Carleton UNIVERSITY
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EUREKA!

NEWSLETTER OF THE FACULTY OF SCIENCE

Fall 2007

Digging for answers

- Unearthing fossils
- Ensuring food safety
- Funding early researchers

Carleton UNIVERSITY SCIENCE

The introductions

Welcome to the 2007 fall edition of *EUREKA!* It's with great pleasure that I write my first welcome to you, as the new dean of science. In doing so, I take up the reins from Jean-Guy Godin, the outgoing dean. To his credit, I find a youthful faculty of great positive energy and outlook. You will get a sense of this as you read through *EUREKA!* Please consider this an invitation to visit campus to deepen that taste of excitement and to reconnect with all that is happening in research, the learning experience, and connection to community at Carleton Science.

What do we want to be? Where do we want to go as a Faculty of Science? In consultation with each of the departments, schools and institutes, we have begun to answer these questions. We've had lively discussions about vision and objectives for the academic units and, of course, about history and past experiences. I have appreciated the respectful attitudes and the positive outlook in these sessions. Our goal is to have these discussions lead into a planning process that will guide our priorities and actions in the coming months and years. I am optimistic that a solid plan will develop each unit in distinctive and strategic ways that will be rewarded with the resources we need to ensure our continued success. I believe that we need to communicate effectively our accomplishments and plans within our Faculty, Carleton University and our off-campus communities. With the addition of Mandy Sinclair, our first communications officer, we can more actively tell our stories and celebrate our successes in a visible manner.

Behind the scenes, Yolana Junco, Faculty administrator; Julie Madsen, administrative assistant; and John Armitage, associate dean for undergraduate affairs, have been providing me with support and guidance in my first months at Carleton University, for which I am very thankful. I would like to introduce Mark Forbes, professor and Canada Research Chair in biology, as our new associate dean of research, and thank Jörg Sack for his past service in that capacity. I also welcome Tiffany Shields to the post of administrative assistant to the dean. Please come and say hello to the team whenever you are on campus.

I hope I've conveyed the tremendous excitement I feel in beginning my term as dean. The Carleton Science community—faculty members, staff, students and alumni—provides me with this feeling and a sense of optimism as we look ahead. This is a strong and caring community, and I look forward to working together to realize our plans. I welcome your participation in the active life of the Faculty and any comments you may have about Carleton Science today, and what it might become in the future.

George Iwama
Dean, Faculty of Science

EUREKA!
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Newsletter Mission Statement
EUREKA! is published for the alumni, faculty, staff, friends and partners of the Faculty of Science. The newsletter is intended to communicate the Faculty's goals, strategic direction and activities in order to connect alumni to each other and the university. It is published in collaboration with the Department of University Advancement.

On the cover
Michael Ryan with the holotype skull of the new horned dinosaur, *Albertaceratops nesmoi*.

Photo courtesy of Chad Kerychuk, Digital Dream Machine.

Your input is important!

Please send your feedback, letter to the editor or story ideas to newsletter_editor@carleton.ca.

Take our online survey
Visit eureka.carleton.ca to share your opinions.

The risky business of food safety

By Burton Blais, MSc/87, PhD/90

Breaches in food safety, such as the widespread cases of tainted pet food and bacteria-laden spinach earlier this year, focus our attention on what can go wrong with our food supply. There is simply no way to guarantee that the food we eat is entirely free of hazardous agents. To do so would require testing every morsel, leaving nought to eat!

Instead, Canadians take the more practical approach of focusing our precious resources on those food safety issues that represent the greatest risk to public health. This entails a close examination of the entire food production chain—from primary agricultural practices to the manufacturing, packaging and distribution of foods—to identify those nefarious agents with the potential to contaminate and harm. By identifying and controlling those points in the continuum where problems are likely to creep in, the degree of risk to the integrity and wholesomeness of the food supply can be mitigated.

When it comes to the safety of the food supply in the industrialized world, risk is continually changing. New microbial or chemical threats can arise due to natural evolution, climate change, the introduction of novel foods and changes in manufacturing practices. The globalization of trade in agricultural commodities and changes in consumer habits may also foster new risks. An example is the increasing demand for imported, ready-to-eat foods, such as fresh packaged salads and meats, which can develop critical levels of live pathogenic bacteria. Another factor is the practice of centralizing large-scale food manufacturing operations with broad distribution bases. In North America, where the majority of ground beef is processed in a handful of mega-plants, even a small amount of microbiologically compromised raw meat can contaminate an entire production lot with continent-wide distribution.

Many North American food manufacturers have implemented a systemic approach to reasonably assure the safety of their products. Developed by the Pillsbury Corporation and NASA to ensure the safety of the food for the first manned space missions, the widely used Hazard Analysis and Critical Control Point system allows food manufacturing operations to evaluate their systems for risks by identifying microbial or chemical hazards and monitoring the critical control points where these hazards can enter the process. The overall effectiveness of the system is often verified by testing representative portions of the end product for the presence of the hazardous substance that the system is designed to eliminate.

> "even a small amount of microbiologically compromised raw meat can contaminate an entire production lot with continent-wide distribution

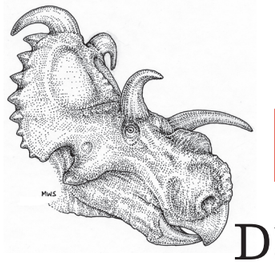
In addition, the safety of the food supply is enhanced through compliance with regulations aimed at ensuring that food products meet specific safety standards. To protect Canadians from preventable health risks, the Canadian Food Inspection Agency (CFIA) uses a risk-based inspection system with comprehensive inspection and testing activities to verify the food industry's compliance with standards. At the heart of the system is risk assessment, a scientific process that provides an estimate of the probability and severity of illness attributable to a particular hazard.

It all comes down to understanding the nature of the risk agent (Which pathogen are we dealing with? How "armed and dangerous" is it?) and the context in which it is encountered (What type of food product is it found in? How will the product be processed, distributed and handled by the consumer?). With this knowledge, it may be possible to predict whether its presence in a particular scenario constitutes a significant health hazard.

Of course, an important element in an effective risk-based inspection system is the research laboratories that develop the analytical technologies to detect food safety hazards and provide tools to characterize the hazards so that the degree of risk can be determined. For example, in the development of analytical methods for the detection of *Salmonella*, the CFIA is interested not only in quickly identifying the pathogen's presence in foods, but also in determining the presence of virulence factors—the toxins and proteins that enable it to colonize a human host—and the ability to resist antibiotics used in the treatment of infections.

In the course of developing new analytical technologies to meet the changing needs of regulatory inspection programs, CFIA laboratories frequently host university undergraduate and graduate students conducting their thesis research projects. Thus, these regulatory research activities provide an excellent venue for training the next generation of food scientists who can contribute to the development of effective strategies to control future threats to the safety of the food supply.

Carleton alumnus and former sessional lecturer Burton Blais is a section head at the Canadian Food Inspection Agency's Ottawa laboratory. His focus on the detection of food-borne pathogens has resulted in the application of novel techniques that increase the safety of food in Canada.



Dino hunter

During the Late Cretaceous Period, an *Oviraptor* sitting on a clutch of eggs, her feathered wings spread wide, was killed in a fierce sand storm. The sand that buried the flightless dinosaur also preserved her skeleton and eggs. This summer, vertebrate paleontologist Michael Ryan spent two months in Mongolia where he and his crew dug the skeleton and nest out of the cliff face that housed her for more than 70 million years.

"We saw eggshell and leg bones sticking out of the cliff and ended up recovering the skull," says Ryan, BScHons/80. "It's a thrill that never gets old."

Now the fossil sits wrapped in a plaster field jacket in Mongolia, awaiting transport and further study.

"The task at a dig is to get all the fossil out of the ground despite the harsh conditions and limited time. We always have more fossil specimens than our technicians have time to prepare," says Ryan, who is the curator of vertebrate paleontology at the Cleveland Museum of Natural History. His job—"to collect, research and present"—takes him out of the museum for months at a time, landing him at digs in Mongolia, North Africa, South America and China.

But it's his work in Alberta that has really made his name.

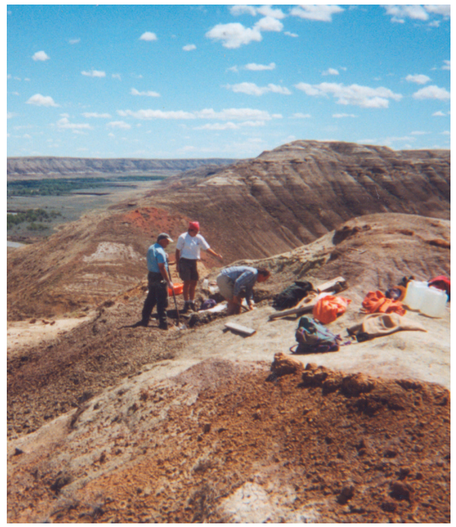
Ryan's fascination with dinosaurs was fostered by the original *King Kong* movie and the discovery that downtown Ottawa housed real-life monster bones. "I spent a lot of time in the Canadian Museum of Nature as a kid, and I noticed that all the dinosaur skeletons came from Alberta," says Ryan. "I knew I'd go there as soon as I was old enough."

After studying biology at Carleton—which he describes as the toughest years of his life, but which have served him well—Ryan headed to the University of Calgary for his graduate degrees and the chance to dig for dinosaurs.

In 2001, after four hot, dry summers spent searching for long-horned centrosaurs in southern Alberta, Ryan unearthed a new species of dinosaur. The skull he found is only the second horned dinosaur discovered in Canada since the 1950s. With long brow horns, a long, low bump in place of a nasal horn, and thick hooks that curl from the corners of the creature's frill, *Albertaceratops nesmoi* is a primitive member of the Centrosaurinae family. The plant-eating dinosaur lived more than 10 million years earlier than its small-horned relative *Triceratops* and sheds new light on the evolutionary history of the Ceratopsidae dinosaur family.

Approximately six meters long and weighing as much as a pickup truck, the dinosaur lived nearly 78 million years ago in what is now southernmost Alberta. It's a locale that Ryan feels has untapped potential.

"New regions offer the potential for new types of dinosaurs," says Ryan, who co-founded the Southern Alberta Dinosaur Research Group to help researchers coordinate their work with each other, government agencies and local residents. "We know of less than 10 per cent of the dinosaurs that lived, so as we move into less sampled areas, our knowledge will improve."



Michael Ryan named *Albertaceratops nesmoi* for Alberta, where it was discovered, plus *ceratops* (horned-face) and a patronym in honour of Cecil Nesmo, a rancher whose friendship and hospitality facilitated the collection of many paleontological specimens.

Sharing what he knows comes naturally to Ryan, who also earned a bachelor of education degree. As chief paleontologist for the Phaeton Group, a science and media organization that unites experts in natural science, history and exploration, Ryan runs dinosaur digs for multi-disciplinary groups, training students and amateurs alike. His involvement with Phaeton has also seen him consult for comic books and the film industry—he relocated the lost Star Wars filming locations in Tunisia for Lucasfilm.

"I'm as happy in pop culture as I am in the science world," says Ryan, who turned down a spot in animation at Sheridan College to study biology. As it turned out, he spends a lot of time drawing in science, enhancing features of bones and visualizing life from rock. The true test of his decision was the field work.

"The more advanced your degree, the more time you spend digging holes in the ground, or so it seems. If you don't like back-breaking labour in the hot sun, this is not the profession for you—but it can be incredibly rewarding," says Ryan. To make the thrill of field work more accessible to students, he is working with the Department of Earth Sciences to develop a field course at Carleton.

"Carleton students have access to a premier collection of vertebrate fossils housed at the Canadian Museum of Nature. It's a fantastic resource," says Ryan, who is a research associate there as well as the Royal Tyrrell Museum of Paleontology in Drumheller, AB. "Now students need the chance to walk onto a field site, to find material. That's when you know if you've picked the right job."

For a scientist who has discovered two new dinosaur species and is currently working on describing a third, the job was a perfect fit.

"I have the job that I wanted as a kid, and it's even better than I imagined."

For more information on the Southern Alberta Dinosaur Research Group and the Phaeton Group, visit dinoresearch.ca and phaetongroup.com.

Student Aaron Phillips, foreground, collects samples from bone beds on what was the eastern shore of the Western Interior Seaway. After slowly dissolving the rocks in acid, he was left with a jumble of thousands of teeth and bone fragments to sort under the microscope. Charlie Underwood, from the School of Earth Sciences, Birkbeck College, University of London, is in the background.

Rock bottom:
Fossils from the sea floor

Piecing together the history of the planet is pain-staking work. Earth scientists work backward through millions of years, relying on fragmentary evidence damaged by the ravages of time. But each discovery adds to the understanding of how the Earth was formed, populated and continues to change.

Master's student Aaron Phillips' piece of the puzzle is the ancient remains of an inland sea that once covered Canada's prairies. During the Cretaceous Period, one of the warmest time periods on Earth, there were no ice caps and sea levels were high. North America was cut in two by the Western Interior Seaway, stretching from the Arctic Ocean to the Gulf of Mexico. The Rocky Mountains were rising up on the west side of the seaway, causing a down warp of the continent. The sea's shallow eastern shore, now the Manitoba Escarpment that straddles the border with Saskatchewan, would have experienced dramatic alteration as sea level changes covered or exposed huge amounts of land.

To deduce what was happening to the seaway, Phillips, in cooperation with researchers from Carleton and the Canadian Museum of Nature, is examining the marine bone beds formed 97-95 million years ago that riddle the eastern shore.

"It's a potpourri of fossil animals," says Phillips. "Fragments less than one or two centimetres in size from numerous species of sharks, bony fishes, plesiosaurs, occasional turtles and toothed, flightless birds are all jumbled together."

The concentration of bones and teeth at Phillips' site, and the lack of non-biological material, makes it unusual—and intriguing. In order to understand the ecosystem and geological processes at work, Phillips must first figure out what's there, how it got there, and what the accumulation of bones means to the big picture of the sea.

"Although there is no modern analogue for the seaway, it's easy to imagine that sharks were eating fish since predators play the same role in any ecosystem," says Phillips. "The challenging part is understanding why the bones accumulated in such dense concentrations. What was happening in this sea to create this deposit?"

By measuring and describing the shape, size and condition of more than 3,000 specimens, Phillips is teasing out which features can tell him how they were deposited. Surprisingly, the bone beds Phillips is investigating are all biological in origin. What appeared to be sand holding the bones and teeth together was revealed under the microscope to be calcite derived from the shells of giant clams.

"There's no sand mixed in, so there was no erosion bringing in material from the land," he says. "There is also little evidence of reptiles and no fish that ate hard-shelled prey, so I need to account for their absence."

Were these animals not living in the habitat, or were their bones excluded from the deposit by the conditions of the sea? Since water can sort out particles of different sizes, the homogeneity or diversity of the bone beds could reveal the energy and action of the seaway.

"The deposits were created by repeated, rapid changes in sea level," says Phillips. "At the best of times the water here would have been quite shallow, and bottom water conditions weren't terribly hospitable to life. Yet, we see that the fauna is quite diverse. The bigger questions then are: how did life thrive here in spite of this difficult, changing environment? How do these sites compare with contemporaneous ones from elsewhere in the seaway? What can we learn about the history and impact of sea level changes in this era of well-documented global warming? These are just some of the questions we'll keep working to answer."

ENTREPRENEURASAURUS

"With talking dinosaurs one can never get too serious," says Ryan North, BCSHons/03, who chose dinosaur clip art over astronauts for his online, fixed-art comic.

Unable to draw, the computer programmer settled on static panels featuring T-Rex and Utahraptor, opting to change only the dialogue.

Originally created for a Sprott School of Business class on entrepreneurialist culture, *Dinosaur Comics* has blossomed into a full-time job and business for North.

You can check out *Dinosaur Comics* at qwantz.com.

Fast track

When Phil Trinh graduated from an Ottawa high school with a 99 per cent average, he had already co-authored two scientific papers. Even for an accomplished student, it's remarkable that Trinh earned his undergraduate degree—with a perfect grade point average—and master's degree in mathematics in only three years.

Trinh, MSc/07, is now pursuing a doctorate in applied mathematics at Oxford University, where he earned the Clarendon Fellowship, which pays his fees in full and provides a living stipend. To take the Clarendon Fellowship, Trinh turned down five other significant scholarships, including a Commonwealth Scholarship and Carleton's Gary S. Duck Graduate Scholarship in Photonics, Mathematics and Physics.

Trinh's master's thesis on non-linear wave interaction has applications in optics, photonics and the physics of plasmas. A teaching assistant and vice-president of the Carleton University Math Society while at Carleton, Trinh hopes to return from England to work as a summer instructor at his *alma mater* while completing his degree.

Summer science

Ossama Abouzeid plans to return to the Enriched Xenon Observatory (EXO) experiment next summer. Working on small EXO projects during the academic year will keep him up to date on the experiment's progress.

Prying out the secrets of the universe is no easy matter, especially when neutrinos are involved. The elementary particles travel close to the speed of light, lack an electrical charge and can pass through ordinary matter almost undisturbed—making them difficult to detect and hard to study. Yet, determining the mass of the neutrino could be essential to our understanding of the origins of matter and the fate of the universe.

"Neutrinos have mass, but no one yet knows what it is," says undergraduate student Ossama Abouzeid. As one of the first recipients of the Science Faculty Summer Research Internship, Abouzeid worked with Assistant Professor Kevin Graham on the prototype phase of an experiment attempting to measure the mass of the neutrino and determine its nature by observing the rare process of neutrinoless double beta decay of xenon into barium.

Carleton's portion of the Enriched Xenon Observatory (EXO) experiment, led by Stanford University, uses gaseous xenon. The prototype under development should improve the energy resolution of the two electrons resulting from the decay. To that end, Abouzeid worked on a simulation program to determine the best way to collect information on ionization and measure scintillation light.

"I expected to be in the background, but I was given the chance to really contribute to the project," says Abouzeid, who mastered a new programming language and learned to use the necessary software. "There was a steep learning curve, but I never felt in over my head because the supervisors were fantastic."

Designed to give students an opportunity to put classroom theory into practice, the privately funded summer internship program exposes undergraduates to intense research projects. "I saw what physics is like academically at a higher level," says Abouzeid, who has a passion for teaching. "The experience has encouraged me to carry on studying physics. Perhaps I'll teach at the university level."

For the birds

With up to 80 per cent of northern shorebird populations declining, the research of Paul Smith on the ecology of Arctic shorebirds, the factors that limit breeding and the influence of environmental change is urgently needed. Smith, a PhD candidate in biology, was recently named one of Canada's most promising northern scholars and was awarded one of five inaugural Garfield Weston Awards for Northern Research for his project.

"This scholarship will allow me to continue my work to improve our knowledge and understanding of the situation," says Smith. "I take pride in knowing that my work contributes to conservation and raising public awareness."

Smith is among the first five doctoral students to receive the scholarship, valued at $40,000 over two years. For 2006-2007, he also received the J.H. Stewart Reid Memorial Scholarship and the Orville Erickson Memorial Scholarship.

Faculty "frosh"

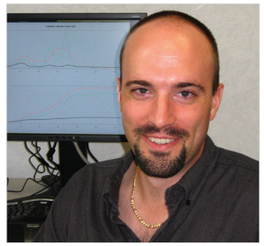
A leader in discovery and innovation, the Faculty of Science is committed to ensuring an outstanding learning experience for its students. Here's what the newest tenure-track teachers and researchers in our dynamic faculty are working on.

Brian Cousens, assistant professor, Department of Earth Sciences

Cousens has been part of Carleton's Isotope Geochemistry and Geochronology Research Centre since 1992, providing isotopic analyses for researchers in Canada and internationally. In 1996 he became a research adjunct professor and has held a Natural Sciences and Engineering Research Council grant ever since. Now, as assistant professor, Cousens and his students can expand research programs in igneous petrology and isotope geochemistry, particularly in recently active volcanic areas in northern California and Nevada, active volcanoes on the ocean floor off the west coast of North America, and billion-year-old volcanic belts in northern Canada including the Yellowknife Greenstone Belt. These rocks record how the Earth's mantle and crust have evolved chemically over geologic time, as well as how volcanic activity is related to the formation of economic metal deposits.

Minyi Huang, assistant professor, School of Mathematics and Statistics

In many socio-economic and engineering systems, it is common to have a large number of agents participating in decision-making, each with its own objective yet interacting with the overall population. For studying such models, game theory provides an ideal framework; however, complexity is a fundamental difficulty to finding meaningful solutions. Huang's research develops low-complexity optimization methodologies by exploiting the relationship between an individual and the population, and forecasting population behaviour. This approach has intimate connections with physics in studying interacting particles. To develop applications for information processing in wireless sensor networks, Huang is also working on coordination and computation with networked agents, each communicating with a small number of neighbours—such as in schooling fish and flocking birds—to investigate how the agents can cooperatively learn in a noisy environment.



Jason Nielsen, assistant professor, School of Mathematics and Statistics

The study of recurrent event data, such as that gathered on the repair history of manufactured items, the migration patterns of birds, or patient health over a period of time, can help identify cause and effect, make predictions and show the effect of treatment or intervention. Nielsen, active in interdisciplinary collaboration in health statistics and environmetrics, is particularly focused on estimating and inferring the underlying functional mechanisms assumed to be generating the data without resorting to strong parametric specification. He is also interested in mixture distributions and their application in regression analysis as they are fundamental to modeling complex data. Because estimation is intrinsically challenging in fitting such models to data, he has become fascinated by computational methods, particularly global optimization strategies.

George Iwama, dean, Faculty of Science; professor, Department of Biology

In his first appointment away from an ocean, Iwama began his six-year tenure as dean in July. Most recently the acting vice-president academic at Acadia University, Iwama served as the dean of science there from 2004-2006. Prior to that, he spent four years as director general of the National Research Council's Institute for Marine Biosciences in Halifax and as the first director general for the National Research Council's latest institute for nutrisciences and health. Before he headed east, Iwama spent 15 years as a professor at the University of British Columbia.

Iwama's research on the physiology of stress in fish—particularly heat shock proteins and their relationship with stress hormones—examines the effects of the stress response on health and adaptation to environmental change. While Iwama's studies have involved fishes around the world, he also works with aquaculturists to help identify and mitigate fish stress.

Susan Bertram is preparing to eavesdrop on crickets.

Listen carefully

In the summer of 2008, researchers at Carleton University will begin eavesdropping on up to 100 singing insects, recording and analyzing their mating songs and signalling. This acoustic voyeurism will help Assistant Professor Susan Bertram answer a fundamental question in evolutionary biology: what maintains the underlying variation in traits that influence lifetime reproductive success and survival?

With funding from the Canada Foundation for Innovation, Bertram's state-of-the-art Behavioural Acoustic Research Facility is being established in the Nesbitt Biology Building. Equipped with the tools necessary for an integrated approach, Bertram aims to reveal the mechanisms underlying variation in insect acoustic signalling behaviour by examining bioacoustic, genetic, behavioural, physiological and ecological factors.

"This level of data collection would have been unheard of even two years ago," says Bertram. "Being able to collect data on so many individuals simultaneously will enable us to fully quantify the heritable components of fitness enhancing behaviours and determine how variations in the environment influence insect reproductive systems."

The Behavioural Acoustic Research Facility will be used to train undergraduate and graduate students, thereby increasing the pool of highly qualified research personnel in Canada, and the research on insect reproduction will have applications for pest management and conservation biology.

! Fast fact...

The ability to make calibrated acoustic recordings of multiple field crickets simultaneously is crucial to the research program. Microphones will record each signal and software will analyze the signals in real time. Data acquisition hardware and software will coordinate play-back experiments, and speakers will broadcast sounds to which the insects will respond.

Digging deeper

Physicists are burrowing deeper into critical and fundamental questions behind the origin of the universe and the nature of matter—and deeper into the Earth.

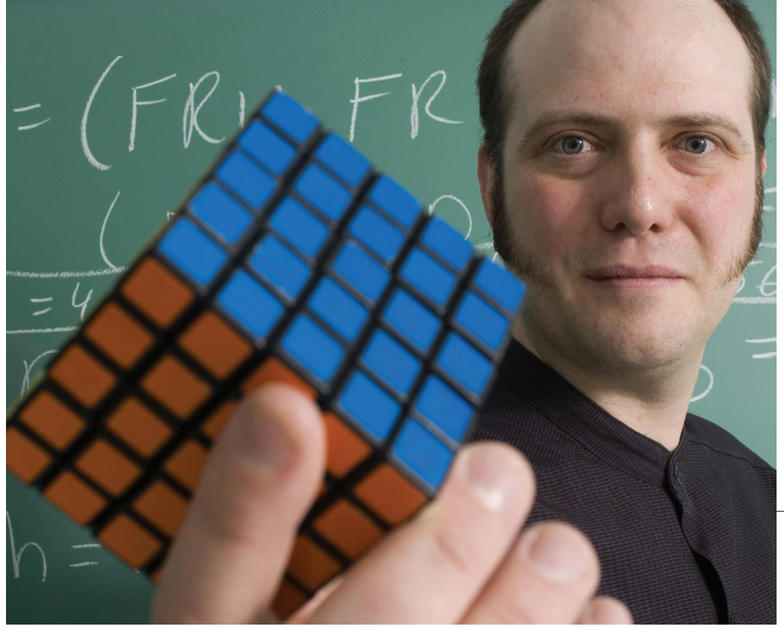
The Ontario Research Fund and the Northern Ontario Heritage Fund allocated $8.73 million to expand SNOLAB, the permanent underground research facility being constructed two kilometres underground in CVRD Inco's Creighton Mine in Sudbury, ON. The world's foremost underground lab for particle physics and astrophysics research will be expanded to include a cryopit: a large cavern to store the low-temperature liquids and gases needed to conduct large-scale cryogenic experiments for the next generation of research into dark matter particles.

Administered by Carleton University, the SNOLAB collaboration involves a number of Canadian universities and international partners. By finding new ways to view elusive dark matter particles, SNOLAB researchers hope to learn new information about what the universe is made of and what holds it together.

! Fast fact...

The Sudbury Neutrino Observatory team discovery in 2001 that solar neutrinos change into other neutrino types on their way to Earth was ranked the second most important scientific breakthrough in the world by the international journal *Science*. SNOLAB researchers continue to search for previously undetected components of the dark matter thought to make up about one-quarter of the universe, as well as new properties of neutrinos.

George Iwama, dean of Faculty of Science; Northern Development and Mines Minister Rick Bartolucci; and SNOLAB Director David Sinclair at the August cryopit announcement in Sudbury, ON.



Brett Stevens uses algebra to solve the Rubik's Cube. He's also using math to improve software testing.

Research programs get a boost

Building a research team of graduate students, post-doctoral fellows and research associates, setting up and equipping a laboratory, and conducting cutting-edge research doesn't happen overnight—or without money.

Five promising researchers in the Faculty of Science got an infusion of funds from the province's Early Research Awards program, designed to give promising, recently appointed Ontario researchers a running start.

For Brett Stevens, an associate professor in the School of Mathematics and Statistics, the award means he can expand his research team and improve the financial support he provides to his current students.

"I can support my master's students at the level they deserve," he says. "I've also been able to hire a post-doctoral fellow to bring more expertise to the team, and I hope to recruit a PhD student."

For software and hardware developers, bringing new products to the marketplace error-free is critical to success; companies spend a great deal of time and money on testing. Stevens' research project, to develop new mathematical methods that will improve the speed and efficiency of software testing, is based on a covering array that samples the range of inputs and contexts a program might encounter. To bridge the mathematical theory to the software tester, Stevens' team is developing interface modules that can plug into an open source code project developed by colleagues at IBM Israel.

"The students are building the modules and changing the covering array in response to feedback from the software people. The project becomes even more mathematically interesting as it becomes more practical," Stevens says.

Shelley Hepworth

The awards are also supporting the work of David Asner, an assistant professor in the Department of Physics, who is conducting a feasibility study and conceptual design for a new high luminosity particle collider that will enable significant advances in the area of particle physics.

Steven Cooke

Shelley Hepworth is discovering more about the genes responsible for plant organs and how they contribute to diversity in plants. The assistant professor's work will help people who cultivate flowering and ornamental plants breed new varieties and generate technology transfer to Ontario's agricultural biotech sector.

Developing efficient sets of rules for solving problems in a finite number of steps called algorithms can solve problems involving massive amounts of data. The algorithms of Pat Morin, associate professor in the School of Computer Science, will make it feasible to perform previously impossible analyses.

Steven Cooke, assistant professor in the departments of Biology and Environmental Studies, is focusing on understanding the fate of fish released by anglers in order to develop strategies that reduce their injury, stress and death. His ultimate goal is to ensure the sustainability of recreational fisheries.

Read more about the research of Shelley Hepworth (fall 2006), Pat Morin (spring 2007) and Steven Cooke (spring 2006) online at eureka.carleton.ca.

Must be something in the water

Birds sing. Painters paint. Researchers research. It's what they do. It is why, despite retiring in 1991, Chuni Lal Chakrabarti is still in his office and lab in the Steacie Building today.

With 42 years of continuous research funding from NSERC, Chuni Lal Chakrabarti was awarded an additional five-year grant in March 2007.

"Retirement is a dirty word," says the distinguished research professor, who displays the motto *Aut invenium viam aut facium* (I shall either find a way or make one) in his laboratory. "It means you relinquish your responsibilities. I merely stopped drawing a salary from the university."

Chakrabarti now supervises four graduate students; his research laboratories in the Department of Chemistry have been designated a National Centre of Excellence as part of the Canadian Water Network; and his research project on kinetic control of metal biouptake in natural waters recently received funding from the Natural Sciences and Engineering Research Council (NSERC) for five years. In fact, Chakrabarti's research has received continuous funding in Canada since 1965—when he joined Carleton's chemistry faculty.

"It is a gamble for the government to invest in environmental research," says Chakrabarti, "but it is weighed against the potential benefit to society. I am willing to take the risk."

Chakrabarti's research could improve the health of aquatic organisms and humans by better predicting toxicity. Because of their versatility in a variety of chemical reactions, many trace metals are essential micronutrients in biological systems. However, their reactivity can also lead to toxicity even at relatively low levels. Currently, potentially toxic levels of metal, such as those from mine effluents, are measured in natural waters using a method that presumes chemical activities or concentrations have no net change over time. However, this chemical equilibrium is often not achieved in dynamic water systems, resulting in erroneous estimates that have health, environmental and economic consequences.

Chakrabarti is working on a prediction model that uses knowledge of the metal distribution among the different physical and chemical forms—the actual chemical speciation—instead of the presumed chemical speciation based on the local equilibrium assumption. His kinetics-based approach offers a more precise tool for regulatory agencies.

"The creativity of research motivates me," says Chakrabarti. "It is natural to seek fulfillment. You don't ask a nightingale to sing—it does it to cheer up in its solitude. I don't have to be asked to do this, I find fulfillment here."

Parting ways for particle physicist

At the Ottawa-Carleton Institute for Physics Christmas Symposium in 2006, Richard Hemingway presented an overview of his 50 years in physics. Among photographs, a telegraph of his first job offer in the field, and remembrances of people and projects past, Hemingway included a retirement prayer: "God, grant me the senility to forget the people I never liked anyway, the good fortune to run into the ones I do, and the eyesight to tell the difference."

Given the unusually large number of former colleagues in Europe and North America with whom he maintains warm and strong friendships, Hemingway is not likely to need the prayer answered.

When he retired from his positions as honourary research professor in physics at Carleton University and senior research scientist of the Canadian Institute of Particle Physics on July 1, Hemingway left a career that spanned countries as well as decades. A member of the Carleton particle physics group since 1977, he was a leader in the development and strengthening of particle physics research at the university and throughout Canada.

During his time at Carleton University, Hemingway participated in three major particle physics projects: studying the properties of a class of mesons containing a strange quark at the Stanford Linear Accelerator Centre; leading collaboration work on software development, data analysis and physics analysis at the 21-year OPAL project at the CERN electron-positron collider LEP; and leading the Carleton University group investigating solar neutrinos at the Sudbury Neutrino Observatory (SNO).

The OPAL measurements tested and confirmed current theories of the electroweak and strong interactions to extraordinary precision, and set the stage for the next generation of Large Hadron Collider experiments at much higher energy. The SNO experiment showed that neutrinos produced in the sun's core oscillate to a different flavour of neutrinos by the time they reach terrestrial detectors. This solved an important and perplexing 30-year-old scientific problem concerning neutrinos and how energy is generated in the sun. Hemingway continues to work at SNOLAB, to answer critical and fundamental questions behind the origin of the universe and the nature of matter.

Along with other members of the SNO collaboration, Hemingway received the award of the inaugural Polanyi Prize in 2006 and the Benjamin Franklin Medal of Philadelphia's Franklin Institute in 2007.

With files from Carleton Now.

Serving up food science and nutrition

Stop and consider what's on your plate tonight. Is the food nutritious? Was it genetically modified to withstand pests? How was it preserved and protected from decay and micro-organisms? Has it absorbed toxins? Suddenly, there's a whole lot more to dinner.

Students in a new honours Bachelor of Science program will tackle those questions and more when the program in food science and nutrition begins in September 2008. Drawing on Carleton University's chemistry and biology departments and the Institute of Biochemistry, the program also adds statistical modelling courses from the Faculty of Public Affairs to create a unique program of study with a solid science base and an emphasis on assessment, management and communication of risk in food safety.

"The food industry needs people who are knowledgeable scientists and who are able to assess risk and formulate policy," says Bob Burk, BSCHons/80, MSc/82, PhD/91, chair of the Department of Chemistry. "This will be the first food and nutritional science program in Canada that provides this depth in the science and in the economic, risk assessment and policy areas."

After a general science first year, enrolled students—expected to number 30 each year—will take courses such as principles of nutrition, food chemistry, analysis, packaging, engineering and microbiology, quality control, and regulation of the food industry. After graduation, they'll be poised to fill the demand for food scientists in Canada's food industry.

A nobel pursuit

On December 10, Peter Grünberg will be presented with the 2007 Nobel Prize in Physics. He will share the honour with Albert Fert, as both men independently discovered giant magnetoresistance (GMR)—that the electrical resistance of thin magnetic layers can be greatly changed through external magnetic fields.

While ubiquitous laptop computers and MP3 players today use GMR to read magnetic bits and bytes, Grünberg had not yet discovered the effect that allows hard disks to be miniaturized when he came to Carleton in 1969. As a postdoctoral fellow of the National Research Council of Canada, Grünberg worked for now-retired physical chemistry professor J. Arnold Koningstein until 1972. The pair was using a laser to excite an ion in crystals, and studying the small steps by which the ion switches to a higher level of energy. It wasn't until 1988 that Grünberg discovered GMR.

The Royal Swedish Academy of Sciences said in its citation that Grünberg's contribution "can also be considered one of the first real applications of the promising field of nanotechnology."

Getting engaged

George Iwama is on a mission to engage science alumni. The new dean of science wants you to get involved in the faculty that gave you your start: attend events, provide career advice and mentoring to current students, be an ambassador for Carleton Science and connect with other alumni.

In November, Iwama travelled to British Columbia as the featured Faculty of Carleton University Speaker (FOCUS) for the Victoria and Vancouver branches, hosted by the Carleton University Alumni Association. In addition to talking about his research on the physiology of stress in fish, he had the opportunity to meet alumni and share his vision for Carleton Science. A soon-to-be-launched Science Café (in local coffee shops, of course) will bring research to life and help people understand the hot issues in science.

In Ottawa, Iwama is planning a winter meet-and-greet event for alumni. This is your opportunity to meet the dean and learn more about how you can get involved in alumni activities.

Check alumni.carleton.ca and www.carleton.ca/science for event details. To get involved, contact Heather Theoret, alumni coordinator, at heather_theoret@carleton.ca or 613-520-2600, ext. 2273.

! Upcoming events

CARLETON UNIVERSITY ALUMNI REUNION WEEKEND

See you at CU!

Graduates from the classes of 1958, 1963, 1968, 1978, 1983, 1988 and 1998 are invited back to campus for **Alumni Reunion Weekend**, May 23-25, 2008. Visit carletonreunion.com for details.

Online job postings

A new tool in the **Carleton Café** gives job seekers and employers a new way to connect, free of charge. Students and alumni can search for career opportunities, internships and part-time work, while employers can tailor their postings to programs and majors. It's just one more way the Carleton University Alumni Association and the Career Development and Co-operative Education Office are helping you make a career connection.

myCareer

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