based learning in kindergarten through grade 2 classrooms in the subjects of science, social studies, and personal development. Still, educators of students in this age range have expressed a lack of programming to support first-hand interactions between students, the community, and the environment. This project explores the creation of a grade 2 book, a resource composed of four lessons and complementary detective activities that address prescribed curriculum outcomes. Concepts of environmental science, sustainability, conservation, and civil society within the context of their community are explored. The "book" itself is a multimedia endeavor including a textbook, classroom lessons, an outdoor activity workbook, and especially, a detective tool kit!

*A Case Study in Rural Economic Development - Meggie MacMichael  
Geography and Environment - Supervised by Dr. Michael Fox*

Rural Canada is vitally important to the nation, both economically and socially, but it faces challenges and opportunities that require policies and programs aimed at the development of rural places. Strategies for rural development have changed over time. This paper explores current trends in the rural economy and how they are addressed through rural economic development strategies. The development of the Debert Air Industrial Park in Nova Scotia is examined according to these trends. The research attempts to answer two questions; Is the planned development in Debert in line with current models for rural development or does it use traditional approaches and values? Is it likely that the development of the DAIP has and will benefit the community of Debert and Colchester County holistically?

## **Trivia and Award Presentations (6:05 – 6:30 pm) AvarD Dixon 118**

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