Advancing Research
and Teaching in the
University of British Columbia
Faculty of Science

UBC Science Synergy
issue 6.2
spring 2001

Manipulating Waxes and Oils in Plants

By studying the mechanisms of wax and oil production in plants and genetically manipulating their fatty acids chains, Ljerka Kunst hopes to produce hardier, more drought-resistant crops, and novel, locally-produced seed oils for industrial applications.

Botany Professor Ljerka Kunst uses forward and reverse genetics to determine which enzymes are involved in the synthesis of waxes and oils in plants.

All land plants produce a thin wax coating on their stems and leaves as protection from drought, UV-light, insects, and other pathogens. Unravelling and altering the complex array of enzymatic reactions involved in wax production is an integral part of plant geneticist Ljerka Kunst's research.

Most plant lipids and membranes are composed of 16- and 18-carbon fatty acids. However, in some cells, these fatty acids are elongated to between C24 and C34 lengths. These very-long-chain fatty acids (VLCFAs) are the precursors of wax biosynthesis. VLCFAs are formed by a process called microsomal fatty acid elongation, which involves sequential addition of 2-carbon units to C18 fatty acid chains. Each cycle of elongation involves four enzymatic reactions. The condensing enzyme that catalyzes the first step in the complex dance along the biosynthetic pathway is key to determining the chain length of the VLCFA products in each cell. "And the length of the fatty acid carbon chain is central to its function as a component of plant membrane lipids, seed oil, or surface waxes," notes Kunst.

Using the process of reverse genetics on the plant model *Arabidopsis thaliana* (related to canola), Kunst and her lab discovered the condensing enzyme involved in wax synthesis, which they call CUT1. By manipulating this condensing enzyme they were able to alter the processes of elongation and wax production. However, it also has other consequences. "If you over-express a rate-limiting enzyme like CUT1, you expect to get more wax on plant surfaces—and we did," says Kunst. However, when the enzyme was over-expressed far above normal limits, the plant cells destroyed the messenger RNA for that particular gene. The phenomenon, called co-suppression, resulted in a waxless plant.

The Kunst lab also discovered that co-suppressed CUT1 plants produced waxless pollen grains. As a result, CUT1 plants were

cont'd on p. 3

Inside

Life Sciences
Botany
Microbiology & Immunology
Zoology

Mathematics & Information Sciences
Computer Science
Mathematics
Statistics

Physical Sciences
Chemistry
Earth & Ocean Sciences
Physics & Astronomy

Biotechnology Lab

ß-Lab pioneers Bioinformatics & Algorithmics

Advances in molecular biology and genomics have spawned a new field of research. Bioinformatics focuses on computational approaches to problems such as sequencing the genome, predicting the structure of biomolecules, or determining phylogenetic relationships between organisms—problems that require significant new developments in algorithms and databases. Computational biology, algorithmic and complexity theory research will be brought together in UBC's newly formed Bioinformatics and Empirical & Theoretical Algorithmics Laboratory (ß-Lab). "While much of the bioinformatics work involves understanding the data that nature gives us, another trend is to compute and build nano-structures in a programmable fashion at the molecular level," says lab co-founder Anne Condon, who has pioneered work in DNA computing.

Holger Hoos, Computer Science colleague and also lab co-founder, says one of ß-Lab's goals is to facilitate complementary theoretical and empirical approaches to algorithm research. "There has been a huge gap between what we can do well theoretically and what we can do empirically, without a full understanding at the mathematical level why some of these algorithms actually do what we want them to do," he notes. "Few bioinformatics groups in the world are taking this direction."

Other members of the ß-Lab include computer scientists Will Evans, David Kirkpatrick, Nick Pippenger, and adjunct members Alan Mackworth and Raymond Ng (Computer Science), Tim Menzies (Electrical and Computer Engineering), Richard Anstee and Joel Friedman (Mathematics), and Maria Klawe, Dean of Science. Collaborative projects with researchers from biochemistry and molecular biology have recently been initiated. The ß-Lab was funded by UBC, the Computer Science department and a $101,000 grant from the Canada Foundation for Innovation. The group also expects to receive matching funding from the province.

Liquid Mirror Telescope Makes Waves

Paul Hickson

In the age of quantum cosmology, UBC astronomer Paul Hickson has been making headlines with a telescope designed on Newtonian physics. The idea is simple enough: fill a slightly concave, parabolic container with liquid mercury and spin it at high speeds until the mercury spreads out to form a thin layer over the surface. The resulting Liquid Mirror Telescope (LMT) is an accurate, and much less costly ($500,000 versus $92 million), alternative to conventional telescopes for the study of certain phenomena, such as observing stars and galaxies, tracking space debris and atmospheric research. "The liquid mirror has to rotate about a vertical axis, so the shape is ideally suited for looking at things that are directly above it," Hickson says.

Hickson has been working in collaboration with Ermanno Borra at Laval, Valerie De Lapparent of the Institut d'Astrophysique de Paris, and Gordon Walker, professor emeritus at UBC. Undaunted by initial lack of funding for a site, Hickson built the first 2.7-meter LMT in his backyard. Eventually, NASA got wind of the project and commissioned a 3-meter telescope for tracking particles of space debris that are too small to be detected by radar. "Bits of boosters, nuts and bolts, and even flecks of paint have the impact of a rifle bullet when travelling at 7 km/sec," notes Hickson. A similar telescope in Alaska observes faint echoes of laser light reflected back from molecules and particles in the atmosphere in order to determine its composition and density, as well as temperature and wind speed.

With funding from NSERC, Hickson and his team are building a 6-meter LMT to be installed this summer. The scaled-up telescope will allow them to probe further into the past to study the composition and evolution of galaxies. They will also be able to search for asteroids that are calamitously close to earth. Their next project, now in the planning stage, is to build the world's largest telescope using liquid mirror technology. (Watch for updates in upcoming issues of Synergy)

UBC Mathematicians Sweep CMS Awards

The Canadian Mathematical Society (CMS) recently awarded its three top prizes to UBC mathematicians. Edward Perkins received the 2002 CMS Jeffery-Williams Prize for his pioneering work in the application of non-standard analysis to probability theory. He is a world leader in the study of superprocesses and the space-time behaviour of super-Brownian motion. Recently, with Richard Durrett (Cornell) and Theodore Cox (Syracuse), he has *cont'd on p. 3*

Professors Emeritus win Accolades

Oceanography professor emeritus Timothy Parsons became the first Canadian to win the Japan Prize. The 50 million yen ($685,000) award is Japan's equivalent to the Nobel Prize. Indeed, the distinguished list of past recipients includes five Nobel laureates. Parsons was honoured for his career contribution to fisheries oceanography and he is credited for influencing a new school of holistic ocean scientists and managers. The award was presented at a ceremony in Tokyo this April.

Fellow fisheries researcher and professor emeritus of Zoology, Tom Northcote was presented the Naumann-Thienemann Medal from the Socitas Internationalis Limnologiae, which is considered the highest honour in global limnology (the science of lakes and inland bodies of water). Northcote received the award for his contributions to limnology and salmonid biology, his interdisciplinary approaches to solving practical water problems, and his careful nurturing of students.

Professor emeritus of Botany GH Neil Towers received the 2000 Pergamon Phytochemistry prize for creativity in plant biochemistry. The $5,500 US prize recognizes his work in medicinal phytochemistry, ethnopharmacology, photobiology, and chemical ecology relating to plants, fungi and insects.

Mathematicians; *cont'd from p. 2* made a very exciting link between particle systems and superprocesses.

Priscilla Greenwood, professor emeritus in Mathematics, was named the winner of the 2002 Krieger-Nelson Prize for outstanding research by a female mathematician. Her interest in the applications of probability and statistics, particularly the statistics of general stochastic processes, led to her leadership of a large interdisciplinary research project at UBC (1997–2000). The project was funded by the Wall Institute and involved scientists in mathematics, geophysics, psychology, zoology, and physics.

The CMS Coxeter-James Prize recognizes young mathematicians who have made outstanding contributions to the field. Kai Behrend won for his work in algebraic stacks and the geometry of moduli spaces of stable maps. This has become one of the most important areas in algebraic geometry because of the unexpected predictions made by physicists working on string theory.

Ljerka Kunst; *cont'd from p. 1* male sterile when grown at 30 to 40 percent humidity, but exhibited normal fertility when the humidity was raised to 80 to 90 percent. The trait of conditional male sterility is favoured by seed producers to encourage cross-pollination and to control seed production. Although restoration of fertility is very difficult in most sterile plants, Kunst's genetically modified *Arabidopsis* plants simply require increased humidity to produce seed. "You can change the sterility of different segments of a plant merely by moving it from low to high humidity during growth, so it is very tightly controlled," she notes.

Kunst is also interested in modifying wax composition to make plants less palatable to insects. "Now we have the tools—the genes and the promoters—to change these specific traits without altering the rest of the plant." Given the uncertainties agriculture faces in light of global climate change, her work is both timely and prescient.

Designing Better Industrial Oil Seeds

For most people, agriculture is synonymous with food crops, but many plants are grown for industrial purposes. For example, there is a huge market for castor oil, which is rich in hydroxy fatty acids. The US alone imports 35,000 to 50,000 tonnes per year (at roughly $750 US a tonne). It is used in hydraulic fluids, waxes and polishes, and for the manufacture of nylon and polyurethane. Castor oil contains almost 90% ricinoleic acid and is one of the few plants to store hydroxy fatty acid in its seed oil. However, it is highly allergenic, very toxic, difficult to grow, and must be harvested by hand.

"People who pick and peel the castor seeds get terrible allergic reactions on their hands," says plant scientist Ljerka Kunst. And ricinoleic acid may not even be the best hydroxy fatty acid for certain applications. "It always makes a polymer with certain properties because the hydroxy group is always on position 12 of the carbon chain," she says. By elongating the chain so the hydroxy group is in position 14 or longer, Kunst and colleagues hope to provide the chemical industry with a new range of oils that could make more flexible, elastic materials. "With our collection of condensing enzymes we should be able to move the hydroxy group from C12 to C16 and all the way down the chain," says Kunst. She is working with Vancouver-based Linnaeus Plant Sciences to develop interesting new compounds for industrial applications.

"The more difficult thing will be to figure out how castor seeds accumulate such high levels of hydroxy fatty acid so that we can eventually engineer local, more benign oilseed crops that efficiently produce these compounds."

Dynamics of Changing Environments

Why are some species common and others rare? What happens when introduced organisms invade new habitats, and what is the best way to control them? These are the questions that fascinate Professor Judy Myers and motivate her research in population dynamics.

EVOLUTIONARY THEORY IS BASED ON OBSERVING the nature of change over millennia. Yet changes in habitats and species can occur within decades or even years. Fluctuations in the populations of small mammals and insects occur naturally, yet are not well understood. And the introduction of exotic species into environments can drastically alter native species and habitats. Population ecologist Judy Myers is working to understand what causes these natural fluctuations, and what can be done to control introduced pests.

As a female science student in the '60s, Myers herself was a member of an exotic species. Even in 1970, as the first woman biologist to receive the prestigious Miller Post-doctoral Fellowship at Berkeley, she was not allowed to participate in the faculty's all-male natural history group. She was hired at UBC in 1972, and for years was one of only the few women in the entire Faculty of Science. As associate dean for Women in Science from 1991–1998, Myers helped change hiring policies to include more women. The Faculty of Science now has 30 female faculty members, and this year received three out of 22 University Faculty Awards in Canada to hire top women scientists. Even though attitudes change over time, Myers admits that changing the academic environment is a slow evolutionary process—and she prefers to talk about her work.

"Invasive species are second only to habitat destruction as a threat to biodiversity," she says. Because exotic species introduced from other continents lack natural enemies, they are able to outcompete native species, which are controlled by local predators, parasites and herbivores. Zebra mussels and purple loosestrife are two well-known examples of introduced species that have wreaked havoc in Canada's waterways and wetlands.

Agricultural Sciences and Zoology professor Judy Myers is a member of the International Organization for Biological Control, Canadian Biological Control Network, and associate editor of Ecoscience *and* Biocontrol Science and Technology.

"One way to deal with the invasion of exotics is to introduce natural enemies from their native habitats," says Myers. For example, *Galerucella calmariensis*, a leaf-eating beetle from Europe, is now controlling purple loosestrife. Myers and her students have also studied biological control of knapweed, winter moth and tansy ragwort. "It is not easy to predict what will make an effective biological control agent and why it is that some natural enemies reduce their prey or hosts while others do not," she says. "We must ensure that introduced agents do not attack native or rare species."

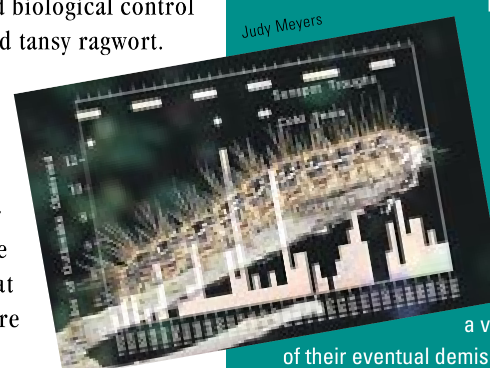
Traditionally, biological control has involved a shotgun approach, introducing several control agents at once. Myers favours a more conservative method. Her research has shown that in most successful cases of weed control, only one introduced agent is responsible. Yet *Rhinocyllus* beetles that attack native as well as introduced thistles, and other seed predators that are rarely successful control agents, continue to be distributed. Myers believes that to preserve natural biodiversity, we must increase the monitoring of agents after they are released, and limit introduced species to agents that kill target weeds—not just nibble away at them.

The Ebb and Flow of Tent Caterpillars

Who doesn't remember at least one childhood summer when it seemed to rain tent caterpillars? The furry forest *Lepidoptera* have few friends—and few natural enemies, since birds find them unpalatable. Yet roughly every ten years their populations peak, and then decline sharply. For years, scientists have been struggling to correlate these outbreaks and declines to food supply, weather, fecundity, larval size, and even tent shape, with little statistical success.

Population ecologist Judy Myers and team have attempted to create "out of phase outbreaks" by moving caterpillar eggs from an outbreak site to a new location, but they were unable to alter the natural cycle. However, they discovered that the caterpillar eggs carry a virus—the cause of their eventual demise. "We are now exploring how warm springs, which allow caterpillars many chances to bask in the sun, may be speeding the pace of viral infection and population decline," says Myers. Just as unsuccessful biological control agents fail to kill target weeds, tent caterpillars usually have little impact on the density of forest trees. "While their coexistence is not always harmonious, insects and trees have evolved to maintain the existence of both."

Judy Meyers



Unravelling the Mystery of Natural Materials

Materials solutions to an incredible variety of engineering problems can be found in nature. Carl Michal studies the complex and mysterious properties of natural materials to further the development of more sophisticated and sustainable synthetic ones.

When it comes to producing advanced materials, UBC biophysicist Carl Michal believes that we have a lot to learn from Mother Nature. Take the hinge of an insect's wing, for example. It can stretch thousands of times per minute and it lasts for the life of the insect. The shells of molluscs are composite ceramics that self-heal. And spider's silk is a material that has intrigued scientists for centuries with its incredible tensile strength and resilience. Dragline silk is tougher than Kevlar, yet it is synthesized from organic starting materials and is biodegradable.

"Wouldn't it be fantastic if we could make materials that fulfill our needs without extracting oil from the ground or leaving plastics in landfills for the next thousand years?" says Michal. He studies complex molecular and mechanical properties of biomaterials to find out how they work, and what we can learn from them.

For example, how is spider's silk able to absorb the energy of an incoming insect and relax without bouncing the bug back out? Or why will an unrestrained piece of silk shrink to about half its length in the rain? "In the first instance, the silk seems completely optimized for its function," says Michal. "When it gets wet, it undergoes a dramatic transition and the function is not completely clear." The reason for this supercontraction is one of nature's secrets he hopes to decipher.

The UBC Laboratory of Molecular Biophysics' new 9.4 Tesla NMR spectrometer—with a magnetic field 188,000 times as strong as the earth's—will help Carl Michal and colleagues unravel the proteins in dragline silk.

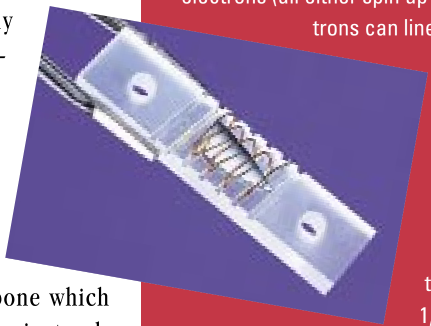
Silk is almost pure protein. The fibres are a semi-crystalline polymer composed of long chains of amino acids, mostly glycine, alanine and glutamine. The two main components, alanine and glycine, are also the two smallest amino acids. Michal's work has shown that almost one-third of the alanines are tightly organized crystals oriented perpendicular to the fibre axis, as expected for a very strong material. However, when the silk gets wet, parts of the protein backbone which are generally rigid reorient radically.

The glycines in silk also pack tightly together; they are more flexible and can take on a wider variety of conformations than the larger amino acids. "We think we know what the alanines are doing, and the glutamines seem to play a role in confining the alanines. Now we want to find out what the glycines do." Are they more amorphous? Could they play a role in the flexibility of silk? "I'll let you know," he says, with the inscrutability of Mother Nature herself.

Optical Pumping

Proteins associated with membranes, such as calcium and sodium ion channels, are of great interest to researchers, but difficult to analyze using traditional nuclear magnetic resonance (NMR) and x-ray diffraction methods because large enough samples aren't available. Optical pumping, a technique being perfected by biophysicist Carl Michal, will facilitate the study of biomaterials at the nano scale.

The technique involves cooling certain semiconductors to very low temperatures and illuminating them with light tuned to match their bandgap, producing spin-polarized electrons (all either spin up or down). Contact with the electrons can line up the nuclear spins in the semiconductor. Since the size of an NMR signal is determined by how many of the nuclei are aligned, and most are usually oriented randomly, the signal is normally very small. Optical pumping can increase the signal by factors of 100 to 1,000. By placing a thin layer of biomaterial onto a semiconductor, Michal and his lab are hoping to transfer the nuclear spin polarization from the semiconductor to these surface molecules. "If we can enhance the signal size, we could reduce how much sample is needed by a factor of 100 or greater."



Not many researchers are working on this technique, Michal notes, because of the need for high-power lasers, and because samples must be cooled to very low temperatures. A recently purchased cryostat (with funds from NSERC) will allow his group to do NMR experiments at liquid helium temperatures (4° Kelvin). They are also working with indium antimonide, a semiconductor in which it may be possible to line up the electron spins without the use of lasers. If it works, it would reduce the complexity of the process immensely, says Michal.

Using Lasers to Explore Exotic Molecules

UBC's new Chemistry Head John Hepburn works at the interface between chemistry and physics—and administration and research. His expertise in spectroscopic analysis and laser chemistry is furthering the study of molecular properties and change in chemical reactions.

THE SPECTACULAR CHEMICAL REACTIONS that propel a shuttle into space are the stuff of headlines. But most chemical reactions go unobserved, except by physical chemists such as John Hepburn. He studies energy change in small molecular systems, and at the atomic scale, small does not mean less complex. Hepburn uses various laser spectroscopic techniques to probe the structure and behaviour of molecules and ion fragments to increase understanding of chemical reactions in all systems.

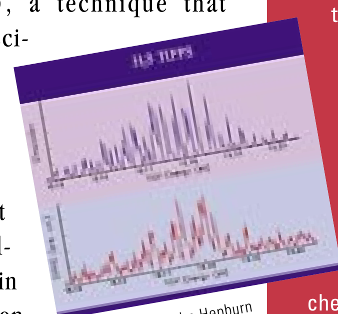
Hepburn, who holds a joint professorship in Chemistry and Physics and Astronomy, recently came to UBC from the University of Waterloo, where he helped to pioneer zero kinetic energy photon electron spectroscopy (ZEKE). He is one of an elite group of chemists who use extreme ultraviolet lasers for molecular spectroscopy and he will be moving a large part of his lab to UBC to continue his work.

One way atoms and molecules ionize, or lose electrons, is by being subjected to electromagnetic radiation. Traditionally, photoionization has used short wavelength light between the visible part of the spectrum and x-rays. While advanced instruments such as synchrotron radiation sources produce light in this wavelength range, Hepburn's group uses laser sources for short wavelength light. "There are coherence properties with laser radiation that allow you to do things that you can't do with any conventional light source, including a synchrotron," Hepburn says.

A molecule's "ionization threshold" is the amount of energy required to produce a molecular ion (the starting molecule minus one electron) in a specific quantum state when beginning from a well-defined molecular quantum state. ZEKE allows Hepburn and his lab to study dynamic states above the ionization limit of small molecules and even remove selective electrons from different places within the molecule. "We are also able to produce ions that have different amounts of rotational and vibrational energy in order to study the internal structure of exotic molecules," he says.

"The infrastructure provided by the Canada Foundation for Innovation has been integral in allowing Canada to compete with the US for top researchers," says new Chemistry Head—and commuter cyclist—John Hepburn.

A related technology developed by Hepburn and his lab in Waterloo is threshold ion pair production spectroscopy (TIPPS), a technique that allows scientists to precisely measure bond energies, or the energy required to break apart a molecule into a specific set of fragments. Hepburn notes that the Dept. of Energy in the US spends millions each year on technologies like TIPPS in order to facilitate the modelling of combustion reactions. "Even a minute increase in the efficiency of converting fossil fuel into energy can translate into billions of dollars."



John Hepburn

While Hepburn's research may seem esoteric, his vision for the department is pragmatic. "UBC has a great record of attracting high calibre researchers and grad students," he says. One of his first priorities is to reinvigorate and expand the undergrad laboratories. "Chemistry is ultimately a practical, experimental discipline. You can't teach it using computers alone."

Laser Detection in Large Molecules

Certain classes of compounds are structurally very similar, yet have extremely different properties. "One compound might be carcinogenic, but when we move a few atoms around suddenly it will be relatively benign," says Chemistry Head John Hepburn. Polyaromatic hydrocarbons (PAHs) are an example of large molecules that are extremely similar but difficult to separate, particularly in environmental samples that contain minute amounts of different but closely related molecules.

High-resolution photoionization spectroscopy provides Hepburn and colleagues with laser detection methods to selectively ionize and select specific molecules out of a sea of very similar ones. This has applications in pharmaceutical chemistry, where identical molecules of thalidomide, for example, are stereoisomers—or mirror images. One is a beneficial drug: the other is deadly. Similar problems exist in molecules with different arrangements of the same atoms. "We are developing spectroscopic techniques that have high sensitivity and selectivity to help us determine the difference between these deceptively similar molecules," says Hepburn.

UBC's Science Brain Gain

The Faculty of Science welcomes eight new faculty members with a glimpse into their research and their passions outside of the lab.

Paul Carter, Instructor, Computer Science. "I believe that lectures can be an interactive experience even when the number of students is large, and that technology will continue to provide us with new media that can be used to enhance the learning experience. When I'm not climbing the walls in my office, I can be found hiking the local mountains!"

Will Evans, Computer Science. Research: "I am interested in simplifying terrain data to permit virtual hiking and virtual flooding, reducing the size of programs so they can run in limited memory environments, discovering new algorithms for solving problems, and proving fundamental properties of computational structures. While fond of virtual hiking, I prefer the real thing."

Greg Morton, UBC Media Group

Marcel Franz, Physics & Astronomy. Research: Physics of high temperature superconductors and other exotic states of matter. "When not in my office, I am searching for new ideas and inspiration while negotiating extreme slopes of Whistler-Blackcomb."

Ronald Rensink, Computer Science and Psychology. Research: visual attention. "I want to know what visual attention is and why humans have it. I plan to use what we know about visual attention to help design more effective visual interfaces, as well as more flexible computer vision systems."

Thomas Mattison, Physics & Astronomy. Research: high-energy particle physics. "Why collide an ampere of 9 billion volt electrons with two amperes of 3 billion volt anti-electrons? To explain why the Big Bang made a universe instead of just a flash of light. In the future, I hope to squeeze megawatts of 500 billion volt electrons into nanometer beams to learn the origin of mass. And watch my three-year-old daughter grow up."

Ulrich Mayer, Hydrogeology. Research: multicomponent reactive transport in porous media. "I am interested in the geochemical evolution of natural and contaminated groundwater systems. I focus on the mechanistic study of the complex interactions between transport processes and geochemical reactions involving solutes, gases, and minerals."

Kris De Volder, Computer Science. Research: logic meta programming. Self-referentiality and meta-circularity have always fascinated me. Now, I am conducting research about how to write programs that write programs. Maybe, the next step is to write programs that write themselves. In my spare time I enjoy meditation: reflecting on my own self-nature."

Lang Wu, Statistics. Research: Statistics and Biostatistics. "I have been working on missing data problems in statistics and biostatistics with applications in AIDS/HIV studies. I really enjoy being a statistician and it has become an increasingly important discipline."

Bits and Bytes cont'd from page 8.

Physics Undergrads win awards

Two UBC physics undergrads were winners at the last Canadian Undergrad Physics Conference. Hong Ma won the $1000 EXFO Scholarship for best overall presentation and Caitlin Bever won 3rd prize in the "Best Talk" category.

Hancock and Bonn receive top UBC research awards

Bob Hancock of Microbiology and Immunology was awarded the Prof. Jacob Biely Faculty Research Prize for his research in antibiotic-resistant mutant superbugs. Hancock directs the Centre for Microbial Diseases and Host Defence Research. Physicist Doug Bonn received the Charles A. McDowell Award for Excellence in Research. Bonn is recognized internationally for his work in high temperature superconductors.

Science students dominate Westbrook Scholars Awards

Ten of this year's 16 Wesbrook Scholars are from the Faculty of Science. Recipients Adrien Desjardins, Ana Luiza Sayao, Brian Mayson, Colleen Ann Brown, Cydney Nielsen, Priscilla Brastianos, Timothy Chan and Robin McKillop all have standings in the top 10 percent of their faculty or school, and have demonstrated the ability to serve, work with and lead others. Adam Mott and Ioana Lupu also receive the award as recipients of Premier Undergraduate Scholarships.

Science Dean receives Wired Woman Pioneer Award

UBC Dean of Science Maria Klawe recently received the Wired Woman Pioneer Award presented to a female pioneer in the field of technology and new media. The award recognizes her research in mathematics and computer science and her role as founder and director of E-GEMS (Electronic Games for Education in Math and Science) and SWIFT (Supporting Women in Information Technology). Klawe holds the NSERC-IBM chair for Women in Science and Engineering in BC and the Yukon.

2001 Killam Award Recipients

Three UBC Science faculty members recently received Canada's top research award, the **Killam Research Fellowships**. Garry Clarke from Earth and Ocean Sciences, Beverly Green from Botany and Harvey Richer from Physics and Astronomy will be able to devote the next two years to full-time research. In addition, **Izaac Walton Killam Memorial Fellowships** were presented to Paul Gustavson from Statistics; Wilfred Jefferies, Biotechnology; and Janis McKenna and Douglas Scott, Physics. The fellowships top up faculty salaries by $15,000 and provide $3,000 for travel and research during sabbatical leave. Science recipients of this year's $5,000 UBC **Killam Research Prize** were David Kirkpatrick and Alan Mackworth from Computer Science, and James Zidek from Statistics.

Snutch receives top CIHR award

Terry Snutch of the Biotechnology Laboratory received the Senior Scientist Award from the Canadian Institutes for Health Research (CIHR) of $350,000 over five years. Snutch, who also holds appointments in Zoology and Psychiatry, was recognized for his research in electrical and chemical signalling in the brain and heart.

Mackworth, Pippenger and Schluter appointed Canada Research Chairs

Computer scientists Alan Mackworth and Nicholas Pippenger, and zoologist Dolph Schluter were among the first recipients of the Canada Research Chairs program. Nineteen UBC researchers received the inaugural appointment.

Unruh elected Fellow of the Royal Society

Physics and Astronomy Professor William Unruh has been elected a Fellow of the Royal Society of London for his pivotal contributions to the study of quantum physics, gravitational theory and cosmology. He was also recently elected a Fellow of the American Physical Society (APS).

Bits and Bytes cont'd on bottom of page 7.

CANADA POST POSTES CANADA
Postage Paid Post Payé
Publications Mail Poste-publications
1657402

UBC Science Synergy is published by the
Faculty of Science
University of British Columbia
Address correspondence to:
UBC Science Synergy
Faculty of Science,
6270 University Boulevard
University of British Columbia
Vancouver, B.C., Canada V6T 1Z4
Website
http://www.science.ubc.ca/

Publisher:
Bob Carveth, Director, Science Communications,
Faculty of Science, University of British Columbia
carveth@unixg.ubc.ca.
Editor and Writer:
Mari-Louise Rowley, Pro-Textual Communications
Designer:
Chris Au, Didax Design Group Inc.
Principal Photographer:
Janis Franklin, The Media Group (UBC)

Printed in Canada on recycled paper