

Interdisciplinary Graduate Student Research Symposium

Crystal P. Mann¹



How does the malaria parasite handle iron in the human blood? What is the ecological footprint of international trade? Do magma reservoirs recharge with magmas of similar composition? Can top quark events be identified?

These research questions and more were discussed at the Interdisciplinary Graduate Student Research Symposium: Scientific Approaches to Complex Natural Systems, 16–17 March 2006, McGill University, Montréal, Québec, Canada. The event, which featured 84 student presentations, was organized by graduate students for graduate students. Participants included the McGill departments of Atmospheric and Oceanic Science, Biology, Chemistry, Earth and Planetary Sciences, Geography, Mathematics and Statistics, Natural Resource Science, Physics, Psychology, School of Computer Science, and School of the Environment, and graduate students from Concordia, Centre de Recherche en Géochimie et en Géodynamique, Michigan Technological University, Queen's University, Université de Montréal, University of Windsor, and Université du Québec à Montréal.

The objectives of the symposium were for students to (1) communicate their research across disciplines, (2) enrich their own research by exchanging ideas with researchers from different scientific backgrounds, (3) give and receive valuable feedback on presentation formats, and (4) develop skills to network with other researchers and industry



Sylvie Tissandier, Biology/Redpath Museum, McGill University, presenting "Morphological Changes in the Pectoral Fins of Ray-Finned Fish" on 17 March 2006

personnel. To create a sense of continuity amongst the various disciplines, the sessions were designed to reflect scale: nanoscale, microscale, macroscale, and planetary and cosmological scales. Students were asked to present at the session that best encompassed their research topic and objectives, that concerned the scale applicable to their own research, and that provided them with the type of feedback they desired. Judges, recruited from both academia and industry, provided students with written feedback covering a range of criteria, from soundness of research to presentation format. Cash awards were given out for outstanding oral and poster presentations.

The symposium opened with a keynote address by Dr. Don L. Anderson, a noted geophysicist

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Cherry-Picking Your Results

Kaspar Mossman²



It's mid-June, and peaches and strawberries are in season at the farmer's market in Berkeley, California. Yum! But there's a catch. Ripe peaches and strawberries are soft and fragile, and impossible to transport to market without damage. So vendors rotate the peaches in the bins and flats to hide the bruises. They pick moldy berries off the tops of the baskets; I find the others when I get home. The perfect fruit on the top doesn't honestly represent the contents of the container.

I'm familiar with this kind of trick not only from the market, but also because I see it all the time in scientific journals, and I do it myself when I present my research at seminars. I pick the best-looking images, which I then claim represent my experiments.

As a PhD student in biophysics, I study how T cells communicate. T cells are white blood cells that play important roles in the immune system. Characterizing T cells is different from measuring the properties of an element like titanium. Every time you measure the electrical conductivity of pure titanium, you get the same answer. But not all T cells are the same, even if they come from the same genetically engineered mouse. They may be at different stages in their growth cycles, or have been exposed to slightly different concentrations of hormones. When I observe them under the microscope, every cell behaves in a slightly different way. Some cells completely defy expectation, and either don't adhere as I think they should, or just crawl around like slugs, leaving fluorescent trails as they shed molecules.

To get useful information from images, I have to discard the deviants—some of which may not even be T cells—like a farmer picking the really moldy strawberries out of the basket. Then I'm left with an ensemble of cells, all of which are doing more or less the same thing. In the language of statistics, there's an average and a standard deviation. Every experimental scientist who works with complex natural systems, such as cells, petroleum deposits, or the geomagnetic field, faces a similar challenge: to identify and delete outlying data points, and obtain data that agree with their model of the system.

In a 2005 survey by the Office of Research Integrity, American scientists were polled on whether they'd committed a "scientifically dubious act" in the last two years: anything from publishing the same result in two different journals to outright falsifying their data. Of the respondents, 30% said yes. But I'd argue that nearly all cell biologists—including me—regularly misrepresent their results when it comes to publishing images. Rest assured that only rarely this extends to outright fraud.

For a start, no image makes it into a paper in *Cell* without the author spending hours massaging it in Adobe Photoshop, to enhance what the author wants you to believe are the important regions. There is an honour code governing this manipulation: you're not allowed to add anything that isn't there or highlight

some aspect of the image that doesn't represent "true" results. Beyond this, though, researchers always pick what they believe are the "best" images for publication. What do I mean by "best"?

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¹ Crystal P. Mann is a PhD candidate in volcanology at the Department of Earth and Planetary Sciences, McGill University. She received her MSc also at McGill and her BSc at the University of Washington, Washington State, United States. Her PhD research thesis is focused on the transfer of volatiles during recharge of a more mafic magma into a shallow magmatic reservoir.

² Kaspar Mossman recently graduated with a PhD in biophysics from the University of California, Berkeley. He studied meteor dynamics for his BSc at Mount Allison University and high-temperature superconductivity for his MSc at the University of British Columbia. A stint masquerading as a radio-frequency engineer in Santa Barbara ended when he saw the glory of biophysics.

ROBERT WILHELM BUNSEN MEDAL TO RICHEL



The French scientist Pascal Richet has won the prestigious Wilhelm Bunsen Medal of the European Geoscience

Union (EGU) for his seminal achievements in advancing our fundamental understanding of geomaterials and for providing conceptual frameworks for the thermodynamic and transport properties of matter within the Earth. The Wilhelm Bunsen Medal was established by the Division of Geochemistry, Mineralogy, Petrology and Volcanology in recognition of the scientific achievements of Robert Wilhelm Bunsen. It is awarded for distinguished research in geochemistry, mineralogy, petrology and volcanology. Pascal Richet works at the Institut de Physique du Globe de Paris. He has been a pioneer in mineral and melt physics for a quarter of

a century. His early work on the thermodynamic and transport properties of silicate melts led to remarkable insights and provided a thermodynamic basis for the calculation of transport properties that is still being analyzed and tested to this day. His groundbreaking studies of pre-melting in crystals have contributed substantially to the understanding of elastic modulus variations in sub-melting temperature solid phases. Finally, his calorimetric studies of silicates have significantly advanced our picture of melt energetics. Without Pascal Richet, our present picture of silicate melts would be much more primitive than it is, full of many of the myths and uncertainties that he has almost single-handedly banished from the literature. Professor Richet accepted his medal and gave his medal lecture 'Volcanic Eruptions and Physics of Lavas' during the EGU General Assembly, in Vienna, Austria, 2-7 April 2006.

EWING RECEIVES DANA MEDAL



Rod Ewing received the Dana Medal of the Mineralogical Society of America (MSA) at the 2006 Joint Assembly of the American Geophysical Union, in Baltimore, May 23-26, 2006. The medal was presented to Rod by MSA president John Valley before his Dana Lecture "Plutonium, Mineralogy and Radiation Effects." The lecture was the inaugural talk of the Dana symposium "Mineral-

ogy and the Nuclear Fuel Cycle," convened by A. Navrotsky and L. Wang and organized by the Mineralogical Society of America. Many colleagues and former students participated in the symposium. Rod particularly appreciated the chance to meet with old friends and discuss the scientific progress that has been made during the past several decades.

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and philosopher of science from California Institute of Technology. To choose the speaker, the organizing committee asked the participating McGill departments for nominations, compiled the names, and sent out the list of nominations for student vote. Dr. Anderson was the top student pick with over 100 votes.

The interdisciplinary graduate student symposium was conceived and organized by a group of graduate students doing science research. As a member of this committee, I can speak on behalf of my teammates when I say that our drive came from the importance of being stimulated by research outside our own discipline and the necessity of good communication and networking.

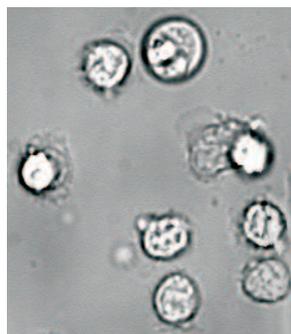
Was the event a success? You decide. Here are a few of my observations. During one question period, a graduate student in the audience offered his lab computer with a high memory capacity to one of his peers to tackle a research question for which the required resources were not available. Questions for the

speakers were from fellow graduate students with different backgrounds, forcing the speakers to think outside the "box." A faculty member, excited about research being done by a graduate student in a different department, offered this student a post-doc position after graduation. Judges from industry gave business cards to students in their last term.

Without the much-needed financial support from the Canadian Society of Petroleum Geologists, the Post Graduate Student Society, the Geological Association of Canada, the Environmental Sciences Research Centre, Falconbridge, Esso, GENEQ Inc., McGill Institute of Advanced Materials, Fisher Scientific, Vancouver Petrographics Ltd., and alumni from the Department of Earth and Planetary Sciences, this student initiative would not have been possible. We would like to acknowledge not just the financial support, but also the continual encouragement from the academic faculty within the different departments and the dean of the Faculty of Science, Dr. Martin Grant.

Cherry-Picking Your Results

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T cells are white blood cells that play important roles in the immune system.

Out of the thousands of cells in the experiment, the cell in the image chosen for the paper is the finest example of what the scientist thinks the cells should be doing. This is like the farmer at the market rolling the peaches over so the bruises don't show. When you read a biology paper, you know that the images in the paper are absolutely the best ones the scientist had, so if the images are sketchy, you know the actual data were far worse.

Live cells and animals are notoriously complex, and therefore biologists may have the greatest opportunities to develop pet theories and claim that their cells or mice are behaving just as they predicted. But I imagine that a geologist

with a sack of ore samples, some of which feel heavier or look more silvery than others, might choose to send off for assay the samples that fit best with his theory (or investment portfolio).

Are we wrong to pick what we think is the best micrograph to go in a paper? It depends. If the "best" sample truly represents the average behavior, that's OK. But if the image in question is an extreme example, then we should be careful. Our theory might be wrong. By choosing to publish data that support our theory, we not only risk misleading others for our own profit, we risk that tomorrow someone else could embarrass us with more honest results—turning our perfect peach over to reveal the moldy underside.