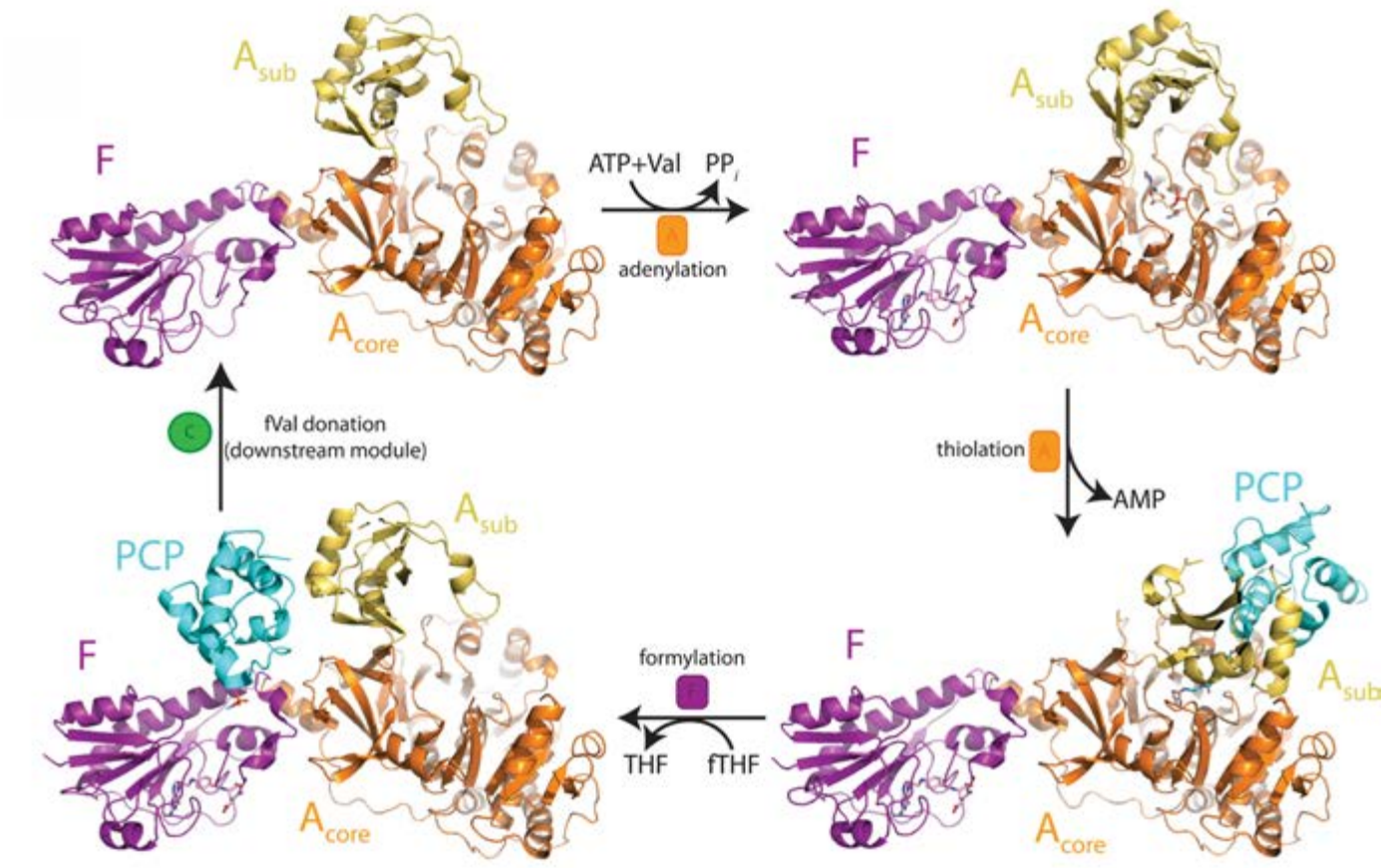
Bulletin



The Canadian Society for Molecular Biosciences
La Société Canadienne pour les Biosciences Moléculaires

2017

www.csmb-scbm.ca

Bulletin

The Canadian Society for
Molecular Biosciences
La Société Canadienne pour les
Biosciences Moléculaires

2017

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President's Report 2017

Dr. Phil Hieter

CSMB President, Phil Hieter

In 2017, CSMB ramped up efforts, from the momentum built in previous years under the leadership of former Presidents Kristin Baetz and Christian Baron, to advocate for increased funding of fundamental discovery research by the federal government. Indeed, 2017 was a pivotal year for science advocacy for several reasons. First, the Canadian scientific community had experienced a serious decline in federal support for science research and teaching over the past decade. Second, we were encouraged by the release of the Fundamental Science Review Report (the "Naylor Report") that was commissioned by Dr. Duncan, the Minister of Science. This report outlines a truly outstanding vision for Canadian research and a roadmap for increased funding and better tri-council organization that would restore Canada to its rightful place among the global leaders in research and development.

The impact of fundamental research funding on the national good is difficult to overstate, and should be an important concern for our members of parliament and the public at large. Basic research provides the knowledge base without which innovation and technological development could not take place. We train highly qualified personnel who represent the country's future. We support solid middle-class jobs in conducting research with federal support. Cutting-edge research is a beacon for highly qualified immigrants.

Starving basic research is a capital strategic error, but that is what occurred over a 10-year period (2007-2016). The Fundamental Science Review provides a well-designed action plan to strengthen research and training in Canada and its impact on the economy. Researchers recognize the acute budgetary pressures our government faces, and the fiscal responsibility required to manage an advanced economy in uncertain times. However, advancing health care, industry, and economic well-being are constant pre-occupations of Canadians, and as basic researchers, we are important contributors to advancing all three of these. CSMB will continue to work together with you to make the arguments for fundamental research so that the government will have the vision to robustly fund basic research in order to ensure the future success and well-being of Canada.

Below, I highlight some of the initiatives and events that the CSMB has poured its efforts into in 2017.

Trainee activities

In support of the Naylor report, the trainee committee launched a successful Twitter campaign in the summer of 2017 titled "Put a face on Canadian Science". The focus was to advocate for the federal government to increase funding for basic science in Canada. For the campaign, trainees were asked to describe their research, take a picture of themselves doing research, and post it on Twitter. Tweets were sent to Justin Trudeau and Bill Morneau. The hashtags that were used were: #NextGenCanScience and #SupportTheReport. Approximately 150 trainees across Canada participated in the campaign. The trainee committee also provided feedback for the career skills workshop offered at the 61st Annual Meeting of the Canadian Society for Molecular Biosciences. A list of graduate student associations (GSA), post-doctoral associations, undergraduate associations and professional trainee societies/associations across Canada, was also put together by the committee. In addition, CSMB supported several student-led symposia and research conferences with $500 awards, as described later in this Bulletin.

CSMB Board response to Budget 2017

The CSMB Board issued a statement of concern that Budget 2017 (released in February 2017) fell short in support of discovery research. CSMB expressed surprise and disappointment that besides some modest targeted investments into programs such as the Stem Cell network, the budget did not contain any new resources for discovery research, especially for the open competitions at the Canadian Institutes of Health Research (CIHR) and the Natural Sciences and Engineering Research Council (NSERC). CSMB

questioned the rationale for expanding both infrastructure and numbers of researchers in a context where funding for CIHR and NSERC is stagnant. The operational funding for fundamental research in Canada had declined well below our nation's research capacity, and as a consequence, many Canadian research labs were downsizing or closing, thereby eliminating skilled jobs and squandering prior investments in research. CSMB strongly supported the allocation of resources for creating the office of a Chief Science Advisor but was concerned that the recommendations of the long anticipated Fundamental Science Review had not been released. CSMB also supported measures to improve skills training, to advance gender equity, to attract foreign talent and to support the National Research Council. CSMB pledged to work closely with the Chief Science Advisor and with the Ministers of Science and Health to implement the anticipated Science Review's recommendations to strengthen Canada's research environment.

March for Science

On April 22, 2017, the March for Science, which coincided with Earth Day, took place in more than 500 cities around the world, with 18 marches occurring in cities across Canada. Collectively, the marches were a huge success in raising awareness of the importance of science research. In Ottawa, over 700 people attended the March for Science. The overarching message from all the speakers was how critical science and evidence-based decision making is to Canada. Then CSMB President Kristin Baetz spoke at the rally on Parliament Hill with a strong message that society needs science if we are to tackle problems such as climate change, the next superbug, food security, an aging population and future problems that we cannot yet imagine. Her message was that through science, Canada will improve the lives of its citizens and contribute to the well-being of the world. She also introduced the recommendations of the Fundamental Science Review (that had just been released on April 10) and made a call to arms for its general support.

60th CSMB Annual Conference

The 60th annual CSMB conference, "Celebrating Canadian Molecular Biosciences- from Organelles to Systems Biology" was held in Ottawa on May 16-20, 2017. By all accounts this was an outstanding meeting - it had all the necessary ingredients of great people, great program, great venue, and flawless logistics, to create an atmosphere that generated great science, lots of interaction, discussion and exchange of ideas, new technology, new collaborations, and fun. There were 415 registered participants, 81 talks (with more than 60% selected from abstracts), and 234 posters. A full meeting report is found in this Bulletin.

CSMB calls on its members to #Support the Report through interactions with Members of Parliament

CSMB members at all career stages were encouraged to engage their local MPs to introduce themselves, describe their work and why it is important, to articulate how decreases in fundamental research funding have impacted them directly, to introduce the Naylor Report, and to voice support for its full implementation. Through our website, CSMB assisted by providing suggestions, instructions, and information to facilitate these interactions. One avenue was to **write a personal letter to their MP,** and to include Prime Minister Justin Trudeau, Minister of Finance Bill Morneau, Minister of Science Kirsty Duncan, Minister of Health Jane Philpott and Minister of Innovation, Science and Economic Development Navdeep Bains. Our colleagues at Evidence for Democracy had also developed a great tool kit to aid in letter writing. A second avenue was to request a meeting with their MP**.** The idea was to meet over the summer while the MPs are back in their ridings and consider offering a tour of their lab. Members were also encouraged to make these meetings known by tweeting using the hashtag: #SupportTheReport. For example, at my institution during the summer of 2017, a total of 17 MPs and 12 Cabinet Ministers visited the UBC campus to meet with various faculty members and university leaders to discuss the need for increased federal funding of fundamental research through the tri-councils. Similar events occurred across Canada.

CSMB submits pre-budget consultation to the House of Commons

On August 4, 2017, the CSMB Advocacy committee submitted a pre-budget consultation to the House of Commons Standing Committee on Finance. The document articulated the urgent need to restore investment in fundamental research, in order to generate the knowledge that fuels innovation and to train the next generation for jobs in an increasingly knowledge-driven economy. In particular, the essential component of operating grants that fuel the day-to-day expenses of research and pay personnel (students, post-docs, technicians) is inadequate. The CSMB, therefore, strongly urged the federal government to restore discovery research and training with significant investments into the open competitions at CIHR, NSERC, and SSHRC in the 2018 and future budgets. Specifically, the CSMB strongly endorsed the recommendations of the Naylor Report

for 1) Increased investment of $485M over four years to support investigator-initiated fundamental research (CIHR, NSERC, SSHRC), 2) Increased investment in scholarship and fellowship programs to an additional $140M over four years to support trainees, 3) Stable funding, staged in over four years, for the Canada Foundation for Innovation (CFI) at $300M per year to support research infrastructure, and 4) Increased investment of $485M in facilities and cdministration costs to host institutions over four years to support institutional costs of research.

CSMB Board members travel to Ottawa in support of the Fundamental Science Review

Several CSMB Board members met with various MPs and Ministers at their Ottawa offices to voice support of the Fundamental Science Review. For example, in my case, I travelled to Ottawa as part of a delegation led by the UBC Office of Government Relations and UBC President Professor Santa Ono. Dr. Liisa Galea, a professor and researcher at the UBC's Centre for Brain Health, also joined the delegation. Over two days, our group met with two Cabinet Ministers, including Canadian Minister of Science Hon. Kirsty Duncan, Deputy Minister of Health Canada Simon Kennedy, two Deputy Directors, three Parliamentary Secretaries,two Chairs of Standing Committees, the Chair of the Liberal Caucus, and the President of Universities Canada Paul Davidson. The meetings were used to emphasize the importance of basic science and to advocate for support from MPs for the implementation of the Fundamental Science Review recommendations.

New Board committee structure and appointment of At-Large members

A new and expanded CSMB committee structure, mandated and developed by the Board of Directors at their March 2017 Board meeting, was launched in September 2017. The Committees that were established are: Executive, Advocacy and Communication, Membership and Diversity, Finance and Development, Awards, Nominations, and Trainees. In addition to Board members, each committee includes several "At-Large" members, chosen from the active CSMB membership following an application process. A complete list of the individual committee mandates and current members can be found on the CSMB website. Following a general call for applications in September, the first round of "At-Large" committee member positions were chosen for each of the committees of the CSMB Board. The At-Large members that were selected were Julie Claycomb and Jim Woodgett (Advocacy and Communication), Peter Stirling (Membership and Diversity), Imogen Coe (Finance and Development), Esther Verheyen (Awards), Sarah Hughes (Conferences), Bill Stanford (Nominations), Senthill Kumar, Erin Kennedy and MacKenzie Lawrence (Trainee). The At-Large members will have two-year terms, and another round will be added in July 2018 such that one At-Large committee member will be cycled on, and one off, on an annual basis in subsequent years.

Campaign to encourage business leaders to advocate for the Fundamental Science Review to government

In November 2017, the CSMB Board launched a campaign to encourage business leaders to submit letters to the Federal Finance Committee in support of the Naylor Report funding recommendations through a second pre-budget consultation process that opened in November 2017 (#YourBudget2018). Members of the CSMB Board set up face-to-face meetings with local business/biotech leaders across Canada to brief them on the Naylor Report content, and to raise awareness that Canada was in a funding crisis. Industry relies not only on foundational discoveries, but also absolutely on the pool of university science graduates to provide a skilled workforce in their companies. When made aware of the funding decline (35% per researcher for investigator-initiated research since 2007), and the international comparisons (%GDP budgeted to R and D relative to other countries), many industry leaders decided to submit statements recommending that Canada re-invest in investigator-initiated fundamental research through the tri-councils (CIHR, NSERC, SSHRC), at the levels recommended in the Naylor Report. A template letter was put together (in collaboration with Evidence for Democracy) to assist business leaders in composing a support letter, and information was provided for submitting it easily through the appropriate channels.

Looking forward

The CSMB represents thousands of academic research faculty, fellows, and students in the molecular biosciences across Canada. Our mandate is to advance and promote molecular biosciences, with a focus on advocating for robust and sustainable funding for fundamental research in Canada. I have enjoyed serving as President of the CSMB and am grateful for the hard work and efforts of the CSMB Board and other members of the scientific community. We know there is much more that we need to do to fully realize the tremendous potential of Canadian research, and we need your continued support. We look forward to continue to work together with you, and with government officials and all partners and stakeholders to strengthen Canada's research environment in the years ahead.

Incoming Members of the CSMB Executive Board

Dr. Paola Marignani

Dr. Paola Marignani, *Councillor*

Dr. Marignani started her scientific career at the early age of 6, where she showed an aptitude for STEM. Dr. Marignani's formal education started with a B.Sc. Hons. (University of Windsor) in biology and chemistry, followed by M.Sc. studies (University of Western Ontario) in neuropathology and neurodegenerative diseases, and a Ph.D. (McMaster) in lipids and membrane biophysics. Dr. Marignani expanded her scientific portfolio by pursuing the early days of signal transduction as a post-doctoral fellow at Harvard University, where she created new gene expression strategies for understanding signalling of tumour suppressor/oncogenes. After her return to Canada, Dr. Marignani's fellowship focussed on mass spectrometry at the Samuel Lunenfeld Research Institute and cancer biology at the Ontario Cancer Institute. In 2013, Dr. Marignani successfully completed a rigorous Executive MBA program from the Ivey School of Business (University of Western Ontario) and founded SAGE Medical Consultants Inc., a privately owned biotechnology company.

Dr. Marignani joined Dalhousie University in 2003, and is currently a Professor in the Department of Biochemistry and Molecular Biology, and Director of the Pipeline-2-Precision Medicine Cancer Wave initiative in the Faculty of Medicine at Dalhousie University. Dr. Marignani and her team discovered new combination therapies for the treatment of oncogene-specific breast cancer in spontaneous mouse models of breast cancer. She has also developed a new CRISPR-Cas9 mouse model of lung cancer that will be used for developing more precise and targeted treatments for the leading cause of cancer-related deaths among Canadians.

Dr. Marignani's discoveries have been highlighted by Radio Canada, Global TV, CTV, CBC, in Europe and Asian news sources, as well as in print news. Dr. Marignani trains and mentors the next generation of scientists including grade school students, undergraduate, graduate and post-doctoral fellows, and is actively involved in community outreach and education. Dr. Marignani is the Founder of Canadian Women in STEM, a not-for-profit organization focussed on improving equity, diversity and inclusivity for all people in STEM disciplines. Dr. Marignani is working towards bringing Athena Swan/ SeaChange-like programs to Canadian universities.

For more information about Dr. Marignani, please visit www.marignanilab.com and follow her on Twitter @pmarignani @CDNWomenSTEM

Dr. Nafisa M. Jadavji

Dr. Nafisa M. Jadavji, *Councillor, Trainee Representative*

Nafisa Jadavji is a neuroscientist, post-doctoral fellow researcher and instructor at Carleton University and the University of Ottawa. She completed her doctoral training at McGill University in Montréal, and her post-doctoral training at the Charité Medical University in Berlin, Germany. Her post-doctoral research focusses on understanding how dietary and genetic deficiencies in one carbon metabolism, specifically folate metabolism, affect neurological function over the lifespan using a mouse model. Dr. Jadavji has been funded by the Federation of European Neuroscience Society (Europe), NeuroWIND (Germany), the Canadian Association for Neuroscience, the Canadian Institutes of Health Research (CIHR), the Natural Sciences & Engineering Research Council (NSERC), the International Brain Research Organization, the Parkinson's Disease Foundation (US), the Burroughs Wellcome Fund (US) and Fonds de la recherché en santé Québec. She is the Chair of the Board of Directors for the Journal of Young Investigators (JYI), an online international undergraduate peer-reviewed journal.

As the CSMB post-doctoral representative and chair of the trainee committee, Nafisa hopes to bring her experiences in leadership and research to the position. Her goal while in this position is to increase the visibility of CSMB for Canadian trainees. She also plans to enhance the trainee experience for CSMB members by developing more trainee-oriented programs.

Bensun Fong

Bensun Fong, *Councillor, Trainee Representative*

Bensun Fong, B.Sc (2013) is a Ph.D. Candidate in Cellular and Molecular Medicine at the University of Ottawa, under the supervision of Dr. Ruth Slack. His research focusses on the involvement of Rb Family proteins in the regulation of neural stem cell fate during development and adult neurogenesis. Bensun is a recipient of an Ontario Graduate Scholarship.

As a CSMB graduate student representative, Bensun aims to increase the visibility of Canadian graduate students in molecular biosciences advocating for support of fundamental research, and to increase opportunities and events that support collaboration between CSMB trainee members.

Minutes of the 60th Annual General Meeting 2017

Ottawa, Ontario – 19 May 2017

Attendees: Randal Johnston; Roberto Botelho; Tarik Möröy; Charles Vadnais; Mireille Khacho; Rebecca Shapiro; Bensun Fong; Trang Pham; Logan Donaldson; Jim Davie; Phil Hieter; Christian Baron; Jan Rainey; Kristin Baetz; Vince Tropepe; Stef Bennett; Paula Adler; Martine Jaworski; Daniel Serrano; Marc Coppolino; Kin Chan; Frances Sharom; Jason Tanny; Amy Caudy; Martin Duennwald; Costin Antonescu; Paolo Marignani; H.J. Wieden; Vincent Archambault; Jean Francois Couture; Vanina Zaremberg; Sabine Elowe; Barbara Karten

1. **Greetings from the President (Baetz) – Power Point Presentation**
   Baetz welcomed CSMB members and guests to the AGM. She began her comments with the aid of a slide show, and emphasized the importance of the efforts of the CSMB in the area of advocacy on behalf of fundamental science on Parliament Hill, together with our partners Research Canada and PAGSE. A major thrust where signs of success are evident is in planned reforms with CIHR. Media attention has been very positive, with proposed changes to the competitive funding model, governing council, and diversity/innovation/inclusion. We now arguably have the ear of government. A major effort has been on the double/double campaign and petition for enhanced funding, plus Hill Times ads. CSMB has employed the Research Canada press release service, which is inexpensive and efficient. The next round of focus will be to generate support for the Naylor report - get it off the shelf! Finally, researchers must unite in our support and not waste time and energy criticizing small details, but focus on the big picture.

2. **Approval of Quorum and Agenda**
   Approval of quorum and agenda: Johnston (moved) and Rainey (seconded), approved unanimously.

3. **Approval of the Minutes of 59th Annual General Meeting in Vancouver, July 20, 2016**
   Hieter and Möröy moved and seconded, approved unanimously.

4. **Business arising from the minutes (Johnston)**
   Johnston explained that all items in the previous minutes were upheld or acted upon, with the exceptions that a) electronic voting was not activated for the present meeting as previously hoped; and b) the original large potential deficit from the 2016 Vancouver meeting of approximately $240K had been greatly reduced to approximately $60K, which was still large, but no longer threatened the continued operations of CSMB.

5. **Secretary's Report (Johnston)**
   Membership goal: Membership has stopped declining, and possibly is beginning to increase as our advocacy efforts have increasing impact. We still need to emphasize greater numbers of regular paid memberships, which remain around 200.

6. **Treasurer's Report (Rainey)**
   (a) Presentation of the Accountant's Reviewed Financial Statement.
   (b) A financial loss due to the 2016 IUBMB Vancouver conference and the 2018 ICG cancellation has led to a significant decrease in CSMB reserves.
   (c) Efforts are underway to minimize costs (Bulletin production/mailing; reduced awards and travel support, etc.),

and increase revenue (the current Ottawa meeting is expected to make a significant profit), plus expand advocacy efforts.

(d) Acceptance of the Reviewed Financial Statement (2016): Rainey and Möröy; approved unanimously.

(e) Approval of Signing Officers: Rainey to continue as Treasurer and Signing Officer; Davie to replace Johnston as General Secretary and Signing Officer, with a 6-month transition period. Rainey and Hieter; approved unanimously.

7. Board Membership for 2016 - 2017 (Baron)

Baron reviewed the submitted candidates; he was assisted in the Nominations Committee by members Andrew Simmonds and Steffany Bennett. Baron reminded CSMB members that the Board structure includes trainees; Directors are appointed for 2-year terms, renewable. For this year we have Donaldson stepping down as a Director; Nodwell and Baron wish to renew their roles as Directors for 2 more years; Johnston is stepping down as General Secretary; Hieter will move from President-Elect to President; Baetz will move from President to Past-President; Möröy agrees to be nominated as President-Elect; Jim Davie is proposed as General Secretary; trainees Fong and Jadavji are proposed as new Trainee members to replace Voronova and Lhor; Marignani is proposed as a new Director to replace Donaldson;

a) Call for nominations from the Floor: Baron invited CSMB members that were present for any additional nominations; none received.

b) Councillors and Executive; Baron and Baetz recommended the slate described above for approval; approved unanimously.

8. Board Committees and call for volunteers

Baetz described the Board structure and its proposed updated or new committees. The mandates of the various committees were described, and she encouraged members at large (including trainees) to consider serving on the committees so that diversity and momentum can both be enhanced. The identified committees are: Advocacy & Communications; Membership & Diversity; Finance & Development; Awards; Nominations; Trainee; Conferences.

9. Meeting Reports

a) Presentation of proposed CSMB Meeting Guidelines: Baetz offered the following recommendations for future CSMB conferences: they should be diverse in topics or areas of focus, plus inclusive of a diverse group of participants; presentations should include selections from submitted abstracts; efforts should be made to include women in both organization and presentation; inexpensive; accessible locations; rotate venues among popular sites; employ experienced organizers; control travel costs; identify sponsors for awards and other special activities or speakers; Board costs should be considered separately from conference costs.

b) 2017: Ottawa (Baetz) Celebrating Canadian Molecular Biosciences May 16-20, 2017. 422 participants are registered, which is one of the highest among regular CSMB conferences; 81 talks were presented, of which 60% were selected from abstracts; $120K raised from registration fees; $44K received from sponsors; anticipate profit of ~ $40K (including HST return), which is a big improvement from previous meetings, and a model for future CSMB conferences.

c) April 11-15, 2018: Banff (Johnston) Membrane Proteins in Health and Disease Howard Young is the principal organizer, for a meeting that recurs every five years. Major speakers already confirmed.

d) Call for Organizers: CSMB Conference in 2019 Possible location will be in Montreal, perhaps at U de Montreal; Möröy and Baron will establish a small team to consider venues and theme and will report to the CSMB Board in September.

10. Other Business/Adjournment

No other business was identified for discussion, and the meeting adjourned to enable a general discussion among those attending regarding Advocacy Strategy and how to enhance membership.

Numeris CPA
PROFESSIONAL CORPORATION

Independent Practitioner's Review Engagement Report

To the Members of the Canadian Society for Molecular Biosciences

I have reviewed the accompanying financial statements of Canadian Society for Molecular Biosciences that comprise the statement of financial position as at December 31, 2017, and the statements of operations and changes in net assets and cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements
Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Practitioner's Responsibility
My responsibility is to express a conclusion on the accompanying financial statements based on my review. I conducted my review in accordance with Canadian generally accepted standards for review engagements, which require me to comply with relevant ethical requirements.

A review of financial statements in accordance with Canadian generally accepted standards for review engagements is a limited assurance engagement. The practitioner performs procedures, primarily consisting of making inquiries of management and others within the entity, as appropriate, and applying analytical procedures, and evaluates the evidence obtained.

The procedures performed in a review are substantially less in extent than, and vary in nature from, those performed in an audit conducted in accordance with Canadian generally accepted auditing standards. Accordingly, I do not express an audit opinion on these financial statements.

Conclusion
Based on my review, nothing has come to my attention that causes me to believe that the financial statements do not present fairly, in all material respects, the financial position of Canadian Society for Molecular Biosciences as at December 31, 2017, and the results of its operations and its cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.

Numeris CPA

Numeris CPA Chartered Professional Accountant
Licensed Public Accountant
Ottawa, Ontario April 11, 2018

CANADIAN SOCIETY FOR MOLECULAR BIOSCIENCES

Financial Statement

STATEMENT OF FINANCIAL POSITION

As at December 31, 2017
UNAUDITED

	2017	2016
ASSETS		
CURRENT		
Cash	$ 9,861	$ 9,646
Marketable securities - short term (note 3)	236,115	211,898
Accounts receivable	50,789	35,492
Prepaid expenses	25,032	38,410
	$ 321,797	$ 295,446
LIABILITIES		
CURRENT		
Accounts payable and accrued liabilities	$ 6,163	$ 12,150
Deferred membership fees - short term	3,259	3,343
	9,422	15,493
DEFERRED MEMBERSHIP FEES - LONG TERM	5,774	5,337
	15,196	20,830
	306,601	274,616
BALANCE	$ 321,797	$ 295,446

STATEMENT OF OPERATIONS AND CHANGES IN NET ASSETS

Year ended December 31, 2017
UNAUDITED

	2017	2016
REVENUES		
Annual meeting revenue	$ 237,078	$ 570,820
Membership fees	33,236	23,075
Investment income	4,015	10,282
Miscellaneous	425	2,796
	$ 274,754	$ 606,973
EXPENDITURES		
Annual conference expenses	208,660	628,507
Board meetings and travel	13,134	18,111
Secretariat	10,573	18,763
Website	4,975	12,907
Funding and other sponsorship	2,500	13,000
Science advocacy	2,350	2,325
Bank, credit card, and investment management fees	1,712	1,763
Bulletin	1,646	15,896
Accounting fees	4,806	5,312
Insurance	750	5,250
Office expenses	474	510
	251,580	722,344
DEFICIENCY OF REVENUES OVER EXPENDITURES BEFORE OTHER ITEMS	23,174	(115,371)
OTHER INCOME		
Gain on sale of marketable securities	1,173	26,684
DEFICIENCY OF REVENUES OVER EXPENDITURES	(24,347)	(88,687)
NET UNREALIZED GAIN ON MARKETABLE SECURITIES	7,638	447
DEFICIENCY OF REVENUES OVER EXPENDITURES	31,985	(89,134)
BALANCE, BEGINNING OF YEAR	274,616	363,750
BALANCE, END OF YEAR	$ 306,601	$ 274,616

STATEMENT OF CASH FLOWS

Year ended December 31, 2017
UNAUDITED

	2017	2016
OPERATING ACTIVITIES		
Excess (deficiency) of revenues over expenditures	$ 31,985	$ (89,134)
Adjustment for gain on sale of marketable securities	(1,173)	(26,684)
	30,812	(115,818)
Change in non-cash working capital items		
Marketable securities – short term	(23,044)	164,907
Accounts receivable	(15,297)	(31,149)
Prepaid expenses	13,378	(22,853)
Accounts payable and accrued liabilities	(5,987)	(3,467)
Deferred membership fees – short term	(84)	867
	(222)	(7,513)
FINANCING ACTIVITY		
Deferred membership fees - long term	437	1,559
NET (DECREASE) INCREASE IN CASH	215	(5,954)
CASH, BEGINNING OF YEAR	9,646	15,600
CASH, END OF YEAR	$ 9,861	$ 9,646

NOTES TO THE FINANCIAL STATEMENTS

DECEMBER 31, 2017, UNAUDITED

1. NATURE OF OPERATIONS

Canadian Society for Molecular Biosciences (was incorporated without share capital in 1979 under Part II of the Canada Corporations Act and is recognized as a not-for-profit organization for income tax purposes. The main objective of the Society is to foster research and education in the molecular biosciences in Canada.

2. SIGNIFICANT ACCOUNTING POLICIES

The organization applies the Canadian accounting standards for not-for-profit organizations.

(a) Revenue recognition

The organization follows the deferral method of accounting for contributions. Restricted contributions are recognized as revenue in the year in which the related expenditures are incurred. Unrestricted contributions are recognized as revenue when received or receivable if the amount to be received can be reasonably estimated and collection is reasonably assured.

(b) Capital assets

Capital assets purchased at a cost of less than $2,000 are expensed in the year of purchase. The Society does not own capital assets at this time.

(c) Use of estimates

The preparation of financial statements in conformity with Canadian accounting standards for not-for-profit organizations requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. By their nature, these estimates are subject to measurement uncertainty. The effect of changes in such estimates on the financial statements in future periods could be significant.

(d) Financial instruments

The Society initially measures its financial assets and financial liabilities at fair value.

The Society subsequently measures all its financial assets and financial liabilities at amortized cost, except for investments in equity instruments that are quoted in an active market, which are measured at fair value. Changes in fair value are recognized in the statement of operations.

Financial assets measured at amortized cost include cash and accounts receivable. Financial liabilities measured at amortized cost include accounts payable. The organization's financial assets measured at fair value include quoted shares.

3. MARKETABLE SECURITIES – SHORT TERM

CSMB investments are recorded at market value. As required by CICA Section 3856 unrealized gains or losses on the portfolio as a whole at December 31 are recorded as "Net unrealized gains on marketable securities" and included on the Statement of Operations and Changes in Net Assets.

All amounts below are quoted in Canadian dollars.

	2017	2016
Cash and short term investments	379	978
Fixed income	82,261	73,300
Common equity	87,137	77,248
Cash and short term investments (US account)	2,811	424
Common equity (US account)	63,527	59,948
	$ 236,115	$ 211,898

4. ANNUAL CONFERENCE EXPENSES

	2017	2016
Exhibit and facility expenses	153,877	155,547
Receptions and banquets	30,680	18,656
Speakers travel and expenses	11,954	204,027
Awards	5,426	1,301
Meeting organizer fees	-	111,794
Supplies and other	6,723	137,182
	$ 208,660	$ 628,507

5. FINANCIAL INSTRUMENTS RISKS AND UNCERTAINTIES

The organization's financial instruments consist of cash, short-term investment, accounts receivable, and accounts payable and accrued liabilities. Unless otherwise noted, it is management's opinion that the organization is not exposed to significant interest rate, currency, credit, liquidity or cash flow risks. The fair value of these financial instruments approximate their carrying values, unless otherwise noted.

Market risk is the risk that the value of a financial instrument will fluctuate as a result of changes in market prices, whether the factors are specific to the instrument or all instruments traded in the market. The CSMB is exposed to market risk due to the volatile nature of equity investments.

Meeting Report: The 60th Annual Meeting of the CSMB

Celebrating Canadian Molecular Biosciences – from Organelles to Systems Biology

Dr. Frances J. Sharom
Bulletin Editor, Canadian Society for Molecular Biosciences
Professor Emeritus, Department of Molecular and Cellular Biology, University of Guelph

The 60th Annual Meeting of the Canadian Society for Molecular Biosciences was held May 16-20 2017 at the Shaw Centre in downtown Ottawa, located close to the Rideau Canal, and with great views over Parliament Hill and other historic buildings in our nation's capital. The conference was attended by over 400 researchers from across Canada and the U.S., and was designed to provide access to the special events taking place in Ottawa during 2017, which was Canada's 150th birthday.

Overview

CSMB 2017 was organized in a different format from previous meetings, offering multiple synergistic research themes, with the aim of attracting a larger number of attendees. A commitment was also made to embrace Equity, Diversity and Inclusivity (EDI), and the slate of speakers reflected the diversity of our membership, with over 50% being women and visible minorities. Half the speakers were invited, and the other half were chosen from the submitted abstracts, which ensured that scientists at all stages of their careers were able to communicate their research findings to a large audience.

The conference by jointly organized by researchers primarily at the University of Ottawa/Ottawa Institute of Systems Biology and Ryerson University; the Local Organizing Committee included Kristin Baetz (Ottawa, Co-Chair), Costin Antonescu (Ryerson, Co-Chair), Jean-François Couture (Ottawa), Roberto Botelho (Ryerson), Michael Downey (Ottawa) and Gregory Fairn (St. Michael's Hospital and the University of Toronto).

The conference was structured around 16 parallel sessions (8 in Organelle Biology and 8 in Systems Biology), four Special Joint Sessions, three award lectures and four special purpose Trainee Workshops. Overall, 83 oral presentations were given over the five days of the conference, by both internationally-known researchers and trainees.

The Annual General Meeting of the CSMB was held during the conference, and focussed on the past and future activities of the society on behalf of its members, especially its work to push forward the recommendations of the Naylor Fundamental Science Review regarding the organization and funding of scientific research in Canada. Optimism was expressed that the message was getting through to parliamentarians in the Trudeau government.

Meeting sessions

The main part of the conference opened with the Keynote Lecture and Jeanne Manery Fisher Memorial Lecture, given by Dr. Brenda Andrews, Department of Molecular Genetics at the University of Toronto. Dr Andrews described how her group used synthetic genetic arrays to complete a reference genetic interaction map for yeast, resulting in the largest dynamic biological network of its kind, essentially a genetic wiring diagram of the yeast cell. The lecture was followed by an open reception, which was also attended by local MPs of several CSMB members, which led to ongoing discussion of issues and future goals in the Canadian science funding landscape.

The 8 scientific sessions in the Organelle Biology theme covered the topics Membrane Trafficking and Sorting; Trafficking and Development; Membrane Trafficking in Cancer; Stress, Metabolism and Trafficking; Trafficking and Lipid Signalling; Pathogens; Organelle Contacts; and Organelle Identity and Biogenesis.

The Systems Biology of Neurobiology; Regenerative Medicine; Models of Rare Diseases; Biological and Synthetic Network Analysis: from Hairballs to Knowledge; Metabolomics and Metabolic Diseases; the Microbial World; Emerging Signalling Pathways; and Epigenetics made up the 8 sessions included in the Systems Biology theme.

Each session had at least one invited speaker, and all the sessions were timed to allow attendees to move between the parallel sessions, so that they could attend talks in each theme.

The four Special Joint Sessions were organized around topics of interest to all conference attendees, and covered Cancer Biology, Spatial Organization of Regulatory Networks, and ended with New Technology, and Synthetic Biology and Beyond, on the final morning of the meeting.

Award lectures

In addition to the Jeanne Manery Fisher Memorial Award lecture, delivered by Brenda Andrews (see above), Sergio Grinstein (Hospital for Sick Children and the University of Toronto), received the Canadian Science Publishing Senior Investigator Award, and delivered a fascinating talk on how receptors and integrins interact with both the cytoskeleton and the exoskeleton to initiate the process of phagocytosis. The last award lecture, which was scheduled in the final time-slot of the meeting was delivered by Martin Schmeing of the Department of Biochemistry, McGill University, who wowed the audience with musically accompanied conformational changes, as he described the structural biology of a fascinating group of nonribosomal peptide synthetases. Dr. Schmeing received the CSMB New Investigator Award. This was a suitably high note on which to end a very successful meeting.

Trainee events

The CSMB is committed to offering value-added events for our trainees at the annual meeting, and a group of trainee organizers, led by Victoria Hipolita (Ryerson), Trang Pham (Ottawa), Maneka Chitiprolu (Ottawa) and Kelsey Law (Toronto) did an amazing job at the Ottawa meeting. The afternoon of May 16 was devoted to four trainee workshops, and was followed by a networking event, all held at the University of Ottawa. The afternoon kicked off with two simultaneous 1-hour sessions, one entitled *"Strategic Communications: Marketing Yourself as a Trainee for Your Dream Career"*, led by Drs. Nana Lee and Reinhart Reithmeier from the Department of Biochemistry at the University of Toronto. The other session was devoted to *"Supporting the Professional Development of Women in STEM"*, and was led by Catherine Tsilfidis, Director of the Office of Equity, Diversity and Gender Issues, Faculty of Medicine, at the University of Ottawa, Dr. Imogen Coe, Dean of Science at Ryerson University, and Ariadni Athanassiadis, a lawyer with Kyma Professional Corporation, and President of WISE Ottawa.

After a coffee break, the careers theme continued with a workshop on *"PI/PDF Hunting: Preparing Future Faculty",* led by a group of faculty members from the University of Ottawa; Assistant Professor Mike Downey, Assistant Professor Mathieu Lavalle-Adam, Daniel Figeys, Chair of the Department of Biochemistry, Microbiology and Immunology, and David Lohnes, Chair of the Department of Cellular and Molecular Medicine.

A diverse group of scientists from government, various agencies and the private sector presented alternatives to academia in *"Alternative Career Options in Science: Not so Alternative Anymore"*, with Deborah Gordon-El-Bihbety (President of Research Canada), Linda Harris (Scientist with Agriculture and Agri-Food Canada),

Michael Donaldson (Content Development Manager, Canadian Science Publishing), Rafal Iwasiow (Vice-President, Research & Development at DNA Genotek), Sabrina Kim (Sector Analyst, Innovation, Science & Economic Development Canada), Angela Yeung (Program Officer at NSERC), and Carmen Gervais (Program Deputy Director, Network of Centres of Excellence/NSERC).

All the sessions were very well-attended, and were followed by a Trainee Networking event, where trainees mingled and talked with the workshop invited speakers. Later that evening, a Trainee Pub Night (to which all conference registrants were invited) was held at The Lieutenant's Pump on Elgin Street, where a good time was had by all.

Poster sessions

A large number of posters were presented at the meeting (117 in total) spread over two separate poster sessions on Wednesday and Thursday afternoons. The majority of the posters were presented by graduate and post-doctoral trainees and much lively discussion ensued. A team of volunteer judges visited all the posters that had been entered in the CSMB poster competition, and the authors were asked to explain their research in a brief presentation. It was a difficult task, given the very high quality of the posters overall, but several were judged to be outstanding and were awarded prizes:

Nina Ahlskog: M.Sc. student, University of Ottawa/The Ottawa Hospital Research Institute (Richard Bergeron's group)

Matthew Berg: Ph.D. student, Department of Biochemistry, University of Western Ontario (Chris Brandl's group)

Alexanne Cuillerier: Ph.D. student, Department of Cellular and Molecular Medicine, University of Ottawa (Yan Burelle's group)

Roni Levin: Ph.D. student, Hospital for Sick Children/ University of Toronto (Sergio Grinstein's group)

Emma Smith: M.Sc. student, Queens's Cancer Research Institute and Department of Pathology & Molecular Medicine, Queen's University (Susan Cole's group)

Enjoying Ottawa

Conference attendees were able to take advantage of the museums, the National Gallery, and many other activities on offer in Ottawa, as well as the thousands of colourful tulips on display in flower beds around the city as part of the annual Tulip Festival. The Brew Donkey beer tour held in the free-time afternoon was completely sold out!

The last evening of the conference was party night, with a lavish buffet banquet held at the Canadian Museum of Nature, surrounded by dinosaurs and some of the award-winning nature photos from the Canadian Geographic Wildlife Photography of the Year 2015 competition. The identity of the poster prize winners was revealed, and their awards were presented, to much applause. Everyone was impressed with the fabulous band, the PepTides (https://www.thepeptides.com/), who kept the dance floor packed and the audience rocking until late into the evening.

Sponsors and exhibitors

Finally, the conference benefited greatly from five platinum sponsors (the Canadian Institutes for Health Research, Canadian Science Publishing, Ryerson University Faculty of Science, the Ottawa Institute of Systems Biology and the University of Ottawa), five gold sponsors (Avanti Polar Lipids, the Ottawa Hospital Research Institute, Scientific Reports, StemCore Laboratories and ThermoFisher), three silver sponsors (the Rare Diseases: Models & Mechanisms Network, Traffic, and Wiley), as well as the Genetics Society of America and the International Journal of Molecular Sciences.

We also thank our exhibitors, including Agilent Technologies, GE Healthcare, Qiagen and Quorum, who benefitted from booth spaces located close to the many poster presentations where coffee breaks and refreshments were provided.

Scenes from the 60th Annual Meeting *Ottawa, 2017*

The Shaw Centre in Ottawa

The conference banquet and trainee awards presentation was held at the Canadian Museum of Nature

Participants in the conference could enjoy the thousands of colourful tulips on display as part of the annual Ottawa Tulip Festival

Dr. Nana Lee (University of Toronto) leads a trainee workshop on "Strategic Communications: Marketing Yourself as a Trainee for Your Dream Career"

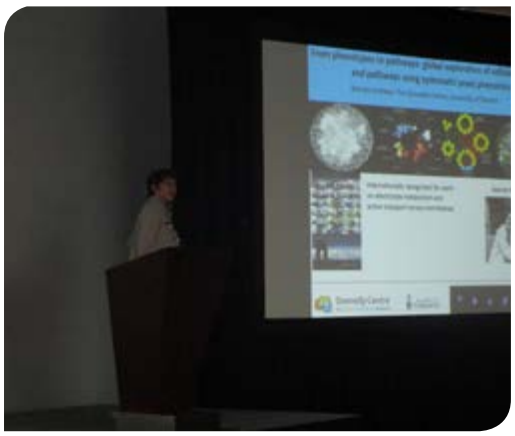
A trainee workshop on "PI/PDF Hunting: Preparing Future Faculty" was led by several faculty members from the University of Ottawa.

A panel of scientists from government, various agencies and the private sector led a trainee workshop on "Alternative Career Options in Science: Not So Alternative Anymore"

The trainee workshops were very well attended

The meeting was opened by conference Co-Chairs Drs. Kristin Baetz (University of Ottawa) and Costin Antonescu (Ryerson University)

Keynote Lecturer Dr. Brenda Andrews (University of Toronto) receives the Jeanne Manery Fisher Memorial Award from Dr. Kristin Baetz, President of the CSMB



Dr. Brenda Andrews (University of Toronto) introducing her talk at the podium

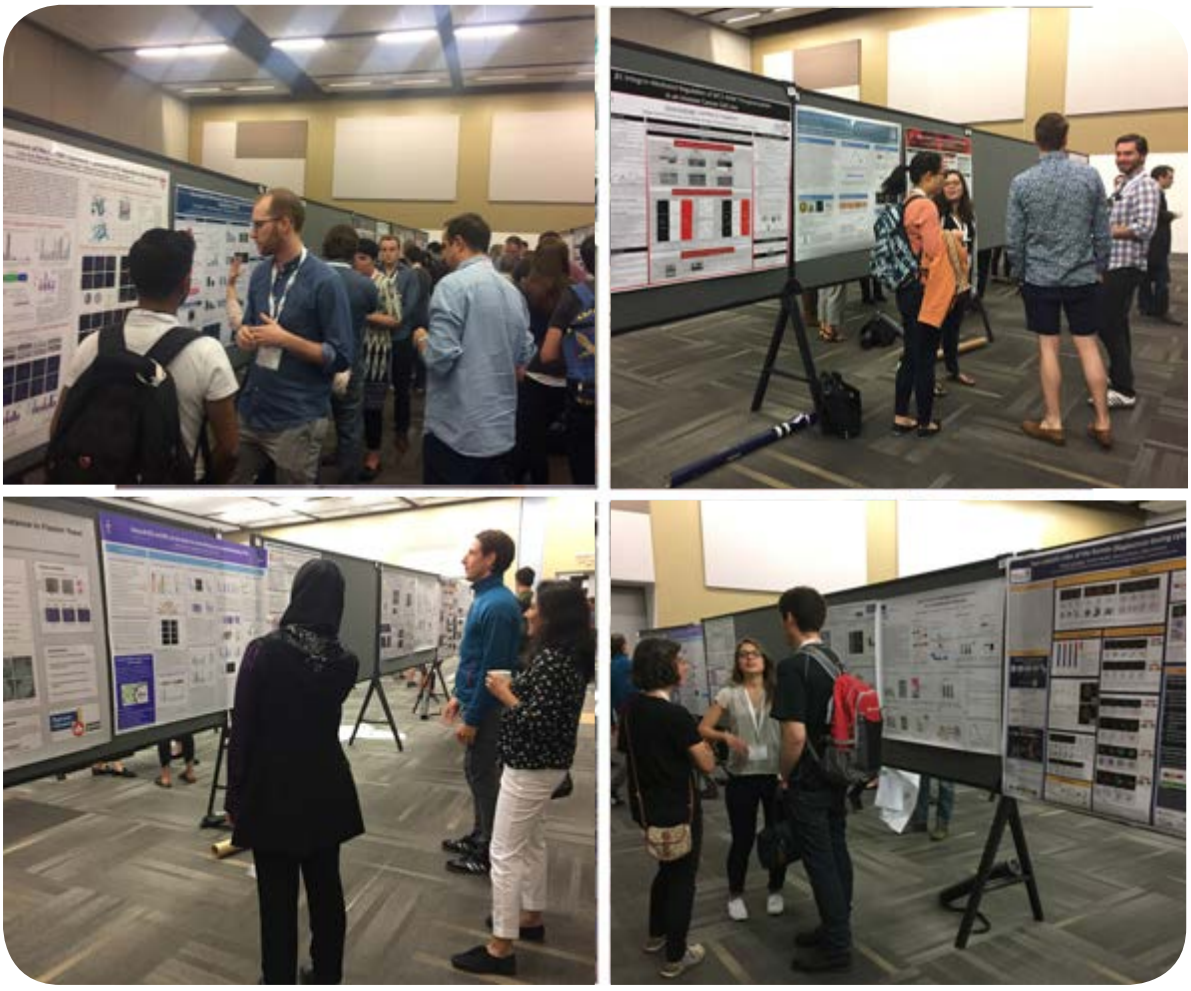
Dr. Kristin Bates, President of the CSMB, congratulates Dr. Martin Schmeing (McGill University), winner of the CSMB New Investigator Award"

Dr. Martin Schmeing delivers his conference talk

Conference attendees at the opening reception in the Shaw Centre

Dr. Imogen Coe (Ryerson University) at the opening reception

Lloyd Longfield (centre), Liberal MP for the Guelph riding, chatting with University of Guelph conference attendees, Dr. Nina Jones (left) and Dr. Frances Sharom (right)



Discussions at the poster sessions

Conference attendees presenting their talks

Agilent Technologies, one of the conference exhibitors

Canadian Science Publishing, a Platinum Sponsor of the 2017 meeting

Invitrogen, one of the conference exhibitors

ThermoFisher, a Gold Sponsor of the 2017 meeting

Qiagen, one of the conference exhibitors

GE Healthcare Life Sciences, one of the conference exhibitors

At the conference banquet, attendees partied with the dinosaurs

Nina Ahlskog receives an award for her poster presentation

Roni Levin receives an award for his poster presentation

Matthew Berg receives an award for his poster presentation

Alexanne Cuillerier receives an award for her poster presentation

High energy performance by the PepTides

The PepTides entertained the crowd for the evening

The dance floor was packed for much of the evening

Dr. Jef Boeke (New York University School of Medicine) gives his talk in the final Special Joint Session on "Synthetic Biology and Beyond"

Dr. H.J. Wieden (University of Lethbridge) gives his talk in the final Special Joint Session on "Synthetic Biology and Beyond"

Trainee Committee Activities 2017

CSMB Trainee Committee Twitter Campaign

The significantly increased investments in fundamental science announced in the 2018 Federal Budget could not have been possible without the unified and consistent voice of researchers at all career stages. We would like to say THANK YOU! to all the graduate students and post-docs who participated in the CSMB #NextGenCanScience Twitter campaign in the summer of 2017, for putting over 150 faces to the next generation of Canadian researchers acknowledged by this budget.

While there is much for trainees to celebrate, Budget 2018 notably did not commit funding to the Vanier-Banting scholarships. As Canada's Fundamental Science Review recommended a "total base increase of $140m per year be phased in over four years, in equal increments of $35m per year", we look forward to forthcoming consultations over the next year.

The Trainee Committee of CSMB continues to advocate for increased investments that better recruit, support and retain trainees in molecular biosciences across Canada.

Bensung Fong B.Sc. and Dr. Nafisa M. Jadavji
CSMB Trainee Representatives

Collage of the many images of trainees tweeted under the hashtag #NextGenCanScience

2018 CSMB Award Designates

CSMB New Investigator Award

The CSMB New Investigator Award recognizes meritorious research in one or more of the fields of biochemistry, molecular or cellular biology in Canada. Recipients have ten years or less of independent research experience, and demonstrate outstanding research accomplishments.

Dr. Katey Rayner

University of Ottawa

Katey Rayner is an Assistant Professor at the University of Ottawa Heart Institute in the Department of Biochemistry, Microbiology and Immunology, where she directs the Cardiometabolic microRNA Laboratory. She obtained her B.Sc. from the University of Toronto, and her Ph.D. from the University of Ottawa. Dr. Rayner's doctoral work focussed on the role of hormones, heat shock proteins and macrophage foam cells in the development of atherosclerosis. After her Ph.D., she pursued a post-doctoral fellowship, first at Massachusetts General Hospital then at New York University School of Medicine, where Dr. Rayner helped to discover a role for microRNAs, specifically microRNA-33, in the regulation of HDL and its atheroprotective effects.

Since establishing her lab at the University of Ottawa, Dr. Rayner's research program focusses on novel mechanisms that underlie the inflammatory processes of plaque progression and vulnerability, with a specific focus on the intersection between macrophage inflammation and microRNAs as drivers of disease. Her group has uncovered a novel role for microRNA control of mitochondrial respiration in macrophage cholesterol efflux. Dr. Rayner's research also examines how extracellular microRNAs are mediating the progression of atherosclerosis in both human and animal models. More recently, her group uncovered a role for programmed necrosis in the development of unstable plaques in mice and how this can be a therapeutic and diagnostic biomarker in humans.

Dr. Rayner has been recognized with awards such as the American Heart Association's Irvine H. Page Young Investigator Award, the Early Researcher Award from the Ministry of Innovation Ontario, and New Investigator Awards from both the Canadian Institutes for Health Research and the Heart and Stroke Foundation. Dr. Rayner's research is currently funded by the Canadian Institutes for Health Research, the Heart and Stroke Foundation of Canada and the National Institutes of Health.

NRC Research Press Senior Investigator Award

This award recognizes a record of outstanding achievement in research in one or more of the fields of biochemistry, molecular or cellular biology, undertaken in Canada by a Canadian scientist.

Dr. Richard Rachubinski

University of Alberta

Richard Rachubinski is a Distinguished University Professor and Chair of the Department of Cell Biology, Faculty of Medicine and Dentistry, at the University of Alberta. Rick is now in his fifth five-year term, and has excelled in research, department building and administration, mentoring of research trainees and service to the scientific community.

Dr. Rachubinski has been investigating and elucidating the molecules and mechanisms controlling the biogenesis of peroxisomes, membrane-enclosed organelles involved in lipid metabolism and the detoxification of reactive oxygen species. Peroxisomes are essential for human survival, a fact underscored by the existence of a number of inherited genetic disorders, collectively called the peroxisome biogenesis disorders (PBDs), resulting from dysfunction of peroxisome biogenesis. Dr. Rachubinski has defined how peroxisomes are made in cells, identified and characterized a number of genes (PEX genes) required for peroxisome biogenesis whose mutation causes the PBDs, elucidated how peroxisomes are inherited by cells to maintain the benefits of having peroxisomes, and developed an insect model of the PBDs that allows for the rapid screening of potential therapeutics to treat the disorders.

Dr. Rachubinski was an MRC Postdoctoral Fellow, Scholar, Scientist and Senior Scientist; a Howard Hughes Medical Institute International Research Scholar (three terms); and a Tier I Canada Research Chair in Cell Biology. He is a Fellow of the Royal Society of Canada, the Canadian Academy of Health Sciences, and the American Association for the Advancement of Science. He received the Royal Society of Canada's Queen Elizabeth II Diamond Jubilee Medal in 2013.

Dr. Rachubinski served as a member of the Advisory Board of the CIHR Institute of Genetics, a member of the Medical Advisory Board of the Canada Gairdner Foundation and co-chair of the Foundation's Medical Review Panel. In 2010 and 2012 he was Chair of the Genomics Research in Human Health Committee for Genome Canada.

Dr. Rachubinski's work is internationally recognized and has been instrumental in taking what was once a rather obscure organelle, with obscure diseases about which little was known, and catapulting it into the mainstream of both basic scientific and clinical investigation.

CSMB Arthur Wynne Gold Medal

The CSMB Arthur Wynne Gold Medal is presented to one or more individuals who have made a major contribution to biochemistry, molecular and cell biology in Canada over their career. The recipients of this life-time achievement award typically have attained an international profile in research, have played a major role in the development and promotion of the discipline in Canada, and have a long-standing record of service to the academic community. The Medal is named in honour of Professor Arthur M. Wynne, the first President of the Society, and was initiated in 2007 to celebrate the 50th Anniversary of CSMB.

Mona Nemer

Chief Science Advisor, Ottawa

As Canada's Chief Science Advisor, Dr. Mona Nemer's main role is to advise the Prime Minister and the Minister of Science on science issues. Before becoming the Chief Science Advisor, she was Professor and Vice-President, Research, at the University of Ottawa and Director of the Molecular Genetics and Cardiac Regeneration Laboratory. Dr. Nemer holds a Ph.D. in Chemistry from McGill University. Prior to joining the University of Ottawa, she was a Professor of Pharmacology at the Université de Montréal and directed the Cardiac Genetics Unit at the Montreal Clinical Research Institute.

Her research focussed on the heart, particularly on the mechanisms of heart failure and congenital heart diseases. She is the author of over 200 highly cited publications that have appeared in prestigious scientific journals. Her work has contributed to the development of diagnostic tests for heart failure and the genetics of cardiac birth defects. She has trained over 100 students from various countries.

Dr. Nemer has served on several national and international advisory committees and executive boards, and is the recipient of many national and international honours. She is a Member of the Order of Canada, a fellow of the Academy of Sciences of the Royal Society of Canada, a fellow of the American Academy of Arts and Sciences, a Knight of the Ordre National du Québec and a Knight of the French Republic's Ordre National du Mérite. She has also been awarded honorary doctorates from France and Finland.

Jim Woodgett

Lunenfeld-Tanenbaum Research Institute and the University of Toronto

Jim Woodgett is Director of the Lunenfeld-Tanenbaum Research at Sinai Health System and a Professor in the Department of Medical Biophysics, University of Toronto. He received his Ph.D. in biochemistry in 1984 from the University of Dundee, Scotland with Philip Cohen, and then pursued post-doctoral research at the Salk Institute with Tony Hunter, where he worked from 1984 to 1987 on the biochemical and molecular genetic characterization of protein kinases. He then moved to London, England to set up a research group at the Ludwig Institute for Cancer Research at the Middlesex Hospital, where he isolated and characterized the genes for several key cellular regulators including Glycogen Synthase Kinase-3, Protein Kinase B/Akt and the Stress-Activated Protein Kinases (JNKs).

In 1992, Dr. Woodgett moved to the Ontario Cancer Institute in Toronto, where his lab focussed on the signal transduction mechanisms underscoring malignant growth, degenerative diseases and diabetes. He also identified pathways regulating several transcription factors, generated the first mouse models for evaluation of GSK-3 functions, and showed that it was a physiological target of lithium. In 2005, he was appointed the fourth director of the Samuel Lunenfeld Research Institute at Mount Sinai Hospital, where he has continued his work on GSK-3, discovered mechanisms to maintain the pluripotentiality of stem cells, and studied the molecular etiology of breast cancer.

Of his 280 publications to date, over one third relate to GSK-3 and date back to the last chapter of his Ph.D. thesis, highlighting the long time-lines associated with pursuit of fundamental biological science. Over that time, he has trained over 40 students and fellows who have gone on to even more interesting things around the world.

Dr. Woodgett is a Fellow of the Royal Society of Canada and has been a Howard Hughes Medical Institute International Scholar, as well as an MRC Scientist and CIHR Senior Investigator. More recently, he has played key roles in Canadian science funding, including remediation of CIHR, and a community builder for support for the Naylor report on fundamental science. He is cautiously optimistic the 2018 Federal budget will begin to restore Canada's place in support of scientific research.

2017 Canadian Science Publishing Senior Investigator Award

Receptors and integrins interact with the cytoskeleton and the exoskeleton to initiate phagocytosis

Sergio Grinstein
Program in Cell Biology, Hospital for Sick Children, Keenan Research Centre for Biomedical Science, St. Michael's Hospital and Department of Biochemistry, University of Toronto

Upon binding their cognate ligands, most receptors transmit the information across the plasma membrane by undergoing a conformational change. As a result, serpentine receptors stimulate heterotrimeric G proteins, while a number of receptor tyrosine kinases become activated and autophosphorylate, and also phosphorylate cytosolic substrates. By contrast, certain immunoreceptors become activated when clustered, forming oligomeric complexes, without undergoing major conformational alterations. These include the phagocytic receptors that mediate the elimination of pathogenic microorganisms and the clearance of apoptotic cells and debris by the innate immune system. Macrophages, neutrophils and dendritic cells express an assortment of such phagocytic receptors with varied selectivity, which enables the recognition of a multiplicity of targets.

Clustering of immunoreceptors is caused by exposure to multivalent targets; in the case of phagocytic receptors, the prey displays on its surface multiple tightly spaced ligands that force the aggregation of their receptors, bringing them sufficiently close to one another to initiate signalling. How such clustering results in receptor activation has been studied extensively, yet remains incompletely understood. It is clear that Src-family kinases (SFKs) are involved in the earliest stages of the process, and that the receptors themselves and/or their ancillary subunits bear tyrosine residues that are substrates for phosphorylation by these kinases. However, whether the SFKs are constitutively active and whether they are physically associated with the receptors is still the subject of debate. The purpose of this brief review is to summarize recent insights into the mechanism whereby innate immune receptors coalesce, become phosphorylated, and thereby initiate the phagocytic response.

Receptor mobility amid a picket fence

Most of our studies of phagocytosis have used Fcγ receptors (FcγR) as a paradigm. Fcγ receptors recognize the Fc (fragment crystallizable) constant region of IgG, which is exposed on the surface of antibody-coated (opsonized) targets. To the best of our knowledge, when unstimulated, FcγR are not constitutively attached to any structural elements and, as such, are expected to diffuse freely along the plasma membrane. Contrary to this prediction, however, we found that FcγR are partly confined (Freeman *et al.,* 2018) and diffuse much more slowly than transmembrane proteins of comparable size reconstituted into plain lipid bilayers (see Kusumi *et al*., 2012 for examples). Confinement was detectable by tracking single FcγR molecules using fluorescently-labelled Fab fragments of receptor-specific antibodies; imaging single receptors over time revealed that, while mobile, a fraction of them are restrained from diffusing freely by a physical barrier akin to a corral.

That transmembrane proteins are constrained by corrals was first realized by Kusumi and his collaborators (*e.g.* Kusumi and Sako, 1996; Nakada *et al.,* 2003); these authors proposed that the dense meshwork of cortical actin and associated proteins that underlies the plasma membrane presents an obstacle to free diffusion, likely by colliding with the cytoplasmic tails of the transmembrane proteins. Fences need to be supported by pickets, and the cytoskeletal fence is no exception. It requires firm attachment sites to remain associated with the plasma membrane, and transmembrane proteins are thought to serve this role. Such pickets could in fact contribute to limit the diffusion of mobile components in the plane of the membrane. In this regard, it is worth bearing in mind that a substantial fraction of the plasmalemmal area (≈50%) is thought to be occupied by the transmembrane domain of proteins; immobilization of a significant fraction of these by tethering to the cytoskeleton would generate impassable obstacles that would retard or even prevent diffusion. This prediction is consistent with the observation that glycerophosphoinositide-linked proteins and even exofacial lipids diffuse more slowly in biological membranes than they do in pure lipid bilayers (Kusumi *et al.*, 2012).

The preceding considerations imply that membrane pickets are not only essential to fasten the cytoskeletal mesh to the membrane (thereby contributing to the establishment of actin-based corrals), but are themselves important diffusion barriers. As such, identifying and characterizing them is important. Remarkably, very little is known about the nature and properties of pickets. To address this issue, we postulated that *bona fide* pickets should meet two minimal criteria: 1) they must be integral membrane proteins that associate (at least transiently) with the cortical cytoskeleton and 2) to have significant impact on the diffusion of mobile components, they must be reasonably abundant. Applying these criteria, we selected CD44 as a likely candidate. This transmembrane protein was known to link to actin filaments *via* ezrin and ankyrin/spectrin (Fehon *et al*., 2010), and was readily detectable by immunostaining in phagocytic cells, suggesting it is abundant. We used specific antibodies to quantify CD44 in macrophages and established that there are approximately 10^6 copies of this protein per cell (Freeman *et al.*, 2018), a comparatively large number. Having met the two criteria to function as a picket, we proceeded to test whether CD44 does in fact curtail the diffusion of mobile transmembrane proteins, such as FcγR. To this end we used two independent approaches: depletion of CD44 using siRNA, and also comparison of wildtype and $CD44^{-/-}$ macrophages. We found that reducing or eliminating CD44 improved the mobility of FcγR, validating the role of CD44 as diffusion-limiting picket.

Collectively, these observations imply that areas of the membrane that are rich in cytoskeletal-anchored CD44 will confine receptors and thereby limit their ability to cluster and become activated. This raises the question of whether CD44 is firmly and homogeneously anchored throughout the cell. In this context, it is worth bearing in mind that, as immune sentinels, macrophages constantly migrate to survey their environment. During this exploratory surveillance the cells polarize, with a leading edge characterized by a broad lamellipodium and a narrower trailing edge or uropod. As described earlier for lymphoid cells, we found that the uropod of macrophages is rich in ezrin, which is comparatively depleted from the lamellipod. If ezrin is indeed responsible for CD44 tethering to the cytoskeleton, immobile pickets should be more abundant in the trailing edge of the cell. This prediction was validated experimentally: we used single-molecule tracking to assess the mobility of CD44 at the front and back of individual, polarized macrophages. Our results clearly indicated that CD44 is considerably more mobile in the lamellipod than in the uropod. Moreover, as predicted based on the differential degree of tethering of the picket(s), the mobility of FcγR was also greater at the front of the cells (Figure 1). These differences are not attributable to disparities in the net amount of F-actin, which seems to be similarly dense in the lamellipod and uropod. Instead, we believe that the manner in which the actin is organized is key: much of the actin driving the extension of the lamellipod is nucleated by Arp2/3, which generates branched filaments that grow perpendicularly to the plane of the plasmalemma. By contrast, in the uropod formins seem to contribute more to the formation of F-actin filaments, which are linear (unbranched) and tend to run close to and parallel to the membrane bilayer (Figure 1).

These observations have important functional implications. Phagocytosis will proceed more efficiently at the leading edge of the migrating cells (Figure 1), where the macrophages are most likely to encounter prey as they move up the gradient of chemoattractants released by the pathogens themselves, or by the cells that are inflamed during injury or infection.

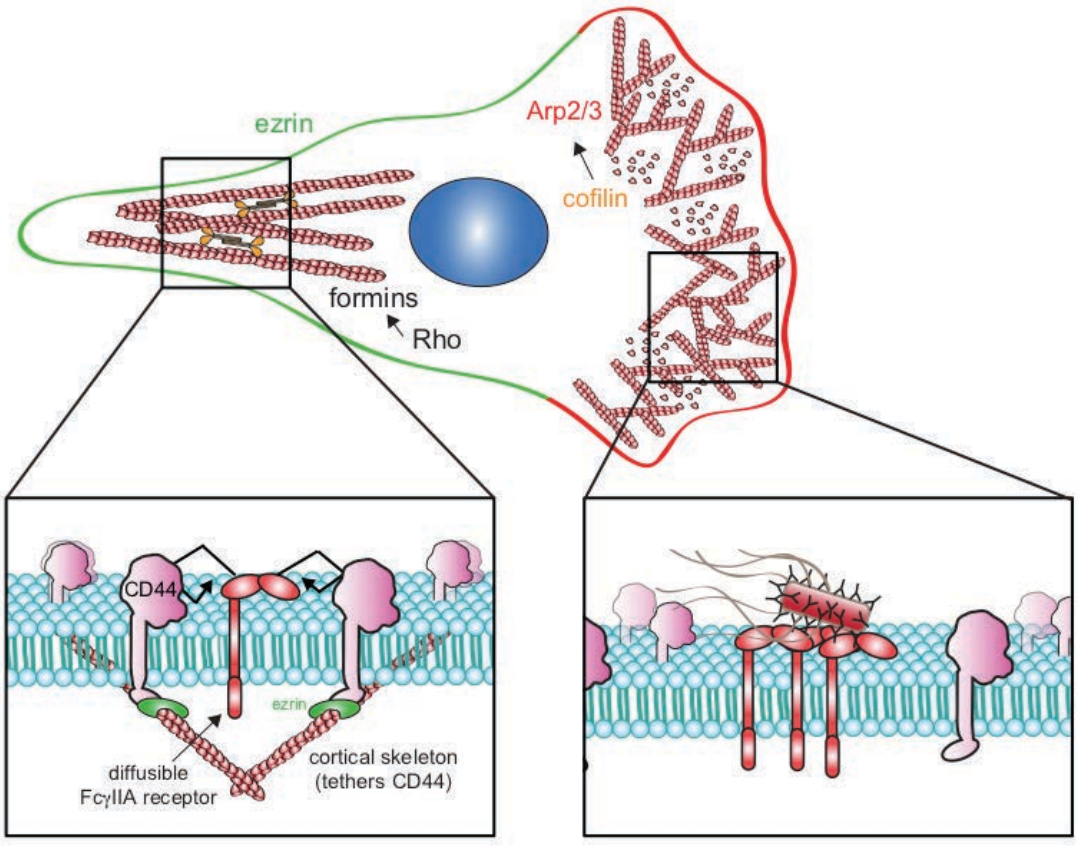


Figure 1. Schematic diagram illustrating the role of the actin cytoskeleton in phagocytic receptor mobility and function. *At the front of a migrating phagocyte, F-actin is primarily polymerized by Arp2/3, which propels the extension of the lamellipodium. This form of branched actin, which grows perpendicular to the plane of the membrane, is conducive to phagocytic receptor mobility, which facilitates engagement of the prey and receptor clustering and activation. Severing of filaments by cofilin provides monomeric actin to the Arp2/3 complex. At the back of the cell (the uropod) actin is mainly polymerized by formins, which are stimulated by RhoA and Cdc42 and generate linear actin filaments that run parallel to the plane of the membrane. Such filaments are preferred by ezrin, which bridges CD44 and other pickets to the actin meshwork, thereby confining and reducing the mobility of phagocytic receptors. As a result, receptor clustering and activation are minimized.*

CD44 is not an ordinary picket. In addition to its transmembrane and cytoskeletal-binding intracellular regions, it has a unique extracellular region bearing a Link (also called XLink, for extracellular Link) domain that serves as a receptor for hyaluronic acid (hyaluronan). Hyaluronan is a long, unbranched glycosaminoglycan consisting of a basic unit, a heterodimer of D-glucuronic and *N*-acetyl-D-glucosamine linked *via* alternating β-(1→4) and β-(1→3) glycosidic bonds, that is repeated hundreds or even thousands of times, forming strands of extraordinary length that can reach several microns! The inordinate length of the hyaluronan polymer, together with the high density of receptors (CD44) on the membrane, result in the firm adherence of the glycosaminoglycan to the cell surface. The profusion of hyaluronan strands, along with its immobility, creates a relatively rigid mesh on the outer surface of the cells, in some ways akin to the inner cytoskeletal meshwork.

Like the cortical cytoskeleton, the hyaluronan glycocalyx can interfere with the lateral displacement of membrane-associated molecules, particularly those that extend considerably into the extracellular space. Moreover, the anionic glycocalyx layer will impede the access of particulate material, especially that which is negatively charged, to the (relatively short) phagocytic receptors. One can therefore predict that treatment of the macrophages with hyaluronidase or with other glycocalyx-removing enzymes will in fact facilitate phagocytosis, and that access of phagocytic targets

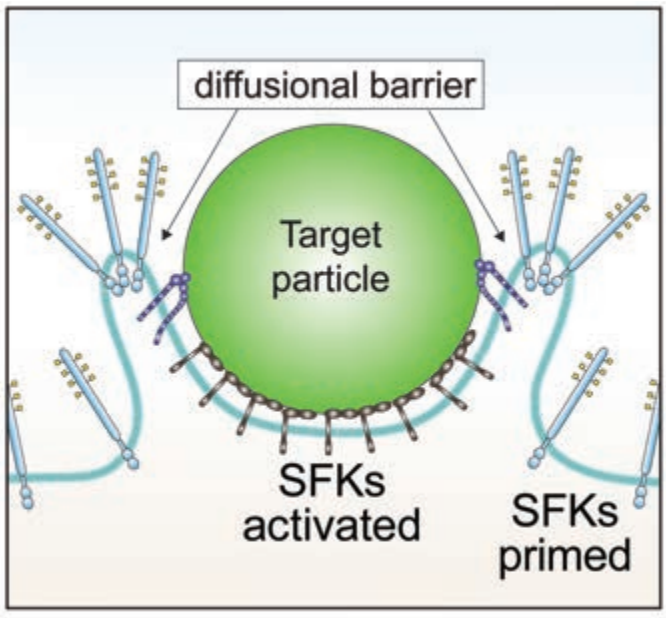


Figure 2. Schematic diagram illustrating the generation of a diffusion barrier during activation of phagocytic receptors.
Engagement of phagocytic receptors (e.g. FcγR; shown in grey under the target) induces inside-out activation of vicinal integrins (shown as heterodimers in violet). The close apposition of integrins and receptors to the target (shown in green) forms a diffusional barrier that excludes the longer and rigid phosphatases CD45 and CD148 (shown outside the phagocytic cup, in blue with yellow sugar residues). Outside the cup, the phosphatases aid in priming the Src-family kinases (SFKs), while their exclusion from the area of the cup enables sustained activation of the SFKs.

would be greater at the front of migrating cells, where the pickets that anchor the exoskeleton are more mobile, than at the cell's back.

Initiation and spreading of receptor signals

It is generally acknowledged that, once the immunoreceptors are clustered, the next step involves the activation of SFKs. SFKs exist in three functional states: inhibited, primed and activated. Phosphorylation of a tyrosine residue located near the C-terminus inhibits the activity of the kinase (Davis and van der Merwe, 2006). This results from a conformational change associated with the intramolecular association of the C-terminal phosphotyrosine with the SH2 domain of the kinase. This inhibition can be relieved by CD45 and/or CD148, two related tyrosine phosphatases that are uniquely abundant in hemopoietic cells. Dephosphorylation of the inhibitory tyrosine primes the SFKs for activation, which requires the additional phosphorylation of another tyrosine residue, located further away from the C-terminus. This phosphorylation can be enacted by the SFKs themselves or by another important tyrosine kinase, Syk.

It is important to note that the activating phosphotyrosine is also a substrate of dephosphorylation by CD45 and CD148. How then is the activation of the kinases established and maintained? The secret lies in the physical segregation of the CD45/CD148 from the activated (phosphorylated) kinases. This striking phenomenon was first observed by Goodridge *et al*. (2011), who noted the marked exclusion of the phosphatases from sites where phagocytosis was being initiated (*i.e.* nascent phagosomal cups). The process whereby CD45 and CD148 are excluded from the cup is as interesting as it is remarkable. The phosphatases are displaced vectorially (radially) away from the sites where phagocytic receptors are engaged by ligands on the particle. Despite the net directional (vectorial) displacement – which can amount to several microns – the individual phosphatase molecules appear to be driven by Brownian motion, as we validated by single-particle tracking (Freeman *et al*., 2016). What confers directionality to the process is the concerted formation and evolution of an expanding diffusion barrier that excludes CD45 and CD148 from the areas where the phagocyte makes contact with its target. The tight apposition of the two interacting surfaces extrudes the phosphatases, which are too long and rigid to fit in the confined space of the contact zone (Figure 2).

While binding of the comparatively short phagocytic receptors to their ligands on the target surface may appear to be sufficient to exclude CD45/CD148, the leading edge of the diffusion barrier (and hence of the exclusion zone) is in fact established by integrins (Figure 2), which generate podosome-like structures ahead of the receptor contact regions. The integrins are activated from the inside out by signals emanating from the stimulated phagocytic receptors. This has two important consequences: 1) it extends the reach of the contact zone to areas where FcγR-IgG interactions have not yet occurred (and may not be able to occur, if the ligand density is low, as is likely

to be the case under physiological circumstances where the supply of immunoreactive IgG is limited), and 2) it enables the more promiscuous integrins to secure the association with the prey and possibly draw distant IgG molecules near additional receptors on the phagocyte surface. How the expansion of the diffusion barrier is coordinated remains to be established in detail and is the subject of current studies in our laboratory.

In closing, I hope that this brief summary of recent work in our laboratory illustrates how a seemingly simple interaction between phagocytic receptors and their ligands, heretofore thought to operate merely as "molecular velcro", is considerably more subtle and complex, encapsulating interactions between the receptors and a highly structured yet dynamic cytoskeletal picket fence, an underappreciated exoskeleton generated by the glycocalyx, and integrins, all interconnected by carefully orchestrated signal transduction.

Acknowledgments

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2017 CSMB New Investigator Award

Structural insight into nonribosomal peptide synthetases, natural antibiotic factories

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Introduction to nonribosomal peptide synthetases and their products

All members of the Canadian Society of Molecular Biosciences are familiar with the ribosome, but not all know that there are other massive peptide-making molecular machines in nature. In bacteria and fungi, there is a class of megaenzymes called nonribosomal peptide synthetases (NRPSs) (*1,2*). Instead of making proteins, NRPS make a wide variety of short peptide secondary metabolites (*3*). For example, NRPS products include antibacterials, antifungals, antivirals, anti-tumours, immunosuppressants, siderophores, toxins and virulence factors. Some of these NRPS products are of critical importance to human health, from the millions of lives penicillin has saved, to the organ transplants made possible by cyclosporin and related compounds, to fighting methicillin-resistant *Staphylococcus aureus* infections with celophalosporin, and countering hospital Gram-positive infections with daptomycin.

NRPS products often don't resemble proteinaceous peptides. As well as the 20 standard amino acids, over 500 others can be incorporated into the peptide, including D-amino acids, non-proteinaceous amino-acids, cyclic amino acids, N-, O- and C-methylated amino acids, hydroxylated amino acids, aryl acids, hydroxy-acids, keto acids and fatty acids (*4,5*). The peptide products are also often cyclic and can be branched (Figure 1A). These differences from proteinaceous peptides result from the dissimilar mechanisms of reaction and processivity of the ribosome and NRPSs.

NRPSs resemble assembly lines that are dedicated to making one kind of peptide (*6*). They are organized into modules of >1000 amino acids, with each module possessing the catalytic activities required for the addition of one specific amino acid or other monomer building block into the growing peptide (*1,2,7,8*). Typically, the number and order of the modules correspond to the length and sequence of amino acids in the peptide product. NRPSs can be as short as one module or as large as eighteen modules, with a molecular weight of over 2 MDa in a single protein chain. They can be a single huge polypeptide chain or be split over multiple chains which assemble through non-covalent interactions (*9*). Modules contain multiple domains, each with a specific function in peptide synthesis. A basic module contains a condensation (C) domain, an adenylation (A) domain and a peptidyl carrier protein (PCP) domain.

Figure 1B outlines the catalytic cycle in a canonical NRPS elongation module, which can be thought of as one group of stations on the assembly line (*1*). The A domain recognizes and binds the substrate amino acid and first catalyzes its adenylation, then its linkage as a thioester to the prosthetic 4'-phosphopantetheinyl moiety on a PCP domain. The PCP domain transports the amino acyl thioester to the C domain. The C domain catalyzes condensation (peptide bond formation) between this amino acyl-PCP and an amino acid or peptide attached to the PCP domain of the preceding module. This transfer creates an elongated peptidyl-PCP, which then moves to the downstream C domain for peptide donation in the

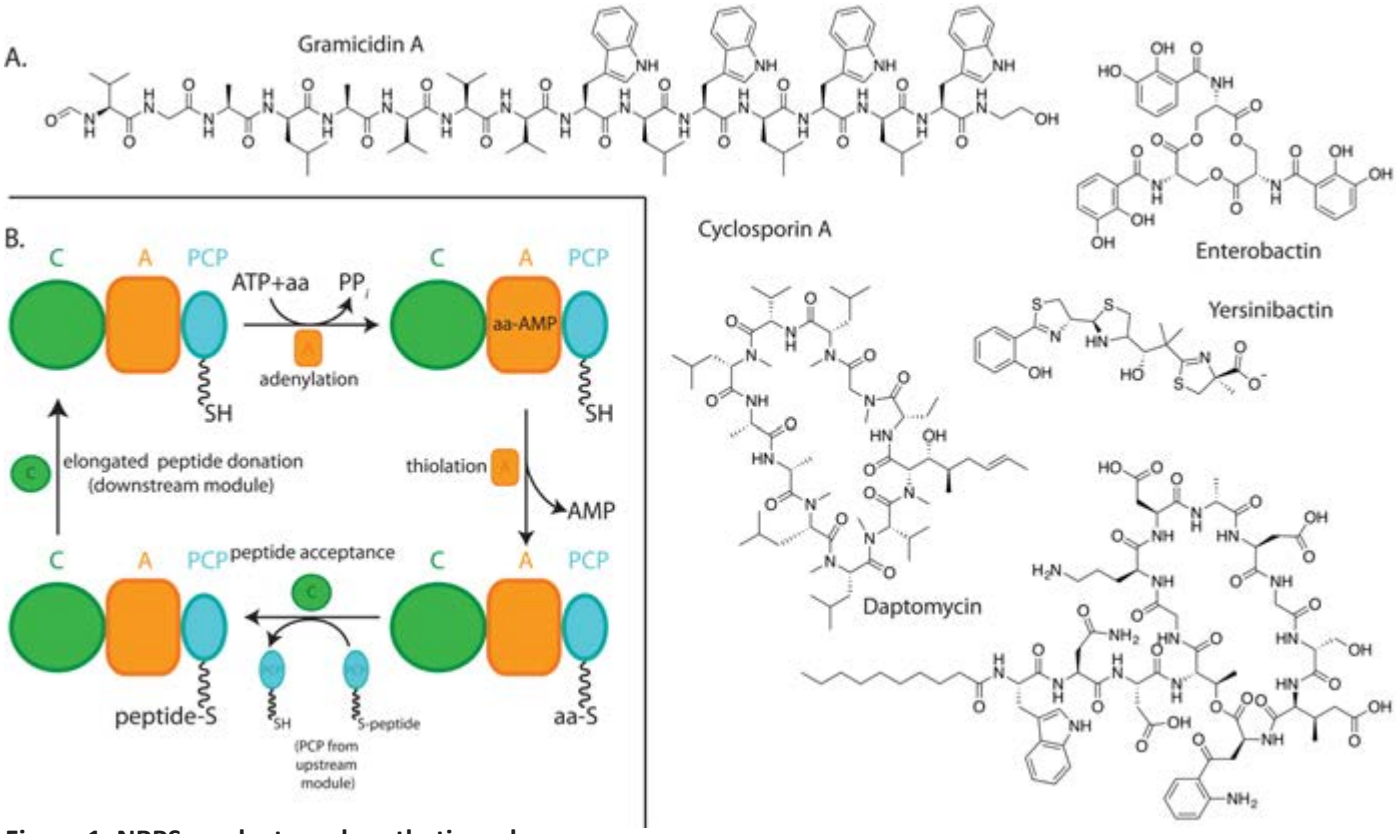

Figure 1. NRPS products and synthetic cycle

A, Some nonribosomal peptides; B, The synthetic cycle of a basic NRPS elongation module. Figure adapted from Reimer et al. (24).

next condensation reaction. Once a PCP domain has donated its attached peptide, it is free to accept a new amino acid from the A domain and participate in the next cycle of assembly line peptide synthesis.

NRPSs usually don't just consist of multiple copies of these three kinds of domains, however. In almost all NRPSs, one or more modules contain additional "tailoring" domains, domains which introduce chemical modification into the peptide co-synthetically (*10,11*). These tailoring domains include: epimerisation (E) domains, which catalyze the racemization of L to D amino acids; methyltransferase domains, which conjugate methyl groups to carbons, oxygens or nitrogens in the peptide; cyclization domains, which replace C domains and catalyze both condensation and intramolecular heterocyclization; reductase and oxidase domains which introduce or remove double bonds, and formylation (F) domains, which N-formylate the first amino acid (*5*). Termination modules also must contain a dedicated domain to release the peptide from its covalent attachment to the PCP domain in the appropriate form. The last domain in an NRPS termination module is often a thioesterase (TE) domain, which cleaves off covalently tethered peptide by catalyzing attack of water (resulting in a linear product) or an internal nucleophile (giving a cyclic product) (*12*). Other NRPSs terminate with reductase (R) domains, which perform reductive cleavage of the peptide thioester to an aldehyde or alcohol (*13*). The general organization of a canonical NRPS is thus A-PCP-(C-A-PCP)n-TE/R, with the tailoring domains sometimes inserted. The combination of the >500 possible building blocks, many tailoring domains and several modes of peptide release allow NRPS products to occupy a vastly larger portion of chemical space than would be expected for small peptides (*4,10,11*).

As described, canonical NRPSs have a straight-forward synthetic logic, with each core and tailoring domain performing a known role. In addition, the selection of the amino acid/monomer substrate is determined by a binding pocket which has been so well studied that it can now be predicted robustly from A domain sequence refinements (*14-17*). Together, this makes NRPSs remarkable in that their metabolite product can

be predicted fairly confidently from simple sequence analyses of the domains present in each module, and the inferred specificity of each A domain.

Because of the simple synthetic logic of NRPSs and the therapeutic or commercial value of their products, there has been great excitement about their potential as a source of new bioactive compounds. Bioengineering strategies for NRPS are conceptually straightforward: Changing the substrate specificity of modules, reordering modules, and inserting or removing individual domains all have predictable effects on the peptide product. Furthermore, combinatorially ordering modules could produce vast libraries of diverse peptides. Efforts to exploit these systems have been underway for decades, but have only had limited success (*18-23*). The potential of combinatorial or rational bioengineering methods can be facilitated by a deep understanding of the architecture and mechanisms of these huge machines. Many excellent structural studies have contributed to our current understanding of the NRPSs. Essentially all the core and tailoring domains have been structurally characterized, there are several nice di-domain structures, and a few modules have been determined (reviewed in (*7,24*)). However, more studies on domain architectures, large-scale motions and domain-domain interactions are necessary to understand these megaenzymes.

Linear gramicidin synthetase

Most of the research presented at the CSMB New Investigator Award lecture focussed on an interesting NRPS called linear gramicidin synthetase, which makes a clinically-used topical antibiotic (*25,26*). Linear gramicidin is part of the Polysporin eye drops and triple action antibiotic cocktails that many CSMB members will have in their medicine cabinet. Linear gramicidin synthetase is a 16-module system, spread over 4 proteins (LgrA-D) that come together through non-covalent interactions. It was first described by Marahiel and co-workers around a decade ago, and has two notable features which are important for the peptide product (*27,28*). First, every second module in the system contains an epimerization domain, and thus every second residue in linear gramicidin has D chirality. (Linear gramicidin is FormylVal-Gly-Ala-*D*-Leu-Ala-*D*-Val-Val-*D*-Val-Trp-*D*-Leu-Trp-*D*-Leu-Trp-*D*-Leu-Trp-Ethanolamine.) This allows the peptide to fold into an unusual "beta-helical" conformation, where the main chain is in the centre of the broad helix and the side chains are facing outward. Second, the first domain in the initiation module of the NRPS is a formylation domain, which catalyzes N-formylation of the first residue, valine. The formyl group allows head-to-head dimerization of linear gramicidin. Two gramicidin helices are just the right size to span a bacterial membrane, insertion into which is promoted by the peptide's non-polar side chains (*26*). The centre of the beta helix is wide enough to allow monovalent ions to pass freely through the membrane, allowing linear gramicidin to form a pore, collapse the ion gradient and kill the bacteria.

We set out to gain a structural understanding of formylation in NRPSs (*25*). Marahiel had established that the formylation (F) domain was homologous to stand-alone formyl transferase proteins, and that it acted after adenylation and ligation of valine to the thiol of the PCP domain's phosphopantetheine arm (thiolation), but before peptide donation in the second module's condensation domain. Our specific questions were: What is the structure of the F domain? Is the formylation event the same as in canonical formyl transferase proteins? How is the F domain incorporated into the NRPS architecture? What are its origins? How does the PCP domain interact with and deliver the substrate to the F domain?

Our first experiments were quite modest in scope. We wanted to solve the structure of a construct of LgrA that only contained the F domain. The two talented graduate students who started working on this project, Janice Reimer and Martin Aloise, had each been focussing on other NRPS projects that were, despite their excellent efforts, not yielding many results. We believed that a construct of a ~180 residue domain, which displayed homology to previously characterized proteins, may be easily amenable to structural study. (And if the larger, more interesting constructs of LgrA were problematic to work with, the studies on the F domain alone would give Janice and Martin their first paper from the lab, allowing them to return to their main projects with a publication in tow.) Janice and Martin cloned and attempted expression, purification and crystallization of F domain constructs from several species, but these constructs proved problematic. The constructs expressed only at low levels, were prone to aggregation and never crystallized. However, the project took a turn for the better when we switched to F-A didomain constructs.

Linear gramicidin synthetase F-A didomain from *Brevibacillus parabrevis* expressed at moderate levels, behaved well during purification and readily formed

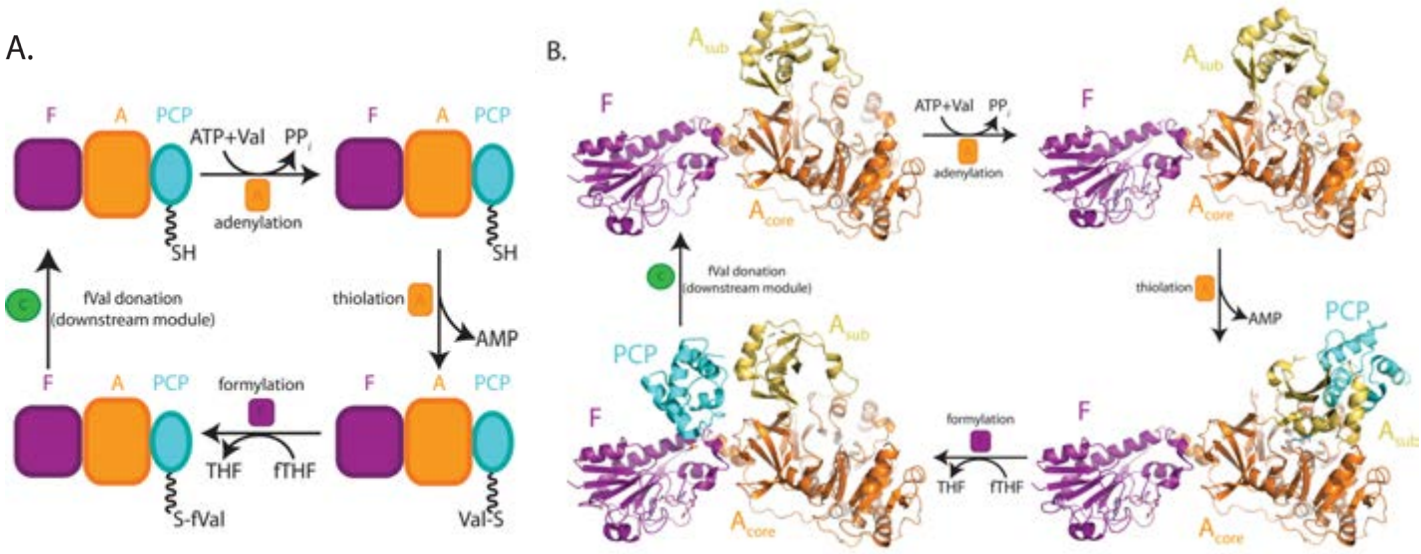

Figure 2. Synthetic cycle of the initiation module of linear gramicidin synthetase A.
A, Schematic of the initiation cycle. B, Crystal structures of the initiation cycle. Figure adapted from Reimer et al. (24) and Reimer et al. (25). Please see also the animation at www.youtube.com/watch?v=0Gge2uSvZ1U&feature=youtu.be.

crystals, the best of which diffracted to 2.5 Å resolution (*25*). Marahiel had established that the formylation (F) domain was homologous to stand-alone formyltransferase proteins (*27*). We solved the structure by molecular replacement, which revealed a very elongated F-A di-domain conformation. The F domain was recognizable because of its expected similarity to formyltransferase proteins and the A domain looked like a canonical A domain (*29*). Their fusion produced a fairly large interface between the ends of each domain, which buries 830 Å^2 of surface area, and gives the appearance that the F domain was "snapped on" like a Lego block to the N terminus of the A domain. The extensive interface is reminiscent of interfaces between C domains and A domains within an elongation module, which is also large, but very different from other tailoring domains, for example the E domain, which is connected to the rest of its module only by a flexible linker. This interface hinted that it was a fortuitous gene fusion event that led to the incorporation of the F domain into the NRPS architecture in this elegant way. Furthermore, structural and sequence analyses showed that the pre-transfer gene likely encoded a formyltransferase involved in modification of sugar-nucleotide substrates (*25*).

The F-A didomain structure revealed how the F domain was incorporated into NRPS architecture, but because of the absence of the PCP domain (and disorder of the important C-terminal part of the A domain called the A_{sub}), it did not show how the F domain functions in the LgrA initiation cycle. So, Janice and Martin expressed a full initiation module (F-A-PCP) construct, treated samples with several different cocktails of substrates and inhibitors, and undertook crystallization (*30*). This full initiation module also gave several initial crystallization "hits", three of which could be optimized for structure determination at between 2.6 Å and 3.8 Å resolution (Figure 2).

The position of the A_{sub} and PCP domain varied between structures, but in each, the extended F-A_{core} conformation was maintained in a very similar way. That this conformation was maintained in many different crystal packing environments hinted that the extended conformation is a constant, but to test this we turned to solution small angle X-ray scattering (SAXS). The low-resolution envelope calculated from the scattering curve fitted well with one crystallographic conformation of F-A-PCP, but not surprisingly, no simulated scattering curve from a single crystallographic conformation fully recapitulated the experimental data. However, when a single extended F-A_{core} conformation was combined with the ensemble of positions of A_{sub} and PCP domain, the simulated scattering curve matched the experimental data exceedingly well. The SAXS data is thus consistent with a constant elongated F-A_{core} conformation and mobility of smaller elements. The active sites of the F and A domains are >50 Å apart in the elongated conformation and must therefore remain far apart throughout the catalytic cycle, despite catalyzing successive reactions. Gratifyingly, through appropriate use of substrates and inhibitors, but with no

small contribution of good fortune, our F-A-PCP structures captured each major catalytic stage of the initiation module's synthetic cycle. Several of the states recapitulated those seen in catalytically-relevant structures of A or A-PCP constructs, but the tailoring story is new, and all these states are seen in the context of a single protein for the first time (Figure 2) (*29,31-33*).

The cycle starts with valine and ATP binding to the A domain in an "open" conformation, where the A_{sub} is rotated back to give access to the binding sites (Figure 2) (*34*). The A_{sub} then rotates "closed", donating a lysine to facilitate the adenylation reaction (*29,35*). This valine adenylate is the substrate in the next step, thiolation, for which the A_{sub} rotates 140°, allowing the PCP domain to bind and accept the amino acid as a thioester on its pantethiene moiety (*36,37*). Next, the valinyl thioester must travel the >50 Å to the F domain, which requires large-scale movements of both the A_{sub} and the PCP domain. The A_{sub} rotates fully 180° and translocates its centre of mass by 21 Å to facilitate the 75° rotation and 61 Å translocation the PCP domain undergoes to deliver the valinyl thioester to the formylation active site. There it accepts a formyl group onto its amino group from N10-formyl tetrahydrofolate by a canonical formyl transfer mechanism (*27,38,39*). The PCP then must make another massive movement to donate the formyl-valinyl in the peptidyl transferase reaction in the C domain of the downstream module (for which no structure is published, but at which the CSMB audience got a sneak peek). Donation of the formyl-valinyl group frees the PCP domain to participate in the next round of assembly-line synthesis. A simplified version of the synthetic cycle in "morphing" animation form was presented, and can be viewed at www.youtube.com/watch?v=0Gge2uSvZ1U&feature=youtu.be.

The most informative single structure of the series we solved is that of F-A-PCP in the formylation state (Figure 2). In this structure, the PCP domain presents the valinyl-pantetheine to the F domain's active site. The PCP domain makes a small contact surface with the C-terminal portion of the F domain, and is at the right distance for the valinyl-pantetheine to stretch out to the catalytic triad and fTHF cofactor. (The 3.8 Å resolution of this structure meant the valinyl-pantetheine was not visible in the electron density, but a conformation which positioned the valine amino group perfectly for reaction could be easily modelled.) Superimposition of the F-A-PCP formylation state with a sugar-nucleotide formyltransferase showed that the valinyl-pantetheine and the sugar-nucleotide substrate bind in very similar ways, and share similar physical lengths and mixed hydrophilic/hydrophobic nature (*38*). This cryptic similarity between substrates likely allowed the nascent F domain to quickly evolve activity on NRPS substrates.

A comparison of the F-A-PCP formylation state with formyl-methionyl transferase (FMT) is also informative. In both enzymes, the macromolecular substrate (valinyl-pantetheine-PCP and Met-$tRNA^{fMet}$) make relatively little contact with the catalytic formylation domain. In FMT, there is a second, C-terminal domain whose role is to make extensive contacts with the tRNA, positioning it for formylation (*40*). In an analogous fashion, we observe the A_{sub} forming a novel, second interface with the PCP domain, which appears to aid in positioning its valine substrate for formylation in the F domain.

More than a module

The studies of the initiation module of LgrA show a nice holistic picture of the synthetic cycle within a module. The publication describing these appeared adjacent to a very nice one from the Gulick laboratory describing structures of elongation modules (*41*). However, the question of what NRPSs with more than one module look like is still an open one. It has been proposed that multi-modular NRPSs assume a super-helical structure with a constant pitch. Mike Tarry and Asfarul Haque from the lab performed a study with a canonical, non-tailoring NRPS to start to look at super-modular architecture (*42*).

The bacillibactin synthetase protein DhbF was chosen for this study largely because of its canonical C_1-A_1-PCP_1-C_2-A_2-PCP_2 architecture (*31,43-45*). We took a double-pronged approach of electron microscopy and X-ray crystallography. In our crystallography work, because we were unable to crystallize the full dimodular construct, we targeted a construct of the 3rd to 5th domains, A_1-PCP_1-C_2. We reasoned that since this construct contains the last large domain from the first module and the first large domain from the second module, it could reveal insightful information about the relative orientations of the two modules. We used an aminoacyl-vinylsulfonate adenosine dead end inhibitor, which becomes attached to the PCP and limits its movements, which facilitated crystallization and structure determination to 3.0 Å resolution (*37,41,42,46-48*). The A and PCP domains of A_1-PCP_1-C_2 were in a conformation similar to the thiolation state, as expected with use of the dead-end inhibitor (Figure

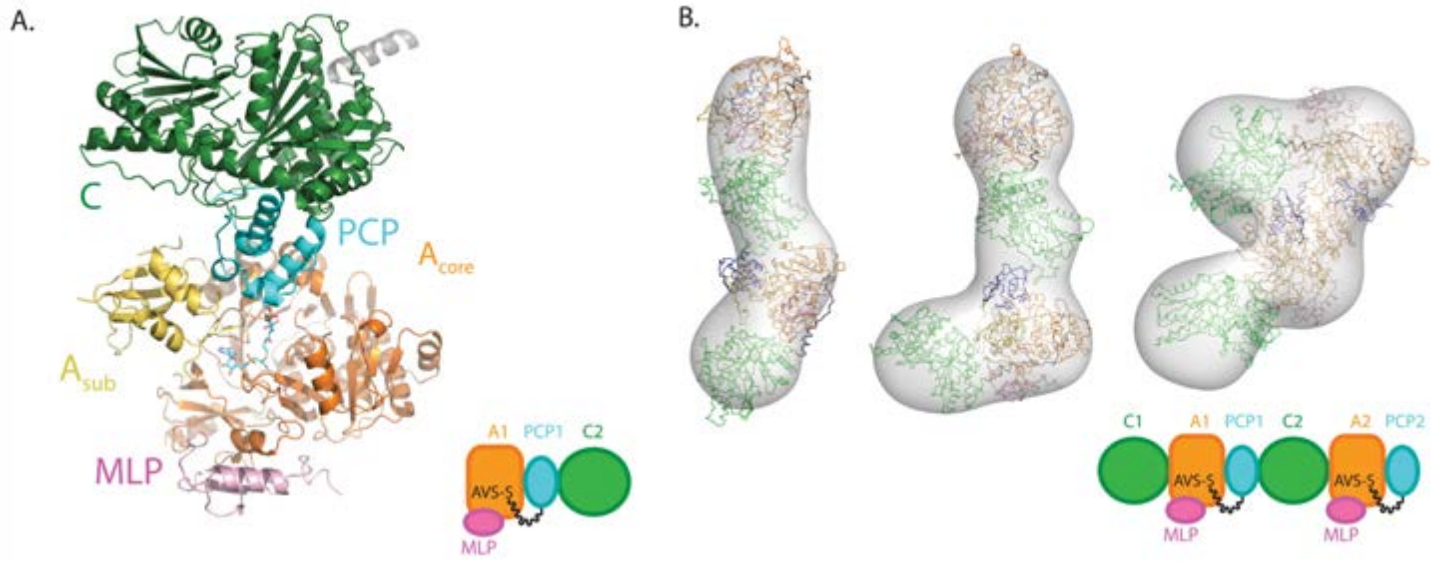

Figure 3. Structural biology of the NRPS DhbF.
A, Crystal structure of the central construct of DhbF. B, Three negative stain EM reconstructions of dimodular DhbF. Figure adapted from Tarry et al. (42) and Reimer et al. (24). MLP is a small accessory protein required by some NRPSs.

3). Surprisingly, there were no interactions between A_1 and C_2. The only contact between C_2 and the rest of the protein is between its donor site and the "back end" of PCP_1. This contact cannot be maintained throughout a productive synthetic cycle, hinting that there is not a constant module:module interface. The negative stain EM of full dimodular C_1-A_1-PCP_1-C_2-A_2-PCP_2 lent support to this notion. From a single data set, inhibited with the same kind of dead end inhibitors, we could calculate 5 (or more) different molecular envelopes, all of which could be fitted to didomain models with different conformations and module:module interfaces. Thus, even when DhbF was restricted to a single catalytic state by dead-end inhibitors, it still displayed a large number of super-modular conformations. It is possible that other NRPSs may assume a regular, helical conformation of modules, but it does not appear that DhbF does (*42*).

Together, the CSMB award lecture is a story of conformational changes. With LgrA, we saw that the main two domains are largely relatively fixed, but that A_{sub} and the PCP domain must be dynamic to perform a synthetic cycle. The studies with DhbF showed that varying module:module conformations are also prevalent. There are certainly likely to be other important conformations to be captured in the future before we have a complete view of these complicated and elegant macromolecular machines.

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News from Member Departments

Dalhousie University

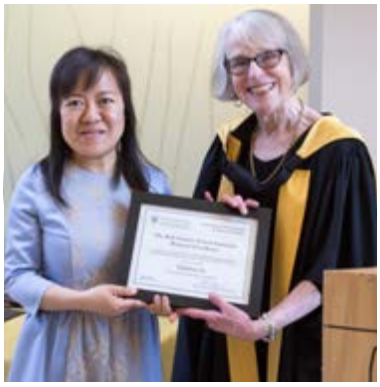
Department of Biochemistry and Molecular Biology
Correspondent: Stephen L. Bearne

The 2017-18 academic year has been an interesting year for the Department of Biochemistry and Molecular Biology at Dalhousie University. With a new strategic plan within the Faculty of Medicine, research has been prioritized into "waves" that could impact future recruitments and research directions for the Department. **Stephen Bearne** was renewed as Head for a second 5-year term. **John Archibald** was appointed Director of the Centre for Comparative Genomics and Evolutionary Bioinformatics, replacing **Andrew Roger** who had served in that role for 9 years since the Centre's inception in 2008. Ford Doolittle was awarded the 2017 Motoo Kimura Lifetime Contribution Award from the Society for Molecular Biology and Evolution. **Paola Marignani** hosted Dr. Feng Zhang (MIT, noted for his work on optogenetics and CRISPER) who, as the Dalhousie Medical Research Foundation/ Gairdner Lecturer, delivered a comprehensive seminar to a packed auditorium. The Department's laboratory technician **Heidi MacKinnon** received the 2017 Faculty of Medicine Excellence in Leadership Award in recognition of the vital role that she plays in the operation of the Department and its undergraduate laboratories.

Dr. John Archibald, new Director of Dalhousie's Centre for Comparative Genomics and Evolutionary Bioinformatics (photo courtesy of Heidi MacKinnon)

The graduate students and post-doctoral fellows organized a student research day that featured poster presentations, brief lectures from various faculty on their career paths, and a seminar by Dr. Anne Spang (University of Basal). In addition, the Department has continued to celebrate the success of its students, post-doctoral fellows, and research associates during the past year. **Mitesh Nagar,** a graduate student with **Stephen Bearne** was awarded the Patrick Prize for best PhD thesis. **Dr. Lingling Xu,** a post-doctoral fellow with **Jan Rainey** and **Paul Liu**, and **Sergio Muñoz-Gómez**, a graduate student with **Claudio Slamovits** and **Andrew Roger** both received Beth Gourley Conference Awards, which were established by **Catherine Lazier** and her husband John Lazier.

Dean David Anderson presents Heidi MacKinnon with the 2017 Faculty of Medicine Excellence in Leadership Award (photo courtesy of Heidi MacKinnon)



Dr. Catherine Lazier presents the Beth Gourley Conference Award to Dr. Lingling Xu (PDF) (photo courtesy of Heidi MacKinnon)

Dr. Catherine Lazier presents the Beth Gourley Conference Award to Sergio Muñoz-Gómez (Ph.D. student) (photo courtesy of Heidi MacKinnon)

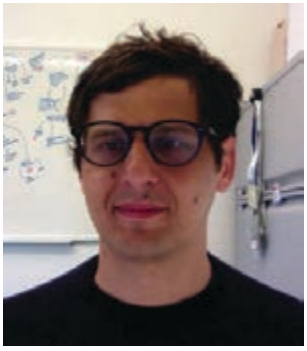
Our alumni (and anyone else interested) are invited to find out about the latest news and events of the Department of Biochemistry & Molecular Biology at http://www.biochem.dal.ca.

Hospital for Sick Children Research Institute, Toronto

Correspondents: Charles Deber and Peter Kim

Cell Biology Program

CIHR Early Career Investigator in Maternal, Reproductive, Child and Youth Health:



Dr. Vito Mennella

Dr. Vito Mennella, Scientist, Hospital for Sick Children, and Assistant Professor, Department of Biochemistry, University of Toronto, was one of the ten recipients of the CIHR Early Career Investigator in Maternal, Reproductive, Child and Youth Health. Dr. Mennella was awarded the grant in the circulatory and respiratory section for his work on the discovery of common disease mechanisms found in sensory and motile ciliopathies. Dr. Mennella is an early career investigator whose research focusses on revealing mechanisms of rare diseases caused by centrosome and cilia proteins using advanced imaging methods.

2017 was the year for new infrastructures for Cell Biology and SickKids. **Drs. Daniela Rotin**, **Michael Moran**, and **John Brumell** were each awarded Canada Foundation for Innovation grants to establish three major infrastructures at the Hospital for Sick Children. Dr. Rotin's application titled "3D-ORG: 3D screening infrastructure for tissue ORGanoids and model ORGanisms" will bring cutting-edge high-content and high-throughput drug and phenotypic screens in organoids, tumorspheres, and small organisms such as worms, zebrafish embryos and fly embryos. Dr. Michael Moran's award will bring state of the art Mass Spectrometry to identify disease-associated proteins in patient samples. Both infrastructures will be housed in the SPARC BioCentre facility at SickKids (http://lab.research.sickkids.ca/sparc/). Dr. John Brumell's award will bring the latest technology in 3D electron microscopy imaging. The combination of a Serial Block-Face scanning electron microscope and a Focus Ion Beam electron microscope will allow researchers to rapidly acquire 3-dimensional EM images as small as a cell and as large as an entire *C. elegans*. Combined with other existing infrastructures at SickKids, this new equipment will provide researchers in Toronto, and the rest of Canada, with novel tools to address unmet biological questions.

Dr. Daniela Rotin

Dr. Michael Moran

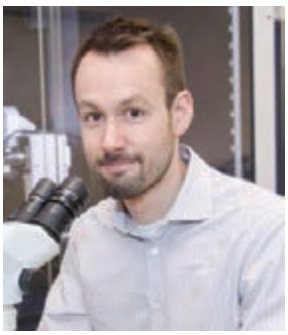
Dr. John Brumell

Dr. Charles Deber

Molecular Medicine Program

Merrifield Award from the American Peptide Society:
Dr. Charles Deber, Senior Scientist in the Program in Molecular Medicine, Research Institute, Hospital for Sick Children, and Professor in the Department of Biochemistry, University of Toronto, received the 2017 Bruce Merrifield Award of the American Peptide Society. The Award was created in 1997 in honour of Dr. R. Bruce Merrifield, who won the Nobel Prize in Chemistry in 1984. The award is presented every two years to leaders in the field who have demonstrated outstanding career accomplishments in peptide research, "recognizing the highest level of scientific creativity". Dr. Deber's research focuses on the hierarchy of forces that characterize the interactions of peptides and proteins with membranes, and the application of these interactions to design novel peptide antibiotics and peptide-based inhibitors of bacterial multidrug resistance.

Canada Research Chair:
Dr. Jean-Philippe Julien, Scientist in the Molecular Medicine Program at SickKids, and Assistant Professor, Departments of Biochemistry and Immunology, University of Toronto, has received a Tier 2 Canada Research Chair in Structural



Dr. Jean-Philippe Julien

Immunology. Dr. Julien's research team uses structural and biophysical techniques to characterize how antibodies target cell-surface molecules. His research is laying the structural foundations to better understand immunological processes associated with cellular and antibody functions. In particular, he uses his expertise to characterize antibody responses at the atomic level to guide the rational engineering of vaccine candidates against malaria and HIV. His team is also working towards the structure-based design of biologics to deplete cells that become dysregulated in autoimmune diseases and cancers.

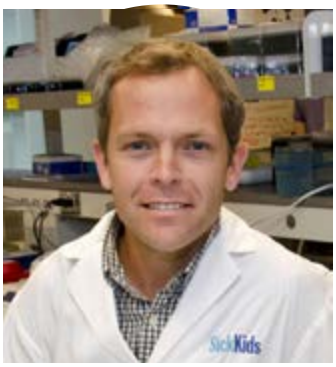
Christian B. Anfinsen Award from the Protein Society:

Dr. Lewis Kay

Dr. Lewis Kay, Senior Scientist in the Program in Molecular Medicine at SickKids, and Professor in the Departments of Biochemistry and Chemistry at the University of Toronto, has received the 2017 Christian B. Anfinsen Award of the Protein Society. The Award recognizes technological achievement or significant methodological advances in the field of protein science. Dr. Kay's research focuses on the development of NMR techniques for studying macromolecular structure and dynamics and their application to problems of biological and clinical importance. His work has led to the development of a number of groundbreaking tools and approaches that have revolutionized NMR spectroscopy and rendered it one of the most powerful techniques in protein science.

Scientific Director of the SPARC Facility:

Dr. Roman Melnyk, Senior Scientist in the Molecular Medicine Program at SickKids, and Assistant Professor in the Department of Biochemistry at the University of Toronto, has been appointed as Scientific Co-Director of the SickKids Proteomics, Analytics, Robotics & Chemical Biology Centre (termed SPARC), a state-of-the-art facility that provides drug discovery services to the research



Dr. Roman Melnyk

community on a fee-for-service/cost-recovery basis, and is designed to be flexible and affordable for academic researchers. SPARC Drug Discovery also serves as a platform where new technologies can be developed and introduced. Dr. Melnyk's research employs chemical biology and targeted drug discovery approaches to identify toxin-delivery platforms to shuttle otherwise non-cell penetrant therapeutics into cells.

McGill University

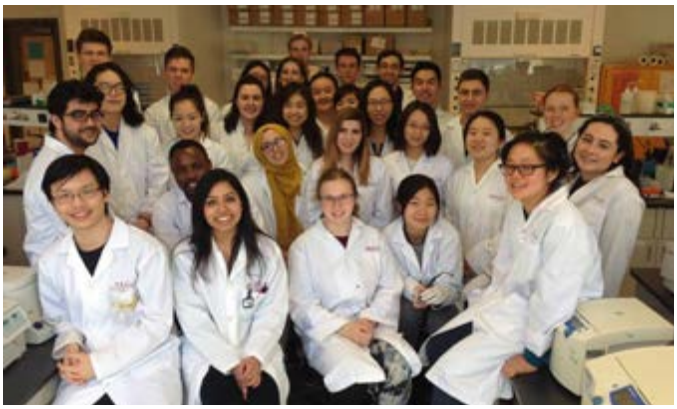
Department of Biochemistry

Correspondent: Martin Schmeing (with Maxime Denis, Marlene Gilhooly and with photos from Christine Laberge)

As always, 2017 was a busy year for the Department of Biochemistry at McGill University. We welcomed **Alba Guarné,** who joined us from McMaster University as a senior hire at the rank of full Professor. **Maxime Bouchard** was promoted to full Professor. **Selena Sagan** of the Department of Microbiology & Immunology was granted associate membership, and **Julie St-Pierre,** upon her move to the University of Ottawa, assumed an adjunct appointment. **Rod McInnes** became the Acting President of CIHR. Two Department stalwarts, **John Silvius** and **Gordon Shore** retired and were conferred the honorific designation of Professor Emeritus. They have each had fantastic careers, have been invaluable to the Department, and their daily presence will be sorely missed.

The Department continues to strive to innovate and strengthen our teaching. One important advance for our undergraduate teaching program in 2017 was the hiring of **Dr. Maxime Denis**, a new full-time teaching faculty member. Dr. Denis is developing new approaches to teaching undergraduates, such as making BIOC 311 (Metabolic Biochemistry) a more interactive course through flipped learning, think-pair-share and in-class discussions. Students seem to have responded with great enthusiasm. BIOC 311 joins a growing body of courses, including BIOC 450 (Protein Structure and Function) and BIOC 470 (Lipids and Lipoproteins in Disease), in featuring

active learning strategies to efficiently increase students' information retention and engagement. These strategies will be a substantial component of our upcoming undergraduate program revision. In other teaching news, special mentions go to **Dr. Sidong Huang** and **Mr. Elie Kostantin** who won the "Excellence in Teaching Award" and the "Excellence in Teaching Assistant" awards for 2017, respectively.



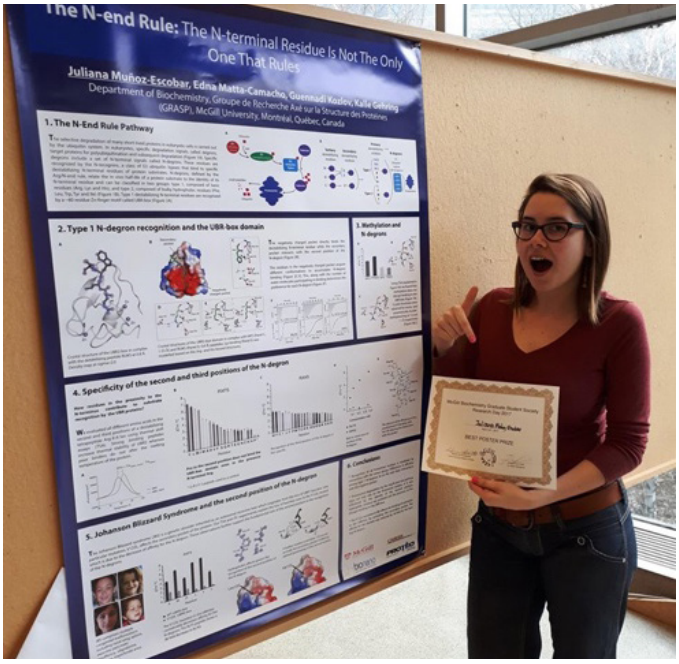
Wearing lab coats make McGill students smile!

Department members continued to publish exciting research results in 2017. We unofficially took over the May 2017 issue of Structure, including the cover illustration and three articles from the **Berghuis, Gehring** and **Schmeing** labs. Other highlights include the following: **Vincent Giguère's** group showed that the mTOR kinase forms a complex with the androgen receptor in the nucleus of prostate cancer cells to control a metabolic program favouring tumour growth (Genes & Dev 31(12)). **Imed-Eddine Gallouzi** and his colleagues demonstrated that STAT3 plays a key role in the onset of cancer-induced muscle wasting in an NF-κB-dependent and IL-6-independent manner (EMBO Mol Med. 9(5)). **Alba Guarné** contributed to the understanding of how a bacterial assembly factor can test out a specific translation mechanism with a structure of the 30S ribosome subunit bound to the YjeQ (PNAS 114 (17)), and to how CD22 is targeted by therapeutic antibodies (Nat Commun 8(1)). **Albert Berghuis**' team elucidated that farnesyl pyrophosphate synthase, an enzyme of the mevalonate pathway and anticancer target, is regulated by allosteric product inhibition, and provided insights as to how to exploit this natural feedback mechanism pharmacologically (Nature Commun 8(1)). **Martin Schmeing** and co-workers gained structural and mechanistic insight into heterocyclization domains of non-ribosomal peptide synthetases, explaining how they catalyze both peptide bond formation and heterocyclization of the peptide backbone (PNAS 114(1)). **Kalle Gehring's** laboratory published a report detailing an interesting parallel-stranded form of poly(A) RNA (Nucleic Acids Research 45(17)).

Department of Biochemistry faculty members were recognized with a variety of external honours and awards in 2017. **Dr. Morag Park** won the Robert L. Noble Prize of the Canadian Cancer Society for her influential biomedical cancer research, and leadership in establishing national cancer research strategies. **Philippe Gros** was appointed to the Order of Canada, in recognition of his pioneering use of molecular genetics to identify risk factors in conditions including infectious diseases and cancer. **Michel Tremblay** was awarded the Royal Society of Canada McLaughlin Medal, for his excellent body of work on the role and function of tyrosine phosphatases in the development of cancer. The Royal Society of Canada also elected **Jerry Pelletier** as a fellow of the Academy of Science, in recognition of his research into protein synthesis and its dysregulation in cancer. **Martin Schmeing** was given the 2017 New Investigator Award from the Canadian Society for Molecular Biosciences for research into the structures and functions of microbial megaenzymes.

The Department had plenty of fun in 2017 as well. Of particular note are the BUGS (Biochemistry Undergraduate Society) Wine and Cheese, the BUGS Career Symposium and the BGSS (Biochemistry Graduate Student Society) Research Day, and the annual Pelletier lab/Biochemistry Department Christmas party. A new tradition started in 2017 with the first annual McGill Biochemistry Dodgeball tournament, which was won by the faculty team, The Professors of Doom. The many student teams will be out for revenge in 2018. More glimpses into departmental life can be found at https://www.facebook.com/mcgillbioc/ and https://www.mcgill.ca/biochemistry/about-us/events/community

A map, a plate and an ordinary McGill scientist



Juliana Muñoz-Escobar, best poster winner, BGSS Research Day!

Ready, set, dodge!

McMaster University

Department of Biochemistry and Biomedical Sciences

Correspondent: John Whitney

2017 marked another exciting and productive year for our department. Our chair, **Karen Mossman**, was promoted to Associate Vice President Research. For the past 4.5 years, Dr. Mossman has overseen many notable advances in our department including the formation of the Biomedical Discovery and Commercialization program and numerous new faculty hires. Dr. Mossman was succeeded by **Brian Coombes**, who began his 5-year term as chair at the beginning of 2018. Dr. Coombes, a Tier 2 Canada Research Chair in Infectious Disease Pathogenesis, leads a highly successful research program studying the evolution of virulence in enteropathogenic bacteria. Dr. Coombes has ambitious goals for our department and we look forward to seeing him enact his vision in the coming years. In 2017, we also celebrated the 50th anniversary of Biochemistry and Biomedical Sciences (BBS), which culminated in a day-long event and reception that included many current and former members of our department. Among the many highlights of the day was a stimulating talk on the commercialization of science by keynote speaker and McMaster alumnus Brian Bloom, co-founder and CEO of the leading Canadian healthcare investment banking firm Bloom Burton & Co.

Dr. Brian Coombes, newly appointed chair of the Biochemistry and Biomedical Science Department

Department of Biochemistry and Biomedical Sciences 50th Anniversary: past and present department chairs (left to right; Eric Brown, Gerhard Gerber, Hara Ghosh, John Capone, Karen Mossman, Gerry Wright, Dennis McCalla, Karl Freeman and Brian Coombes) were present to celebrate past accomplishments and future endeavours

2017 saw the addition of three new faculty members to our department: **John Whitney, Sara Andres** and **Jakob Magolan**. John Whitney obtained his Ph.D. in the Department of Biochemistry at the University of Toronto in 2013 before moving to Department of Microbiology at the University of Washington for post-doctoral training. His lab employs genetic, biochemical and structural approaches to understand toxin secretion by bacteria. Sara Andres completed her Ph.D. in the BBS Department at McMaster before doing post-doctoral training in the Structural Biology Division at NIEHS in Durham, North Carolina. Dr. Andres' lab studies the molecular mechanisms underlying DNA repair. Jakob Magolan

did his Ph.D. at Queen's University and post-doctoral training at the Griffith University Institute for Drug Discovery in Australia. He was then hired as an Assistant Professor at the University of Idaho, where he ran a successful research program for 7 years before moving to McMaster. Dr. Magolan is a medicinal chemist whose research interests lie in the hit-to-lead optimization of compounds in a number of therapeutic areas, as well as the development of useful new synthetic methodologies. The senior faculty in our department have done an excellent job helping the new recruits get their research programs up and running in an expedient manner.

New BBS faculty members: John Whitney (left), Sara Andres (middle) and Jakob Magolan (right) joined our department in 2017

This past year was also highlighted by many outstanding discoveries by members of our department. The majority of our faculty members are associated with one of three major research institutes at McMaster. Members of the Michael DeGroote Institute for Infectious Disease Research (IIDR) made many seminal contributions in the fields of bacteriology and antimicrobial resistance. **Eric Brown** found that the antibiotic colistin potentiates the activity of other antibiotics (*Nature Comm*, 9:458). His lab also published an elegant study on the mechanism of cell wall biosynthesis in Gram-positive bacteria (*Cell Chem Biol,* 24:1537). **Lori Burrows** discovered that bacteria disguise their virulence factors to avoid predation by infectious bacteriophage (*Nature Micriobiol*, 3:47). **Gerry Wright's** lab uncovered a unique mechanism of enzymatic inactivation of the antibiotic rifamycin by rifamycin monooxygenases (*Cell Chem Biol*, in press). Faculty in our Stem Cell and Cancer Research Institute (SCC-RI) also made many significant contributions to their field. **Mick Bhatia** discovered a previously underappreciated link between bone barrow adipogenesis and myelo-erythroid maturation *(Nature Cell Biol*, 19:1336). His group also identified a small molecule that modulates Wnt/β-catenin signalling within human cancer stem cells (*Cell Chem Biol*, 24:833). **Bradley Doble** and his team published a study showing that a single member of a redundant group of transcription factors is sufficient for differentiation of embryonic stem cells (*Cell Reports*, 20:2424). In our Farncombe Family Digestive Health Research Institute, **Jonathan Schertzer** discovered that constituents of the bacterial cell wall can function as postbiotics by sensitizing cells to insulin (*Cell Metabolism*, 25:1063).

BBS faculty continued to achieve high success rates in research funding competitions and faculty awards. In the Fall 2017 CIHR Project Grant competition, funding was awarded to **John Whitney, Lori Burrows, Brian Coombes, Kristen Hope, Lesley MacNeil, Andrew McArthur** and **Dino Trigatti. Jonathan Schertzer** was the recipient of a prestigious CIHR Foundation Grant. 2017 NSERC Discovery Grant Recipients included **John Whitney** and **Yu Lu**, while **Gerry Wright** was awarded an NSERC Infrastructure Award. **Yingfu Li** had a very successful year, obtaining funding from both the CIHR Antimicrobial Resistance Strategic Initiative and the NSERC Strategic Partnership funding competition. Notable faculty awards included a 2017 YWCA Woman of Distinction Award to **Deborah Sloboda** and a McMaster University Faculty Association Award to **Lori Burrows** for Outstanding Service. **Lori Burrows** was also elected as a Fellow of the American Academy of Microbiology, an exclusive group comprising the world's most accomplished microbiologists.

41st Annual YWCA Women of Distinction Awards Ceremony: Deborah Sloboda (left) celebrates her award with her nominator, BBS faculty member Lesley MacNeil (right)

Lori Burrows MUFA award.jpg caption: McMaster University Faculty Association Awards Ceremony: Lori Burrows (left) receives an Outstanding Service Award from her nominator, BBS faculty member Michelle MacDonald (right)

This past fall we welcomed our incoming cohort of graduate students, which consisted of 26 M.Sc., 8 Ph.D. and 1 M.D./Ph.D. candidates. Graduate students in our department continue to obtain scholarships at a high rate, with 23 major external scholarships being awarded in 2017. Among these award winners was Ph.D. student **Beth Culp** from Gerry Wright's lab, who was awarded a highly competitive Vanier Canada Graduate Scholarship. The Karl Freeman awards, given out to students who were deemed to have given the best presentations in our graduate student seminar series, were awarded to **Andrew Tupper** (1st place, Higgs lab) and **Robert Gale** (2nd place, Brown Lab) in the Ph.D. category and **Madeline Tong** (1st place, Brown Lab) and **Linda Liu** (2nd place, Guarné Lab). At our Institute of Infectious Disease Research Annual Trainee Day, **Stephanie Jones** (Ph.D., Elliot Lab), **Allison Guitor** (M.Sc., Wright Lab), and **Daniel Celeste** (Undergraduate, Miller Lab) were awarded Michael Kamin Hart Memorial Scholarships. These awards are made possible by the generous support of the Hart family.

Biochemistry new student welcome BBQ 2017: Students of the incoming graduate class of 2017 were welcomed to our department by faculty and staff

Ph.D. student Beth Culp from Gerry Wright's lab was awarded a prestigious Vanier Scholarship to support her research on antimicrobial resistance

In keeping with the "work hard, play hard" culture of our department, we had a record turnout for the Biochemistry Olympics, which are held during the annual BBS departmental picnic. In this lab-themed pentathlon, teams compete at events that reward both textbook knowledge and manual dexterity – two essential skills of a successful scientist. In the face of stiff competition, the gold medal went to the Brown Lab, followed by silver to the Sloboda Lab and bronze to the faculty team.

Annual BBS picnic: biochemistry students and BBS faculty member Matthew Miller (second from right) participate in our annual Biochemistry Olympics held during the departmental summer picnic

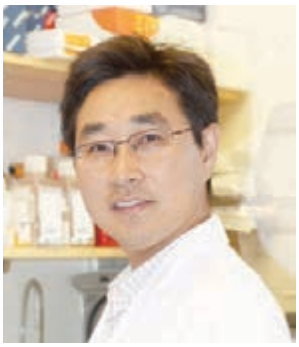
Princess Margaret Cancer Centre, Toronto

Correspondent: Gil Privé

After a long and successful run as the Executive Vice President of Science and Research at the University Health Network, **Dr. Chris Paige** stepped down from the position in order to refocus his energy on his lab and research. Following an international search, his replacement was found within our ranks. **Dr. Brad Wouters**, who served as Interim Research Director of the PM Cancer Centre since 2014, accepted the position of UHN EVP for Science in October 2016. In this role, he is responsible for the five constituent UHN hospital research institutes, including the Princess Margaret. **Dr. Rama Khokha** did an admirable job as Interim Director of the PM research institute from Oct 2016 to Nov 2017, and handed off the reins to the current Interim Research Director, **Dr. Mitsu Ikura**, with **Dr. Aaron Shimmer** acting as the Interim Associate Research Director.

On November 24, 2017, The Honorable Kirsty Duncan, Minister for Science, visited the PM Cancer Centre and toured the facilities and labs at the Princess Margaret Cancer Research Tower (PMCRT). She was highly engaged in her discussions with PM scientists, a fact that bodes well for the engagement of the federal government on science issues.

Research highlights:
In a paper in Nature Genetics, PM Scientist **Dr. Hansen He** has shown that PCAT1, a long non-coding RNA, promotes prostate cancer tumour growth. Previously considered "junk" DNA, regions coding for lncRNAs have been associated with cancer risk, but this paper provides a first mechanistic view of how these nucleic acids can drive biology.



Dr. Hansen He

Dr. Emil Pai

Why are most enzymes oligomeric? PM Senior Scientist **Dr. Emil Pai** and University of Toronto Professor **Scott Prosser** have shown how the two chains of a protein engage in "cross-talk" in regulating the activity of a homodimeric enzyme. By analyzing a large number of crystal and NMR structures of fluoroacetate dehalogenase, the team discovered an asymmetry in the enzyme in which disorder in one active site drives the activity of the other. The findings, published in Science, may represent a fundamental mechanism for increasing the efficiency of catalysis in other multi-chain enzymes.

Dr.Mitsu Ikura

Dr. Mitsu Ikura has reported that the oncogenic properties of the MLL-AF6 fusion protein are the result of an induced dimerization in the abnormal gene product (Nature Communications). The fusion exposes a hydrophobic patch in MLL-AF6, which causes dimerization and promotes association with key mediators of gene expression. Remarkably, inhibiting dimerization completely blocks MLL-AF6 leukemogenesis in mice.

Awards and honours:
Congratulations to the following PM Cancer Centre scientists who were awarded or renewed their Canada Research Chairs: Tier 1: **Dr. Brad Wouters** (new 2017), **Dr. John Dick** (renewed 2016), **Dr. Mitsu Ikura** (renewed 2018); Tier 2: **Dr. Daniel De Carvalho** (new 2016), **Dr. Thomas Kislinger** (renewed 2016).

Dr. Gordon Keller, who has pioneered methods to guide pluripotent stem cells into various cell types, has been elected as a Fellow of the Royal Society of Canada. **Dr. Hansen He** has received one of three Terry Fox New Investigator Awards to support his work on circular RNA in tumour hypoxia. **Drs. Daniel De Carvalho** and **Mathieu Lupien** are the co-recipients of the Canadian Cancer Society Bernard and Francine Dorval Prize for young investigators whose contributions to basic biomedical research have the potential to improve cancer treatment.

Dr. Chris Paige has been recognized for his work in championing health research with the 2017 Research Canada Leadership in Advocacy Award. He has also received the UHN Inventor of the Year for his work in immune-oncology. The technology is being commercialized with AvroBio Inc.

Dr. Chris Paige

Dr. John Dick

Dr. John Dick continues to receive recognition on his work on the identification and characterization of leukemia stem cells, and has recently received two prestigious prizes: the CIHR Gold Leaf Prize for Discovery and the 2017 Keio Medical Science Prize. Dr. Dick's CIHR award will be presented to him by the Governor General during a ceremony in Ottawa on May 16. These awards recognize his outstanding contributions to our understanding of cancer biology, and his global impact

of on the scientific community. As always, John was generous in acknowledging the essential contributions of his many students, post-docs and colleagues.

Ryerson University

Department of Chemistry and Biology
Correspondent: Roberto Botelho

The Department of Chemistry and Biology encompasses multi-disciplinary interests in research and education. Our Chemistry research programs are generally focussed on macromolecular, synthetic and medicinal chemistry. The research interests in Biology enjoy strengths ranging from biochemistry, molecular and cell biology to genetics, microbiology and environmental biology. The breadth and variety of research interests creates an exceptional environment that permits cross-pollination of ideas and an open-concept milieu for learning and teaching. Last year, we had several notable events worth sharing with the CSMB community.

New faculty member:
In 2017, our department continued its growth trajectory by recruiting **Dr. Gagan Gupta.** Dr. Gupta brings to the department his expertise in functional genomics and centrosomal cell biology, specializing in both protein-interaction methods and high content imaging. Dr. Gupta's research will focus on using protein interaction networks to understand ciliopathies and membrane trafficking diseases.

Dr. Gagan Gupta

Awards, recognition and publications:
Our researchers have published in *Mol. Biol. Cell, J. Cell Biol., J. Immunol, PNAS, J. Cell Sci., and Clinical Proteomics*, among others, with novel discoveries related to phagocytosis, endocytosis, receptor tyrosine kinase signalling, host-pathogen interactions, glycobiology, proteomic biomarkers, and phosphoinositide signaling. As highlights, we point to Naufer, Hipolito *et al., J. Cell Biol.* which identified the luminal pH of phagosomes and endosomes as a regulator of phosphoinositide synthesis, and Delos Santos *et al., Mol. Biol. Cell*, which examined the role of phospholipase C and calcium in EGFR signalling and endocytosis.

Special events:
Ryerson University, its Department of Chemistry and Biology, and the Faculty of Science, was a major sponsor of the 2017 Canadian Society for Molecular Biosciences Meeting that took place in Ottawa from May 16-20, entitled "Celebrating Canadian Molecular Biosciences: from Organelles to Systems Biology". This was arguably the most successful CSMB meeting to date, attracting 420 registrants across Systems Biology and Cell Biology communities in Canada. Dr. Costin Antonescu and Roberto Botelho were members of the organizing committee.

Our department continues to be a key participant in Ryerson's "Science Rendezvous" that ran in May 2017. This was the 10th Science Rendezvous hosted at Yonge-Dundas Square, arguably the busiest intersection in Toronto. Open to the public, it easily attracted over 10,000 visitors by showcasing research, hands-on activities, displays and stage shows that delighted the audience and demonstrated how science plays a part in our everyday lives.

We also held our first Departmental Retreat on the beautiful shores of Lake Simcoe, where we had the opportunity to plan how to best integrate chemistry into biological research and teaching. This is just one of several efforts that we pursued to foster inter-disciplinary research and understanding.

Lastly, we hosted our 6th Annual Research Symposium with more than 80 poster presentations and more than 10 talks. These showcased our exciting and emerging research activities across various disciplines, and highlighted both undergraduate and graduate-based research activities. **Dr. Laura Hug** from University of Waterloo was the keynote speaker.

Simon Fraser University

Department of Molecular Biology and Biochemistry
Correspondent: Christopher Beh

Together with news on faculty and student achievements, this report for the MBB Department at SFU includes notable program changes during 2017 that enhanced our research and teaching. We continue to encourage all our MBB Department alumni to contact us at mbbalumni@sfu.ca so we can hear about your career paths and successes since your days at SFU.

Department highlights:
We congratulate one of our newest faculty members, **Dr. Tim Audas,** on his successful award of a *Canada Research Chair (CRC) Tier 2.* Dr. Audas investigates non-coding RNAs and their involvement in a stress-response pathway that generates reversible amyloid-like structures. We also applaud **Dr. Ryan Morin** on becoming a *Michael Smith Foundation for Health Research (MSFHR) scholar.* In addition to the distinction of being a *CIHR New Investigator,* Dr. Morin has received great recognition for his use of high-throughput sequencing and bioinformatics to identify driver mutations that contribute to cancer malignancy. We commend the research achievements of all our faculty who have done exceptionally well in national and international award competitions.

Meetings and new research groups:
This past year saw the first annual *"Centre for Cell Biology, Development and Disease (C2D2)"* symposium, held at the SFU Harbour Centre campus in downtown Vancouver, which was an outstanding success with over 100 attendees. C2D2 was founded in 2014 as an organization to facilitate collaboration between SFU researchers working on cell and developmental mechanisms that affect disease (http://www.sfu.ca/c2d2.html). As one of the contributing Departments, MBB is working with other research and academic units at SFU to promote opportunities through new interaction amongst faculty and trainees.

Although genomics and bioinformatics have always represented one of the bedrock disciplines of our Department, an *"Omics Group"* was inaugurated this past year to bring the larger SFU community together for integrated studies in "omics". This student-led effort has successfully connected many students, post-docs, and faculty in workshops and meetings.

Student awards and other news:
Among the many awards received by our graduate students and post-docs, three awards are particularly notable. **Ms. Kristen Gray** received a *CIHR Frederick Banting and Charles Best Canada Graduate Scholarship* and **Mr. Justin Jia** received an *NSERC CREATE scholarship.* Both graduate students represent the many successful bioinformatics trainees in **Dr. Fiona Brinkman's** lab. In addition, **Mr. Kurt Yakimovich** was awarded an *SFU Graduate Dean's Doctoral Scholarship*. Our undergraduates have also netted prestigious awards. A *Schulich scholarship* was awarded to **Ms. Jasmine Rai** in recognition of her impressive academic record in high school. As an undergraduate student at SFU, Ms. Rai is continuing STEM-related studies in our MBB joint major program with computer science. **Mr. Andy Zeng**, also a former *Schulich scholarship* awardee, graduated this year after earning the *Gordon Shrum Undergraduate Medal* for his many academic achievements. He has since moved on to the University of Toronto for training in their MD/PhD program.

Sunnybrook Research Institute

Biological Sciences Platform
Correspondent: David Andrews

Our scientists in the Biological Sciences Platform at Sunnybrook Research Institute (SRI) are striving to understand how biological systems function in healthy and disease states. Among our research areas are tumour biology, protein-protein interactions, immune system development, and neurodegeneration and regeneration. Areas of disease interest include cancer, cardiovascular disease, brain disorders like stroke and dementia, and traumatic injury, acute and acquired.

Research grants and awards:
Dr. Juan Carlos Zúñiga-Pflücker, a senior scientist and Chair of the Department of Immunology at the University of Toronto, was awarded a Foundation Grant from the Canadian Institutes of Health Research (CIHR) worth $2.8 million. His research centres on the role of Notch signalling in T cell development and the function of those cells in immune regulation.

Two SRI scientists were successful in CIHR's Fall 2017 Project Grant competition. **Dr. JoAnne McLaurin,** a senior scientist, will receive $933,300 over five years to generate new neurons from glial cells in the memory centre of a preclinical model of Alzheimer's disease. As part of this project she is collaborating with Drs. Carol Schuurmans and Bojana Stefanovic, senior scientists in Biological Sciences and Physical Sciences, respectively, to study a treatment strategy for Alzheimer's disease that aims to balance the neuronal network by converting astrocytes into inhibitory neurons. **Dr. Burton Yang**, a senior scientist, was awarded $990,675 over five years to study the role of the circular RNA circ-Itga9 in cardiac remodelling.

Dr. Carol Schuurmans, senior scientist at SRI

Dr. Carol Schuurmans, a senior scientist and the Dixon Family Chair in Ophthalmology, received a Discovery Grant from the Natural Sciences and Engineering Research Council of Canada. The grant, worth $200,000, will fund her research on the molecular mechanisms controlling Müller glial cell activation in the retina.

Three cancer researchers at SRI received grant funding to advance their work. **Dr. Robert Kerbel**, a senior scientist, was awarded a grant worth £189,132 ($239,635 CAD) from Worldwide Cancer Research to develop a new anti-angiogenic therapy that targets vessel co-option in metastatic cancers. **Dr. Arun Seth**, also a senior scientist, received a one-year grant from the Ontario Molecular Pathology Research Network. The grant, worth $34,800, will support his work looking for markers predictive of progestin therapy response in conditions that affect the endometrium. **Dr. Stanley Liu** was awarded a 2017 Movember Discovery Grant from Prostate Cancer Canada to look for genetic and protein biomarkers that can identify patients whose prostate cancer are more likely to recur after radiation treatment.

Dr. Laurence Klotz, an affiliate scientist, was presented with the Dean's Lifetime Achievement Award from the University of Toronto Faculty of Medicine. The award recognizes alumni who have made outstanding contributions to research, teaching, clinical care, administration or public service.

Research highlights:

Dr. James Carlyle's group has identified the first physiological ligand for the prototypical NK1.1 receptor, a member of the NKR-P1 family of natural killer (NK) cell receptors. The researchers showed that the murine cytomegalovirus-encoded protein m12 binds directly to the inhibitory NKR-P1B receptor to inhibit NK cell function. The study, which was published in *Cell,* found that the viral decoy protein also interacted weakly with the stimulatory receptors NKR-P1A and NKR-P1C in what appears to be an example of host adaptation to a viral immune evasion strategy.

Dr. Oscar Aguilar, former PhD student in the Carlyle lab

Dr. Michele Anderson, senior scientist at SRI

A study from the labs of **Drs. Michele Anderson** and **Juan Carlos Zúñiga-Pflücker** has demonstrated a requirement for the transcription factor HEB in mesoderm development and pre-hematopoietic events. The team used CRISPR-Cas9 to knockout HEB in human embryonic stem cells before inducing them to differentiate into T cells. They found that loss of HEB led to defects in mesoderm development and hemogenic endothelium formation as well as a failure of T cell development. Their results, published in *Stem Cell Reports,* indicate that HEB is a crucial regulator in mesoderm and hematopoietic specification during human embryogenesis.

In a study published in *Cell Chemical Biology*, **Dr. David Andrews'** group identified small molecule inhibitors of Bax/Bak oligomerization. Bax and Bak are members of the Bcl-2 family of proteins that regulate apoptosis. Andrews, a senior scientist and director of the Biological Sciences platform, and his team of international collaborators discovered and characterized three small molecules that block Bax/Bak oligomerization and prevent mitochondrial outer membrane permeabilization, thereby allowing cells to evade apoptotic stimuli.

Université de Sherbrooke

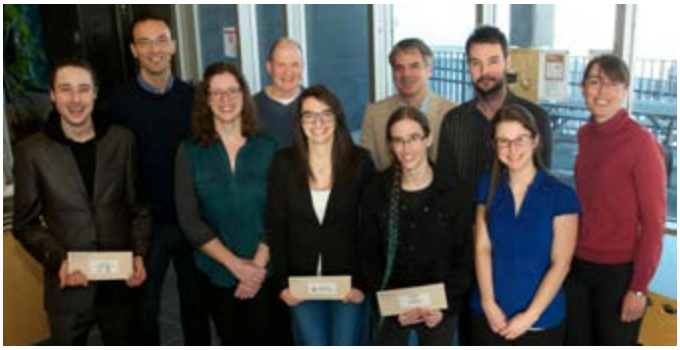
Département de biochimie

Correspondent: Michelle Scott

2017 saw a wind of change within the Biochemistry department, the Faculty of Medicine and Health Sciences, and the Université de Sherbrooke. Professor Jean-Pierre Perreault, previously Vice-Dean of Research and of Graduate Studies in the Faculty, and member of the Biochemistry department, became Vice-Rector of Research and of Graduate Studies for the university. Department chair Martin Bisaillon became Secretary of the Faculty and Vice-dean of student life. Finally, Professor Xavier Roucou, who heads a dynamic group studying the alternative proteome, became head of department.

New department chair, Xavier Roucou

Our 23rd annual graduate symposium held in March 2017, co-organized by our two graduate student representatives, Ariane Brault and Andréa Allaire, as well as by Prof. Michelle Scott, was a success. Prof. Gary Kobinger from the Université Laval, our keynote speaker, discussed the challenges of quickly developing vaccines and therapies to emerging infectious diseases, and his experience with the Ebola outbreaks, while Jean-François Denis, invited Ph.D. student from the Université de Montréal, presented on the differential activation of Smads in the process of regeneration. 10 U de Sherbrooke graduate students from the Biochemistry department presented their research. The finalists were the following: Hélène Mouilleron from the Roucou group won first prize, Fanny Thuriot from the Lévesque group won second prize, while Louis-Philippe Morency from the Najmanovich group won third prize. Simon Boudreault from the Bisaillon lab won the Pierre-Chailler prize for best student of the year.



Graduate Symposium 2017. Top row from left: Martin Bisaillon, Simon Labbé, Gary Kobinger, Jean-François Denis. Bottom row from left: Louis-Philippe Morency, Ariane Brault, Fanny Thuriot, Hélène Mouilleron, Andréa Allaire, Michelle Scott

Prizes and distinctions:

Professor Éric Massé, whose group characterizes small regulatory RNAs in bacteria, won the Research and Creativity Award of the University, while his post-doctoral fellow, David Lalaouna, obtained the Marie Skłodowska-Curie Fellowship. Ph.D. student Jean-François Lemay from Professor François Bachand's group won the prize for the best thesis both at the Université de Sherbrooke level and from the Association des doyens des études supérieures du Québec.

University of Alberta

Department of Biochemistry

Correspondent: Joe Casey

Events:

In November 2017, the Department held a retreat, coordinated by our stellar Teaching Professors, **Drs. Rachel Milner, Adrienne Wright** and **Jo Parrish**, which focused primarily on teaching initiatives and delivery. The result was a productive and well-engaged event which led to many suggestions on how to improve the learning experience for our undergraduates and graduate students.

On June 15, 2017 we celebrated the 50-year research career of **Dr. Michael James,** Distinguished University Professor (Emeritus), who started work at the University of Alberta in 1968. Over 100 department members attended the celebration. Former lab members from around the world – U.S.A., Switzerland, Australia, Ireland, and the U.K. - came for a symposium, with talks from former trainees: **Dr. Randy Read** (University of Cambridge, UK), **Dr. Natalie Strynadka** (UBC), and **Dr. Amir Khan** (Trinity College, Ireland). The evening ended with a dinner at the University of Alberta Faculty club where all participants shared fun stories.

Faculty news:

Dr. Dennis Vance, who is now working 1/3 time as a Professor Emeritus, was invited by the *Journal of Biological Chemistry* to write a historical account of his career in lipid biochemistry. Check out "From masochistic enzymology

to mechanistic physiology and disease" at http://www.jbc.org/content/292/42/17169.full?sid=17085a46-4437-4418-836e-a078106d725d

To celebrate his move to emeritus status, **Dr. Dennis Vance** organized a meeting at the Banff Centre on August 27-31, with 80 scientists from 8 countries, all of whom had been either a trainee or collaborator of Dennis, or **Dr. Jean Vance.**

Attendees at Dennis and Jean Vance's meeting in Banff

Retired former Chair, **Dr. Vern Paetkau,** is living in Victoria, BC, where he reports that life is great.

*Former Chair, **Dr. Vern Paetkau,** enjoying 2017 post-retirement activities near Victoria, BC*

One of our students **Melissa McLellan** finished her master's program in biochemistry at the University of Alberta and earned a competitive Ph.D. scholarship at The Francis Crick Institute in London, a prestigious and globally-renowned hub for health science research, under the direction of Nobel Prize laureate, Sir Paul Nurse. Melissa was one of 40 selected students out of more than 1,000 applicants. She started her program in September, with research focus on the role of protein phosphatases in tissue architecture and cell growth control.

New assistant professors, **Drs. Sue Ann Mok** and **Olivier Julien**, successfully completed their move from the University of California San Francisco to newly renovated laboratories in Biochemistry in August 2017.

Sue Ann Mok and Olivier Julien

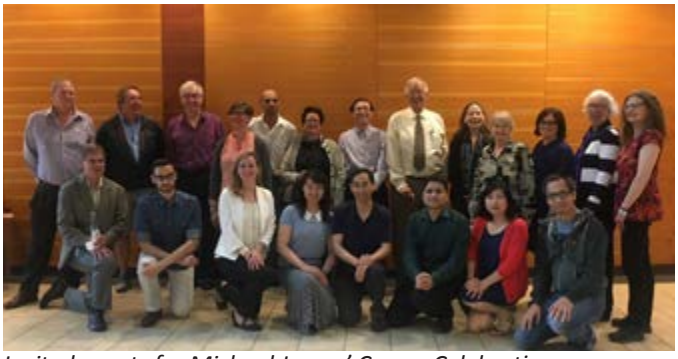
Graduations:

Anamika (Ph.D.; **Spyracopoulos**), Aruna Augustine (M.Sc.; **Fliegel**), Mohamed Eldeeb (Ph.D.; **Fahlman**), Rebecca Gibeault (Ph.D.; **Schang**), Melissa McLellan (M.Sc.; **Holmes**), Robyn Millott (M.Sc.; **Holmes/Glover**), Rory Shott (M.D./Ph.D.; **Schang**), Sietske Speerstra (M.Sc.; **Schang**), Carmen (Ka Yee) Wong (M.Sc.; **Fliegel)**.

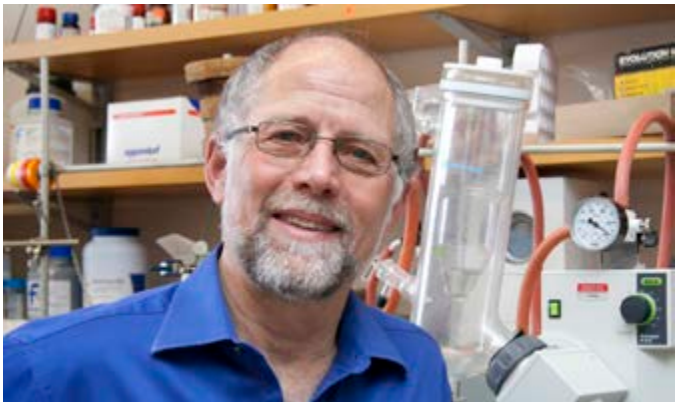
Special lectures:

The Department of Biochemistry has two named lectureships. This year there were two John S. Colter Lectures: in June, as a lead off for the career celebration conference for **Dr. Michael James, Dr. Stephen Withers FRS**, Department of Biochemistry at UBC, presented "Discovery, design and development of human amylase inhibitors: from nM to pM", and in August, as a lead off for the career celebration conference for **Dr. Dennis Vance, Dr. Stephen Young** (UCLA) presented "Triglyceride metabolism along the capillary wall".

Jo Parrish, Randy Read, Michael James, Natalie Strynadka, Asmir Khan and Joanne Lemieux at the June 2017 Career Celebration event for Michael James



Invited guests for Michael James' Career Celebration



2017 Colter Lecturer, Dr. Steve Withers FRS

The Annual William A. Bridger lecture was presented in March by **Dr. Brian Mark**, Department of Microbiology, University of Manitoba, on "Corrupting the ubiquitin system: a viral strategy to evade host immunity."

Obituary:

Dr. Neil Madsen (1928-2017) was a longtime faculty member in the Department of Biochemistry who retired in 1993. His career is wonderfully summarized in an obituary published in *The Times Colonist:*

"Neil distinguished himself in the field of biochemistry at the University of Alberta. He was a great scholar of world-class stature. His legacy in science is well entrenched in the historical record. After receiving the Gold Medal for academic excellence in his class in Agriculture at the U of A, he began Masters studies in 1950. He received his Ph.D. at Washington University in 1955, under Nobel Prize co-winners Carl and Gerty Cori. He subsequently did post-doctoral training in the laboratory of another Nobel Prize winner, Hans Krebs, at Oxford. His life work was glycogen phosphorylase. He and X-ray crystallographer Robert Fletterick made the discovery of the detailed, complicated structure of that enzyme, crucial to human and animal metabolism. Later on, Neil did related work on glycogen-debranching enzyme. He collaborated with other researchers around the world and had many Canadian and foreign doctoral and graduate student, and post-doctoral fellows benefit from guidance in his own lab in Edmonton. He was also president of the Canadian Society of Biological Sciences, a Fellow of the Royal Society of Canada, and a recipient of the Order of Canada and the Queen's Silver Jubilee Medal."

University of Alberta

Department of Physiology

Correspondent: Emmanuelle Cordat

The Department of Physiology at the University of Alberta has been thriving over the past year! Not only have we persisted in being highly successful in securing external research funds and publishing high-impact, peer-reviewed scientific publications, but we have also continued hiring new Assistant Professors to take over the positions of our retired colleagues.

Achievements:

In 2017, our department and importantly, our newest recruits, have been very successful at securing research funds in a highly competitive funding period. Our new Assistant Professors, **Drs. Silvia Pagliardini, Robin Clugston** and **Jessica Yue** are now all currently funded by 5-year CIHR operating grants that were either awarded in 2017 or the year before. Our department has also increased its funding from NSERC, since **Drs. Elaine Leslie, Robin Clugston** and **Emmanuelle Cordat** secured three additional 5-year Discovery grants in 2017. As proof of the dynamic and innovative research occurring in our department, 33 peer-reviewed, high-impact publications have been published over the past year by the 17 principal investigators appointed primarily to our department. Finally, teaching in our department reached a new level in 2017! In September, our department launched the first province-wide on-line Human Physiology course, which has received a lot of enthusiasm among students so far, with 69 students currently registered, including participants from Calgary, Grande-Prairie and even British Columbia!

Retirements and new recruits:

In 2017, we have celebrated the retirement of our colleagues **Drs. Anthony Ho** and **Steve Harvey**. Dr. Ho closed his laboratory and retired in June 2017, and Dr. Harvey is currently enrolled in the Transitional Retirement Implementation

Program until June 2018. We thank Drs. Ho and Harvey for their many years of hard work in our Department and wish them all the best in their new endeavours! Our latest recruit, **Dr. Jesse Jackson** will start in our department in March 2018.

Overall, in 2017, the Department of Physiology has continued its tradition of excellence by successfully recruiting outstanding new Assistant Professors, maintaining the diverse yet complementary breadth of research and teaching, and implementing a new Physiology on-line course that appears to become increasingly popular among undergraduate students and that we hope to expand soon beyond the limits of our province.

University of Calgary

Department of Biochemistry & Molecular Biology, Cumming School of Medicine
Correspondent: Jonathan Lytton

Twenty-seventeen has been a good year in the Department of Biochemistry & Molecular Biology at the University of Calgary, with several significant highlights.

We were very excited to welcome **Dr. Maja Tarailo-Graovac** to the department in August. Maja obtained her Ph.D. from the University of British Columbia in medical genetics and then did post-doctoral work at Simon Fraser University before taking a genome analysis lead position in the "Omics2TreatID" and "TIDE-BC" projects. Maja now joins our group of developmental molecular geneticists with an exciting research program focussed on understanding the genetic contributions to phenotype variability in rare genetic disease, which bridges the worlds of human disease genetics and model organisms.

New BMB Assistant Professor, Dr. Maja Tarailo-Graovac

We also welcomed **Markus Eszlinger** as an adjunct member of the department.

This year marked the retirement of **Don Fujita**. Don was one of the longest serving members of this department, having joined us from the University of Western Ontario in 1986. Don had a distinguished research career studying the molecular mechanisms of the c-src oncogene and developing approaches to target this gene for cancer treatment. Don's many contributions to the department will be missed, but we wish him well in the next stage of his life.

Funding success, though obviously not shared by all, was a positive theme for the year. Our members had particularly strong showings in both NSERC and CIHR competitions. In addition, the developmental molecular geneticists in the department who are part of the "Genes Development and Health" theme group of the Alberta Children's Hospital Research Institute were successful in obtaining a large CFI grant to support a precision medicine for childhood disease research program.

Mayi Arcellana-Panlilio continues to excel in her role as Senior Instructor in the Bachelor of Health Sciences program. This year Mayi received the University of Calgary's 2017 Killam Award in Undergraduate Mentorship, and the iGEM team she led won a gold medal at the Boston Giant Jamboree for their "Astroplastic" project.

Each year our department holds a scientific "advance" meeting in Banff, where we recognize research and educational achievements of both our faculty and graduate students. This year **Sarah Childs** received the "Schultz Award for General Excellence", **Jennifer Cobb** the "Associate Professor Award", **Tara Beattie** the "Hans van de Sande Leadership & Service Award" and **Randy Johnston** the "Education Award". In addition, graduate students **Megan Wong, Heather Paul** and **Katie Greene** were recognized for their outstanding contributions.

BMB students party like it's the 1980s at our annual Banff "advance" meeting

BMB at the University of Calgary continues to grow and flourish, and we are recruiting both new students and faculty. Please visit our website at http://www.ucalgary.ca/bmb/ for more information about our Department.

University of Calgary

Department of Biological Sciences
Faculty of Science
Correspondent: Vanina Zaremberg

The Biological Sciences Department at the University of Calgary is currently organized in four clusters based on general research and teaching interests. They include Biochemistry, Microbiology, Cell Development & Physiology, and Ecology & Evolutionary Biology.

During this year, several colleagues from Biochemistry have been devoted to service in our Department. **Elmar Prenner** and **Greg Moorhead** continued in their roles of Associate Department Head for Research and Planning, and Graduate Program respectively. **Ken Ng** and **Vanina Zaremberg** continued as chairs of the Biochemistry cluster and Biochemistry program respectively.

It has been a prosperous year for our cluster in both research and teaching activities. Many of our members have been involved in the development of multidisciplinary initiatives, have secured important sources of funding, and have received prestigious recognition. Our trainees are the driving force of our Research programs and we are proud of their accomplishments. Several graduate students have finalized their degrees and have been recognized with distinctions/awards for their excellent research and teaching achievements. These are the highlights of the year:

On the research side, **Marie Fraser's** group continues to appreciate remote access to the macromolecular crystallography beamlines at the Canadian Light Source. M.Sc. student Jinhong Hu relied on this access to show how the well-known inhibitor from *Garcinia cambogia* binds to the enzyme ATP-citrate lyase. Graduate students Kyle McDade and Vinh Nguyen were both awarded Queen Elizabeth II Scholarships – they are still seeking diffraction-quality crystals.

Ian Lewis' research group had an exciting year. The main highlight was the launch of a new international collaborative effort to combat the growing global burden of infectious diseases using a new Precision Infection Management (PIM) approach. This new strategy harnesses state-of-the-art diagnostic tools to enable clinicians to identify dangerous infections before they progress into life threatening infections and titrate the level of clinical intervention according to each patient's risk profile. The new approach will help minimize the overall use of antibiotics and will allow more aggressive therapy for those patients who are at the most risk. The international team working on these efforts includes fellow Biological Sciences colleague **Sergei Noskov** and is co-led by **Deirdre Church**, who earned her Ph.D. from the Biological Sciences department in 1985 and is currently a Professor in the Cumming School of Medicine. The effort has been designated by Alberta Health Services as one of the province's key Precision Health Demonstration Projects, and is supported by Genome Canada, CIHR, Compute Canada, the Broad Institute, and Harvard Public Health.

Sergei Noskov's group welcomed two graduate students this year (Mirna Damergi and Shudipto Kazi Amin) to continue projects on selective transport across cellular membranes. The modelling of biochemical phenomena from protein to cellular level remained the major focus of all research activities in the Noskov lab. **Peter Tieleman**, **Sergei Noskov** and Justin MacCallum (Chemistry) were awarded an NSERC-RTI grant to build a state-of-the-art super-computer cluster for applications ranging from protein interface design to systems biology. The computational platform launched in 2018 will provide direct support to Genome Canada Large Scale Applied Research Projects as part of the Antibiotic Resistance Database effort. John Keenan Fanning has successfully defended his M.Sc. thesis on molecular mechanisms controlling calcium-induced conformational dynamics in l-plastin.

Elmar Prenner continued his teaching in the Nanoscience minor and Biochemistry programs. His basic science research focuses on lipid-metal interactions, lipid-based anticancer drugs and nanoparticle-based drug delivery. His applied research, which deals with the design of fluorescence instruments and bioanalytical assays, has moved into commercialization. Elmar serves on the editorial board of BBA Biomembranes.

Dae-Kyun Ro was awarded an Alberta Innovate Grant to investigate genome editing in pea (*Pisum sativum*) to

improve the flavour quality in pea flour. He was invited to Yangtze University, China, as a visiting professor for guest lectures starting in 2018.

The Centre for Molecular Simulation, directed by **Peter Tieleman**, organized several well-attended seminars by visiting speakers. The Tieleman group develops computer models to study lipids and membrane proteins, at both the atomistic level and at a slightly coarser level of detail, in the now widely-used MARTINI force field for biomolecular simulation. Working towards high-throughput computational screening of interactions between lipids and membrane proteins, they continue to develop new tools for membrane protein simulations and applications to ABC transporters and other membrane proteins. 2017 was a particularly exciting year for human ABC transporters, with many new structures appearing in the literature, including long-awaited structures of CFTR. The group is working on several computational projects in this area. Eduardo Mendez-Villuendas successfully defended his Ph.D. thesis on lipid-protein interactions and implications for viral maturation.

Congratulations go out to **Raymond J. Turner** for winning a university teaching excellence award for graduate supervision. Ray spent ten weeks during the Fall as a visiting professor in residence, awarded via a cooperative international funding envelope for small sized universities. He spent his time lecturing in graduate Biotechnology courses and a course on the Biochemistry and Chemistry of Biological Nanomaterials offered between the University of Verona and the University of Venice, Italy. During this time, he built productive collaborations which provided his Ph.D. student, Elena Piacenza, with an opportunity to visit and perform experiments using synchrotron beam lines in Grenoble, France. This came from extending his research on studying the resistance mechanisms against metal ion-based antimicrobials towards using bacteria as biofactories for production of metal nanomaterials. This line of research took off in the Fall of 2017, leading to the production of Te nanorods of impressive stability and size, with dimensions of ~4 x 20 x 800 nm, as recently disseminated in *Scientific Reports*. Ph.D. student Natalie Gugala in Ray's group, who is evaluating the biochemistry of metal-based antibiotics, published her novel findings in *J. Antibiotics* and in *Biofouling*. Post-doctoral fellow Dr. J. Lemire, together with Natalie, had their research on the biochemistry of silver toxicity and resistance highlighted at the Experimental Biology conference, which led to several press releases.

Vanina Zaremberg was invited as a speaker at the 2017 Gordon Research Conference on Molecular Biology of Lipids held in the U.S., to present foundational work on the establishment of signalling lipid pools and their associated metabolism. She currently serves as editorial board member for the Journal of Biological Chemistry and is a member of the NSERC evaluation group, Genes, Cells and Molecules. Ph.D. student Suria Ganesan from the Zaremberg lab was the recipient of an Eyes High International Doctoral Scholarship awarded by the University of Calgary. Suria contributed to a high-quality paper in collaboration with Dr. M. Terebiznik's group (U of Toronto) published in the *Journal of Cell Biology*. The work was highlighted in the JCB "Spotlight" section. Brittney Shabits from the same group received a QE-II graduate scholarship and brilliantly defended her M.Sc. thesis. The group welcomed new M.Sc. student Laura Sosa, who has initiated exciting work on the role of lipid metabolism and telomere silencing in collaboration with Dr. Jennifer Cobb (Cumming School of Medicine). Laura was awarded a QE-II graduate scholarship.

On the Teaching side, **Isabelle Barrette-Ng** launched Program SAGES (SoTL Advancing Graduate Education in STEM) using funding from the University of Calgary Teaching Scholars Program and the Graduate Students' Association Quality Money Program. SAGES consists of two credit courses that help STEM graduate students develop an evidence-based, reflective teaching practice. The first course consists of a survey of the theory of teaching and learning of STEM at the post-secondary level. The second course consists of a teaching practicum. 14 graduate students from across the Faculty of Science completed the program in 2017 and presented the results of their practicum at our first annual SAGES Celebration of Teaching and Learning event on June 29, 2017. For her work on SAGES and other programs, Isabelle was awarded the 2017 Faculty of Science Educational Leadership award.

Elke Lohmeier-Vogel continued teaching and coordinating in three biochemistry laboratory courses in the Fall and Winter terms, as well as an introductory biology course. She was nominated for a teaching excellence award in BCEM 403. Over the summer of

2017, she worked with the iGEM team along with her colleague **Mayi Arcellana-Panlilio** to assist the students in their research project, which they present annually in Boston in a global competition. Elke and Mayi presented a teaching workshop at the annual University of Calgary Post-secondary Learning and Teaching Conference in May, on the interesting process by which students in the iGEM teams select a topic to work on for the year.

University of Guelph

Department of Molecular and Cellular Biology
Correspondent: Frances Sharom

Faculty news:
Dr. Emma Allen-Vercoe was awarded a Research Leadership Chair, a new 3- to 5-year internal award to recognize research excellence and innovation. The awards are based on scholarly output, research-related knowledge mobilization, research-derived innovation and training of highly qualified personnel, and recognize researchers whose research successes already set them apart from colleagues in their disciplines globally. Award winners will present their work to the university and the wider Guelph community through special research events.

Dr. Emma Allen-Vercoe

Dr. Jim Uniacke received 4 years of funding from CIHR to look at targeted treatment of hypoxic, or low oxygen, tumour regions. He plans to use model cancer cell lines and nanoparticles to deliver genetic material to hypoxic human tumours grafted onto mice. Dr. Uniacke's research team aims to learn how hypoxic cancer cells make the proteins they need to survive and spread. These mechanisms could then be targeted in cancer therapy to impair the ability of a cancer cell to make the tools it requires, essentially disarming the cell. Jim's lab was also selected as Guelph Co-op Employer of the Year.

Congratulations go to the following MCB faculty members for successfully renewing their NSERC Discovery Grants in 2017: **Joseph Colasanti, Marc Coppolino, Nina Jones** (who also received an Accelerator grant), **David Josephy** and **Janet Wood.**

Several MCB faculty members participated in successful NSERC group applications for new instruments and infrastructure in 2017. **Steffen Graether** (co-applicants: Leonid Brown (Physics), **George Harauz, Rod Merrill, Stephen Seah, Janet Wood** and **Cezar Khursigara**) acquired ITC and DSC systems as part of a Protein Knowledge Suite. A Zebrafish Advanced Life Support System was awarded to **Terry Van Raay** (co-applicants: Nick Bernier (Integrative Biology), **Scott Ryan**, Glen Van Der Kraak (Integrative Biology), **John Dawson,** Todd Gillis (Integrative Biology) and Niel Karrow (Animal Biosciences)). Doug Goff from Food Science (co-applicants: **Emma Allen-Vercoe, Nina Jones, Cezar Khursigara**, and **Chris Whitfield**) was awarded a cryo-preparation unit for a Scanning Electron Microscope.

In May, **Drs. Nina Jones** and **Lucy Mutharia** were honoured as members of a group of 30 Women of Distinction chosen by the Guelph YMCA-YWCA for their lifetime contribution to STEM (science, technology, engineering and math) and education, training and mentorship.

New faculty appointments:
Three new faculty members joined our department during 2017.

Dr. Melissa Perreault, a neuroscientist with expertise in electrophysiology, cell signalling and behavioural neuroscience using animal models of neuropsychiatric disorders and neurodegenerative disease joined the Department as an Assistant Professor in January 2017. Dr. Perreault's scientific research career began as an undergraduate project student in the laboratory of Dr. C. David Rollo, an evolutionary biologist at McMaster University who studied evolutionary theory based on integrated life history trade-offs. She remained in his lab for an additional two years and after completing her M.Sc. degree, pursued doctoral research under the supervision

of Dr. Henry Szechtman in the Department of Psychiatry and Behavioural Neuroscience, where her studies focussed on opioid-dopamine interactions using an animal model system of obsessive-compulsive disorder. Dr. Perreault continued her research as post-doctoral fellow in the laboratory of Dr. Susan George at the University of Toronto, a molecular pharmacologist whose research focussed on the dopamine D1-D2 receptor complex and its role in addiction and schizophrenia. During her post-doctoral studies she spent a month in Tuscany, Italy at the Neuroscience School for Advanced Studies, where she had the opportunity to meet Dr. Anthony Grace, Distinguished Professor of Neuroscience at the University of Pittsburgh. During her post-doctoral studies she received training in Dr. Grace's laboratory where she learned how to record and analyze neuronal oscillations in awake, freely moving animals. These oscillations, which represent the summed electrical activity from numerous neurons, have emerged as being critical to the neuropathology of a number of CNS diseases. At the University of Guelph, Dr. Perreault will continue to combine cell and systems research with animal behaviour to help gain insights into the mechanisms of disease, with a particular focus on depression, schizophrenia and Alzheimer's disease. She is also excited about being part of the recently implemented Neuroscience major at the University of Guelph, and looks forward to participating in curriculum development for this new program.

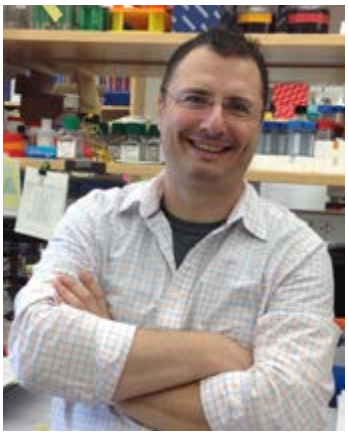
Assistant Professor Dr. Melissa Perreault

Dr. Georgina Cox joined the Department as an Assistant Professor on July 1, 2017. Georgina completed her Ph.D. at the University of Leeds, U.K., where she first became fascinated with antibiotic resistance and the intricate mechanisms bacteria have evolved to circumvent the inhibitory action of these small molecules. Following completion of her Ph.D., Georgina joined the laboratory of Dr. Gerry Wright within the Institute of Infectious Disease Research (IIDR) at McMaster University. Her post-doctoral research built upon her existing skills base, involving the structural and molecular characterization of antibiotic resistance mechanisms, and also exposed her to cutting edge drug discovery campaigns and the world of natural products. Georgina is setting up a research program studying host-pathogen interactions and bacterial antibiotic resistance, and looks forward to participating in the delivery of undergraduate courses in Microbiology and Biochemistry. Utilizing a mixture of structural, molecular and genetic approaches, research in her lab involves gaining insight into two areas: how bacteria resist antibiotics and how they interact with their host. The over-arching goal of her research is to identify and develop innovative alternatives to traditional antibacterial chemotherapy.

Assistant Professor Dr. Georgina Cox

Dr. Jasmin Lalonde, who has interdisciplinary expertise in neurobiology and biological psychiatry, joined the department as an Assistant Professor in August 2017. Jasmin completed his undergraduate studies at the University of Ottawa in 1999. He then moved to McGill University where he completed a Master's degree and Ph.D. in the Department of Psychology. As a doctoral student in the laboratory of Dr. Avi Chaudhuri, Dr. Lalonde initiated a series of studies that revealed unsuspected regulation of the calcium/calmodulin-dependent protein kinase IV (CaMKIV) and the cAMP response element-binding protein (CREB) transcription factor in neuron subtypes of the monkey primary visual cortex. In 2007, Dr. Lalonde joined the laboratory of Dr. Grace Gill at Tufts University School of Medicine as a CIHR Post-doctoral Fellow where he studied the regulation and function of transcription factor Specificity protein 4 (Sp4) in neuronal cultures and a genetic *Sp4* mouse model. While trying to understand which calcium-dependent signal transduction pathway participates in control of Sp4 protein stability, he made striking observations showing that STIM1-mediated Store-Operated Calcium Entry (SOCE) plays a central role in this process when neurons are at rest. His findings on neuronal SOCE were published in *Science Signaling*. As Dr. Lalonde's work on Sp4 and SOCE was reaching its completion, he was in-

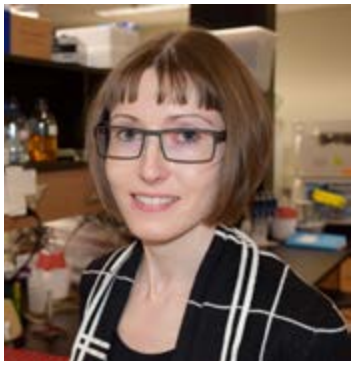
vited to join the laboratory of Dr. Stephen Haggarty at the Massachusetts General Hospital (MGH). There, he gained additional experience with neuropharmacology, translational neuroscience and stem cell biology, as well as high-throughput screening techniques. Among his many accomplishments at MGH, Dr. Lalonde found that acetylation of a specific lysine residue of Activity-regulated cytoskeleton-associated protein (Arc) can prevent the ubiquitin-proteasome system of degrading this key effector of synaptic plasticity and long-term memory consolidation. This work was recently published in *Nature Communications*. His recent CIHR-funded post-doctoral investigation into the molecular basis of store-operated calcium entry in bipolar disorder was recognized with a 2016 Young Investigator Grant from the Brain & Behavior Research Foundation (formerly NARSAD) in the U.S., which currently supports research in his lab that examines the possible connection between SOCE dysfunction and bipolar disorder pathophysiology using patient-derived induced pluripotent stem cells. At the University of Guelph, Dr. Lalonde is establishing a research program examining the molecular mechanisms that control neuronal function, and how these contribute to the pathophysiology of bipolar disorder and schizophrenia.



Assistant Professor Dr. Jasmin Lalonde

Introducing the G. Magnotta Lyme Disease Research Lab:

In June, 2017, the College of Biological Sciences at the University of Guelph was thrilled to announce a partnership with the G. Magnotta Foundation for Vector-Borne Diseases to establish a dedicated Lyme disease research lab in the Department of Molecular and Cellular Biology. Lyme is a debilitating tick-borne zoonosis that is incompletely characterized, and poses an escalating threat to the health of Canadians. Named in honour of the late vintner and avid outdoorsman Gabe Magnotta, who died from complications of Lyme disease, the new lab is harnessing a multidisciplinary approach to uncover disease mechanisms and ultimately improve diagnostics and treatment strategies. Led by a cell-signalling biochemist, **Dr. Melanie Wills**, the lab benefits from departmental strengths in microbiology, protein chemistry, and cellular pathology to support a research programme revolving around microbial characterization, host-pathogen interaction, and human disease determinants. A clinical-academic pipeline is currently in development to support this patient-oriented research. The G. Magnotta Lab is also central to a larger initiative that unites research nodes across the country to address the full complexity of Lyme disease, from its ecological underpinnings to health policy and practice. The Canadian Lyme Consortium is expected to make its public debut in the summer of 2018.



Dr. Melanie Wills, Director of the G. Magnotta Lyme Disease Research Lab

The Magnotta lab team at work

Retirements:

Faculty retirements continued in 2017, with **Dr. Peter Krell** retiring in February, **Dr. Joe Lam** in June, and **Dr. Janet Wood** in August. All three are now winding down their research activities after distinguished careers in both research and teaching at the university over many decades.

Staff news, comings and goings:

Dr. Paula Russell was selected as a recipient of this year's President's Award for Exemplary Staff Service in the category of Hidden Hero. This award recognized Paula's contributions to our Department and the University in running the senior undergraduate laboratories

in Analytical Biochemistry and Enzymology. We all appreciated her willingness to provide excellent behind-the-scenes support to our students, faculty, and staff. Paula left the department in September 2017 for Health Canada in Ottawa; we wish her well in her new position.

Dr. Colin Cooper replaced Paula Russell as Undergraduate Teaching Coordinator in November 2017. He obtained his B.Sc. and M.Sc. in Cell Biology and Genetics from Western University and his Ph.D. in Biochemistry and Microbiology from McMaster University. Engaging students in the active learning environment of the laboratory is Colin's primary focus, with the goal of giving each student a rewarding start to their biochemistry career.

Graduate student awards:
David Sycantha (Clarke lab) and **Danielle Williams** (Whitfield lab) both received awards at the Canadian Society of Microbiologists Conference held in Waterloo in June 2017. David won the Student Symposium Award For Top Student Oral Presentation, and Danielle was the recipient of the Terry Beveridge Poster Competition Award.

Our graduate students won multiple poster awards at the 2017 Waterloo-Guelph-Laurier 3rd Annual Protein Symposium, which was held in June and hosted by the University of Waterloo. Twenty-one excellent posters and 3 short talks were presented by MCB students and research staff. Congratulations to the award recipients: **Liam Doyle** (Whitfield lab), **Carys Jones** (Clarke lab), **Sean Liston** (Whitfield lab) and **Kevin Rea** (Akhtar lab).

University of Lethbridge

Correspondent: Ute Kothe

Faculty news:
Dr. Ute Kothe, an associate professor in the Department of Chemistry and Biochemistry, has been welcomed by the Royal Society of Canada as one of 70 new members to The College of New Scholars, Artists and Scientists.

Dr. Athanasios Zovoilis has been named a Tier II Canada Research Chair in RNA Bioinformatics and Genomics. Dr. A. Zovoilis, a bioinformatician and genomicist, came to the U of Lethbridge from Boston's Harvard University to establish and pursue a research program aimed at developing personalized treatments for diseases like cancer and dementia. He is a member of the Alberta RNA Research and Training Institute (ARRTI).
A collaboration between **Drs. Athanasios Zovoilis** and **Majid Mohajerani** to investigate molecular mechanisms involved in Alzheimer's disease has received funding by the Alberta Prion Research Institute. The two researchers are professors of bioinformatics in the Departments of Chemistry and Biochemistry, and Neuroscience, respectively, and combine their complementary expertise in genomics, bioinformatics and animal studies in an interdisciplinary study.

Dr. Wade Abbott of Agriculture and Agri-Food Canada and his team have published a research study on the degradation of dietary pectic glycans in human colonic *Bacteroides* in Nature Microbiology. The study creates opportunities to manipulate the microbiome and possibly enhance food digestibility.

The pioneering work by the high school iGEM program has been featured in Nature Biotechnology. The article, co-authored by **Drs. Hans-Joachim Wieden** and **Brian Dempsey** of the Department of Chemistry and Biochemistry and their coworkers, describes "A synthetic biology approach to integrative high school STEM training".

The U of Lethbridge iGEM teams are succeeding at all levels:
For several years, the University of Lethbridge has been the proud home of both a collegiate iGEM team comprising graduate and undergraduate students, as well as a high-school iGEM team. Both teams are competing in the international Genetically Engineered Machines (iGEM) competition taking place each November in Boston, Massachusetts, USA. In 2017, both teams were once again highly successful. The U of Lethbridge high school team was awarded a silver medal and the collegiate team a gold medal, and also received nominations in three special categories, including Best Software, Best Education and Public Engagement, and Best Integrated Human Practices. In addition, the team received the Biosafety and Biosecurity Commendation.

"This year, it's safe to say the U of L team was the highest-achieving Canadian team at this international competition," says Dr. Hans-Joachim Wieden, a professor in the Department of Chemistry and

Biochemistry and team advisor. “I am extremely proud of our students. They worked hard and these results prove their efforts were on the mark. What’s more, the Federal Bureau of Investigation (FBI), in their presentation at the jamboree, mentioned the U of L’s work as a positive example.”

The collegiate team focused this year on making synthetic biology safe and available for everyone. Specifically, the team was trying to develop a cell-free synthetic biology system to bring this technology to as many people as possible, and make sure that it’s democratically spread out. Then the team realized that this tool, as useful as it is, also opens up unforeseen biosecurity risks. Following the Biosafety and Biosecurity Commendation after the Giant Jamboree 2017, one of the team members and an M.Sc. student at the U of Lethbridge, **Chris Isaac**, was chosen to be one of five student participants in the iGEM Foundation’s delegation to the Meeting of States Parties to the Biological Weapons Convention (BWC) in Geneva in December 2017.

The high school iGEM team worked towards the development of biological pigment for use in the manufacturing of ink to mitigate the environmental consequences of traditional ink manufacturing. The high school team members wrote a paper about the design of their project and submitted it to Biotreks, an on-line journal for high school students. After being judged by members of the synthetic biology community, the Lethbridge team was given an Education Award to acknowledge their outstanding job in communicating their knowledge and techniques to their peers, and an award for visual communication for their use of tables and figures to augment their work. Moreover, the team was awarded Best Communication at the Alberta competition in June 2017.

Gairdner Awardee Dr. Lewis Kay visits U of Lethbridge:
The Department of Chemistry and Biochemistry at the U of Lethbridge has once again been selected by the Gairdner Foundation to host one of the world-class Gairdner Awardees, Dr. Lewis Kay from the University of Toronto. Dr. Kay’s visit was a special event because his research in the field of biomolecular nuclear magnetic resonance (NMR) spectroscopy is of high interest to all researchers in the department, from biochemistry to chemistry. Accordingly, the visit was jointly organized by the Alberta RNA Research and Training Institute (ARRTI) as well as the Canadian Centre of Research in Advanced Fluorine Technologies (C-CRAFT). Everybody on campus was truly inspired by Dr. Kay’s scientific lecture presenting his impressive studies of the p97 Molecular Machine. Importantly, Dr. Kay also engaged local youth by visiting a high school in Lethbridge for a dedicated lecture that was followed by a long question period. Dr. Kay continues to be an inspiration for the undergraduate and graduate students at the University of Lethbridge. He took the time to closely engage with students in two dedicated career lunches. Moreover, Dr. Kay attended the concomitant annual Chinook Symposium for Chemistry and Biochemistry where he talked with many students about their research projects.

Two Public Professor Lectures from the Department of Chemistry and Biochemistry:
The Faculty of Arts and Science has created a very popular Public Professor Lecture series where University of Lethbridge professors engage with the local community. In 2017, no less than two professors from the Department of Chemistry and Biochemistry were selected to present their research. In March 2017, **Dr. Stacey Wetmore** talked about “DNA Damage, Repair and Disease: How Computers Can Help Us Understand”. In a one-hour lecture, she fascinated the audience with an impressive range of topics from basic chemistry to advanced computational research and applications in medicine such as cancer treatment. The large number of questions after her presentation clearly showed how much Dr. Wetmore engaged the audience. In September 2017, **Dr. Ute Kothe** then followed the example of her colleague in her Public Professor Lecture entitled “From the beginnings of Life to Modern Medicine: Why RNA Matters”. By representing the Alberta RNA Research and Training Institute (ARRTI), Dr. Kothe highlighted several applications of RNA research from biotechnology including the newest uses of CRISPR systems to the understanding of rare diseases and the treatment of diseases such as spinal muscular atrophy. Both Public Professor Lectures were attended by hundreds of community members, leaving a lasting impact.

University of Manitoba

Department of Biochemistry and Medical Genetics, Rady Faculty of Health Sciences

Correspondent: Louise Simard

2017 witnessed the inaugural class of M.Sc. Genetic Counselling trainees. This has been a busy year with a mix of formal coursework, clinical rotations and the development of their graduate thesis topics. Rachelle Dinchong came to us with an Honours B.Sc. degree with High Distinction from the University of Toronto. Her graduate thesis topic is "Mitigating the psychosocial impact of a false positive newborn screen for inborn errors of metabolism". Angela, native to Winnipeg, entered the program with a B.Sc. in Genetics and an M.Sc. in Biochemistry and Medical Genetics at the University of Manitoba. Her graduate thesis topic is "Exploration of the Genetic Assistant Position in the Genetics Clinic". Ashleigh Hansen came into the program with a B.Sc. in Microbiology from the University of Victoria. Her graduate thesis topic is "Exploring immigrants' perceptions of genetic counselling: A case study". Angela Krutish was the recipient of a Manitoba Graduate Student Fellowship, while Rachelle Dinchong was awarded a University of Manitoba Graduate Scholarship.

Angela Krutish, Ashleigh Hansen, and Rachelle Dinchong (from left to right) posing with Rusty, the therapy dog

Additionally, 2017 marked a number of pivotal milestones for **Dr. Tamra Werbowetski-Ogilvie**, who was recruited to our department and the Regenerative Medicine Program in November 2010. This year, Dr. Werbowetski-Ogilvie achieved tenure, and was promoted to the rank of Associate Professor. Evidence in support of these achievements included the national recognition she received through the renewal of her Tier II Canada Research Chair in Neuro-oncology and Human Stem Cells which commenced in July 2017 and runs to June 2022. Furthermore, Dr. Werbowetski-Ogilvie became the first Manitoban, and one of the few Canadians, to be awarded an Alex's Lemonade Stand Foundation Innovation grant. This is a 2 year ~$249K U.S. award to study the role of OTX2-semaphorin gene signalling pathways in highly aggressive medulloblastomas. Part of this work was piloted by 2017 CIHR Project Grant Bridge funding (April-Sept 2017). Together, this has allowed her to recruit two new post-doctoral fellows, Drs. Jamie Zagozewski (Ph.D. trainee of Dr. David Eisenstat), and Brent Guppy (Ph.D. trainee of Dr. Kirk McManus). Dr. Zagozewski was the recipient of a post-doctoral fellowship from the partnership of Research Manitoba, the Children's Hospital Research Institute of Manitoba, and CancerCare Manitoba (2017-2019). We look forward to following Jamie's and Brent's progress in understanding medulloblastoma pathobiology and potential combinatorial therapeutic modalities in the coming years. Finally, Dr. Tamra Werbowetski-Ogilvie was one of the 2017 nominees for the YMCA/YWCA Women of Distinction Award.

Dr. Tamra Werbowetski-Ogilvie

Other faculty members were also successful in attracting research funding despite the current exceedingly competitive and challenging environment; consequently, it is doubly important to celebrate these successes. Funding was attracted from a wide variety of organizations that include the Canadian Statistical Sciences Institute (**Dr. Pingzhao Hu** as Co-investigator), Cancer Research Society (**Drs. Mark Nachtigal** and **Kirk McManus**), CancerCare Manitoba Foundation (**Dr. Kirk McManus**), Children's Hospital Research Institute of Manitoba (**Drs. Pingzhao Hu, Barbara Triggs-Raine**), Canadian Institutes of Health Research (**Dr. Tamra Werbowetski-Ogilvie**), Canada Research Chairs (**Dr. Tamra Werbowetski-Ogilvie**), Diagnostic Services Manitoba (**Drs. Mark Nachtigal** and **Kirk McManus**), Glyconet (**Drs. Gilbert Arthur, Brian Mark** and **Barbara Triggs-Raine**), Heart and Stroke Foundation of Canada (**Dr. Jeffrey Wigle**), Leukemia and Lymphoma Society of Canada (**Dr. Spencer**

Gibson), NSERC (**Drs. Jim Davie, Barbara Triggs-Raine**), Research Manitoba (**Drs. Hao Ding** and **Trevor Pemberton**), St. Boniface Hospital Foundation (**Dr. Jeffrey Wigle**), and the Western Canadian Universities, Collaborative Project Seed Funding (**Dr. Pingzhao Hu**). Dr. Hu was also a Co-investigator on a five-year NSERC CREATE Program grant award of $1.65 million dollars to support the "Visual and automated disease analytics (VADA)" training experience. **Dr. Leigh Murphy** is a Co-investigator of a recently funded "Investigator Initiated Research Scheme" by the National Breast Cancer Foundation in Australia, a >1 million dollar Australian-Canadian initiative that seeks to use "proteomics to transform treatment decisions for breast cancer". An important component of this initiative will be the Canadian Breast Cancer Tissue Bank. Collectively, this funding will advance our research programs, and provide critical support to our trainees.

The department is built upon the productivity of its trainees and fed by our graduate program. This year, **Ifeoluwa Adwewumi** (Dr. Jim Davie), **Yasamin Asbaghi** (Dr. Kirk McManus), **Anna Blankstein** (Dr. Spencer Gibson), **Chi Chen** (Dr. Pingzhao Hu), **Lexi Ciapala** (Dr. Spencer Gibson), **Miriam Derksen** (Dr. Spencer Gibson), **Veronica Lau** (Dr. Jim Davie), and **Margaret Stromecki** (Dr. Tamra Werbowetski-Ogilvie) defended their theses, and their M.Sc. degrees were conferred. Two students received their Ph.D. degrees, **Alexandra Kuzyk** and **Sanzida Jahan**, under the guidance of Drs. Sabine Mai and Jim Davie, respectively.

The quality of our graduate students was recognized by a number of awards. Ph.D. candidate **Lisa Liang** (Dr. Tamra Werbowetski-Ogilvie) was awarded the Sheu L. Lee Family Scholarship in Oncology Research and the Nancie J Mauro Graduate Scholarship in Oncology Research. Ph.D. candidate **Sasha Blant** (Dr. Trevor Pemberton) was the recipient of two very prestigious University and Departmental awards, namely, the President's Graduate Scholarship in Human Genetics and the Phyllis J. McAlpine Graduate Fellowship, respectively. Research Manitoba graduate student fellowships were awarded to **Fadumo Osman** (Dr. Jim Davie) and **Amandeep Singh** (Dr. Spencer Gibson). **Amandeep Singh** was also a recipient of a Masters NSERC Canada Graduate Scholarship. On the post-doctoral front, **Dr. Svetlana Frenkel** (Dr. Pingzhao Hu) was recognized for her "Poster of Distinction" at the recent American Gastroenterological Association Digestive Disease Week. This distinction underscores the fact that her work was rated in the top 10% of all AGA abstracts selected for poster presentation. Finally, our students highlight their research progress at the departmental Seminar Series and every year we witness a wide range of topics that transcend many disciplines. One striking example this year was a number of presentations outlining the use of machine learning to better our understanding of cancer. At the end of each cycle, graduate trainees vote for the most outstanding Oral Presentations, and in 2017 the top three awards went to **Margaret Stromecki** (M.Sc. trainee with Dr. Tamra Werbowetski-Ogilvie), **Laura Thompson** (Ph.D. trainee with Dr. Kirk McManus) and **Chen Chi** (M.Sc. trainee with Dr. Pingzhao Hu).

Not to be outshone by our trainees, faculty were also at the receiving end of several important awards. Congratulations go to **Dr. Jim Davie**, who was the Canadians for Health Research "Researcher of the Month" this past April 2017 and **Dr. Kirk McManus**, who received the "Scientists' Choice Award" for the 2016 Best Drug Discovery & Development Article of the Year entitled "Identification and characterization of cancer risk factors using high throughput cell screening". **Dr. Cheryl Rockman-Greenberg** continues to receive accolades, and this year was given the 2017 Founders Award in recognition of outstanding contributions to Clinical Genetics and Metabolic Disorders, and an outstanding career in Medical Genetics in Canada and abroad.

University of Toronto

Department of Biochemistry

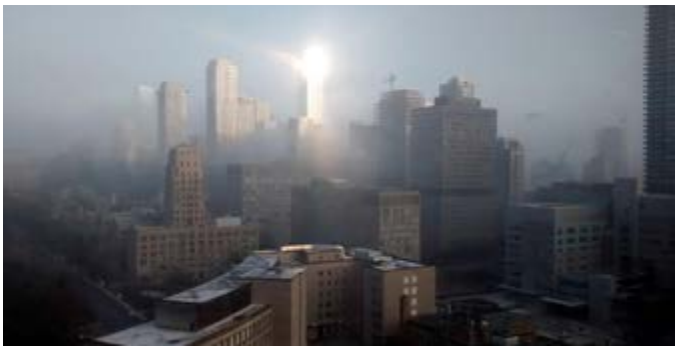
Correspondent: Alex Palazzo

Faculty news:

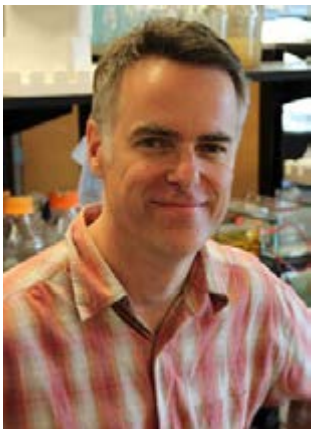
Move to MaRS

In January 2018, we completed the second stage of the move from the Medical Sciences Building to the 15th and 16th floors of the MaRS West Discovery tower, located on the southeast corner of University Avenue and College Street. Overall, 14 of the core faculty members have moved, and were joined by two new recruits, Haley Wyatt and Karen Maxwell. In spring 2018, a third new faculty member, Dr. Kate Lee is slated to set up her new lab in the remaining spot on the 15th floor.

Professor Justin Nodwell was reappointed for another 5 years as chair of the Biochemistry Department. During his first term, Dr. Nodwell played an instrumental role in initiating and implementing the move to MaRS, hiring



A view looking north from the 15th Floor of the MaRS West Discovery tower



Dr. Justin Nodwell

four new tenure-stream and one non-tenure-stream core faculty members, introducing a rotation system for the incoming graduate students, revamping the Biochemistry website and starting an annual retreat for the Department. Besides all of this, he was recently elected as a Fellow of the American Academy of Microbiology.

Faculty awards:

This past year, **Dr. Lewis Kay** was awarded the Gairdner International Award, Canada's highest science prize. Dr. Kay's work on the development and use of nuclear magnetic resonance (NMR) techniques for investigating molecular motion and short-lived conformations in large multiprotein complexes, has pushed boundaries and opened up new paradigms in macromolecular structure and function. He was also named an Officer of the Order of Canada, one of our country's highest civilian honours, which recognizes outstanding achievement, dedication to the community and service to the nation.

Dr. Lewis Kay

Dr. Sergio Grinstein was selected by the Canadian Society for Molecular Biosciences as the recipient of the Canadian Science Publishing Senior Investigator Award for 2017. Dr. Grinstein has contributed many seminal findings to the fields of cell biology, physiology and immunity, particularly on phagocytosis and host-pathogen interactions. His contributions include studies on the V-ATPase and NADPH oxidase in neutrophils, the regulation of cytosolic and organellar pH, membrane dynamics and signalling required for phagocytosis, the spatial organization and signalling of scavenger receptors. He presented a talk at the CSMB meeting in Ottawa in May 2017.

Dr. Charlie Deber received the 2017 Bruce Merrifield Award of the American Peptide Society. This Award was created in 1997 in honour of Dr. R. Bruce Merrifield, who won the Nobel Prize in Chemistry in 1984 for the invention of solid phase peptide synthesis. The award is presented every two years to leaders in the field who have demonstrated outstanding career accomplishments in peptide research, "recognizing the highest level of scientific creativity". Dr. Deber's research focusses on the hierarchy of forces that characterize the interactions of peptides and proteins with membranes, and how these forces produce membrane protein structure and function. The award was presented to Dr. Deber and co-recipient Dr. Robert Hodges, of the University of Colorado, at the 25th American Peptide Symposium in Whistler, B.C. on June, 2017.

Dr. Scott Prosser received the 2017 Jeremy Knowles Award of the Royal Society of Chemistry for "successful application of fluorine and multinuclear NMR to understand conformational dynamics and allostery in enzymes and G-protein coupled receptors". The Royal Society of Chemistry gives out the Jeremy Knowles Award to recognize and promote the importance of inter- and multidisciplinary research between chemistry and the life sciences.

Dr. Greg Fairn had a stellar year as he won the Walter A. Shaw Young Investigator Award in Lipid Research from the American Society for Biochemistry and Molecular Biology and was appointed to the editorial board of the journals *Scientific Reports, Traffic*, and *Cellular Microbiology*. Dr. Fairn also co-organized the 2017 CSMB Annual Meeting in Ottawa.

The department also congratulates **Dr. Stavroula Andreopoulos** on receiving the 2017 Sustained Excellence and Innovation in Life Sciences Education

Dr. Stavroula Andreopoulos

Award, which was presented to her on May 15th at the 15th Annual Education Achievement Celebration. This award recognizes and celebrates the tremendous contributions being made to medical teaching and education scholarship throughout the Faculty of Medicine at the University of Toronto.

Celebrating the 10,000 PhDs Project

Other faculty news:
Canada Research Chairs
Three Biochemistry faculty members were named new Canada Research Chairs by the federal government this past fall: **Haley Wyatt**, Tier 2 Canada Research Chair in Mechanisms of Genome Instability; **Jean-Philippe Julien**, Tier 2 Canada Research Chair in Structural Immunology; and **Trevor F. Moraes**, Tier 2 Canada Research Chair in Structural Biology of Membrane Proteins.

For the past two years, Professor **Reinhart Reithmeier** has been seconded to the School of Graduate Studies as Special Advisor to the Dean for Graduate Professional Skills and Engagement. Reinhart carried out an environmental scan of graduate professional development activities at the University of Toronto that is summarized in a report to the Dean (http://www.sgs.utoronto.ca/currentstudents/Pages/GPD-Report---July-2016.aspx). He established the Innovation in Graduate Professional Development Fund (http://www.sgs.utoronto.ca/currentstudents/Pages/SGS-Innovation-in-Graduate-Professional-Development-Fund.aspx) to help develop and support new or expanded Graduate Professional Development (GPD) initiatives by graduate students and post-doctoral fellows at the University of Toronto.

Dr. Reinhart Reithmeier

Reinhart also initiated and led the 10,000 PhDs Project, which used internet searches to determine the current (2016) positions of the 10,886 individuals who graduated from U of T with a Ph.D. in all disciplines from 2000 to 2015. An opinion piece was published in *University Affairs* and the Project was featured in articles in *Nature* and *Science*. The data from the 10,000 PhDs Project is publicly available in an easy to navigate format on the SGS web-site (http://www.sgs.utoronto.ca/about/Pages/10,000-PhDs-Project.aspx). All graduate students are encouraged to view the employment outcome data for their discipline to make more informed choices as to their possible and imagined career pathways.

In addition to all this work, Reinhart is the incoming President of the Royal Canadian Institute for Science (https://www.rciscience.ca/), a venerable institution created by Sir Sanford Fleming in 1850, whose mission is to bring science to the public. His goal as President is to move the organization beyond the bounds of Toronto to make RCIScience a national voice for science.

Research highlights:
Visualizing the cellular machinery in virtual reality (Nature Methods 2017 14:1122–1123)
The Autodesk Molecule Viewer, a new tool to visualize atomic structures using Virtual Reality (VR) software was developed by a partnership between Aidin Balo, a graduate student in the Ernst lab, and Autodesk, located in the MaRS Discovery district. Their new tool, described in this paper, allows users to easily import atomic coordinates, generate structural representations, annotate in space, store individual 3D structural snapshots and share interactive 3D and

immersive VR structural walkthroughs directly in a web browser. This tool has been used at conferences and structural biology presentations where the audience uses VR headsets to see inside and around 3D atomic structures.

Single molecule imaging of mRNAs by the Palazzo lab provides new insight into protein synthesis in mammalian cells (Cell Reports 2017 21: 3740–3753)
The Palazzo lab, in collaboration with Jeff Chao's lab at the Friedrich Miescher Institute for Biomedical Research in Basel, Switzerland, has resolved a long-standing puzzle in how cells use mRNAs to synthesize proteins. Previously, it was known that most mRNAs that encode secretory or membrane-bound proteins are localized to the surface of the endoplasmic reticulum (ER), a large tubulated organelle found inside of all eukaryotic cells. By visualizing single mRNA particles, the Palazzo and Chao labs demonstrated that a substantial fraction of mRNAs that encode cytosolic proteins are also localized to the surface of the ER, contrary to most current models. This study adds a new wrinkle to our basic understanding of how proteins are synthesized in cells.

Enenkel lab discover how proteasomes reorganize during cellular quiescence (MBoC 2017 28:2479-2491)
The Enenkel lab demonstrated that in quiescent cells, proteasomes, the key proteases for the degradation of toxic proteins, accumulate in motile and reversible granules which protect cells against stress and confer fitness during aging. They also found that ubiquitin is required for the formation of these proteasome granules. How and why protein droplets such as proteasome granules are formed is one of the hottest questions in cell biology.

Rubinstein lab uses cryo-EM to unveil new details about ATP generation in mitochondria (Science 2017 358(6365):936-940)
In the latest of a series of beautiful papers on the structure of the mitochondrial ATP synthase, the Rubinstein lab provide new structural information on the complex, which reveals how protons travel through this macromolecular assembly, how this complex dimerizes, and how the dimers bend the inner mitochondrial membrane to produce cristae, which are a feature of most inner mitochondrial membranes.

Maxwell and Davidson labs help identify a new inhibitor of Cas9 (Cell 2017 170(6):1224-1233)
In collaboration with the Doudna, Sontheimer and Kranzusch Labs, the Maxwell and Davidson groups discovered and characterized two different inhibitors of Cas9 which prevent CRISPR-Cas9 mediated DNA cleavage. These proteins, which are produced by bacteriophage to prevent their cleavage after infection, may one day be used to modulate the activity of CRISPR-Cas9 in diverse gene-editing technologies.

The Houry lab maps the molecular chaperone network (Cell Reports 2017 20(11):2735–2748)
The Houry lab spearheaded an international collaboration to provide a comprehensive view of molecular chaperone function in the cell through the use of a systematic global integrative network approach based on physical (protein-protein) and genetic (gene-gene or epistatic) interaction mapping. Many chaperones were found to interact with proteins that form foci or condensates under stress conditions, and this work provides novel insight into how these intracellular aggregates form.

Ernst Lab use DEER spectroscopy to determine how GPCRs use phosphorylation codes to recruit arrestin. (Cell 2017 170(3):457-469)
G protein-coupled receptors (GPCRs) mediate diverse signalling in part through interaction with arrestins, whose binding promotes receptor internalization and signalling through G protein-independent pathways. Featured on the cover of Cell, work from the Ernst lab in an international collaboration with groups from the U.S., Germany and China, helps to elucidate how GPCRs recruit their downstream target arrestin through phosphorylation. In particular, the Ernst lab used double electron-electron resonance (DEER), a form of pulsed electron paramagnetic resonance spectroscopy to validate some aspects of the crystal structure of the phosphorylated G-protein-coupled receptor (GPCR) rhodopsin in complex with arrestin.

Bear Lab shows that a new cystic fibrosis treatment improves function from a rare CFTR mutation in patient tissue (EMBO Mol Med. 2017 9(9):1224-1243)
The laboratory of Christine Bear, together with the group of Régis Pomès and collaborators at The Hospital for Sick Children and Proteostasis Therapeutics, used *in silico, in vitro* and *ex vivo* techniques to comprehensively

understand the consequences of a rare cystic fibrosis (CF) disease-causing mutation in the CFTR gene: c.3700 A>G (ΔI1234_R1239), and subsequently develop a novel mechanism-based therapeutic strategy.

Howell lab deduces the mechanism of type IV pilus motors (Nature Communications 2017 8:14816)
The type IV pilus is a long and sturdy grappling hook that bacteria use to attach to a surface and then pull themselves closer to it. The molecular mechanism of the motors involved in throwing out and pulling in these grappling hooks was deduced by the Howell lab, in conjunction with the Burrows lab at McMaster University. They solved the structure of the motor ATPase PilB in the presence of non-saturating amounts of either an ATP analogue or ADP, representing "before" and "after" states of hydrolysis. This allowed for the deduction of the movements made during the hydrolysis cycle. They also extended this ATPase mechanism to the previously solved structure of a second ATPase, PilT, which is responsible for the opposite function: pulling-in the grappling hook by disassembling the pilus into pilin subunits.

New genetic disease discovered by the Muise and Kahr labs (Nature Communications 2017 8:14816)
Members of the Kahr and Muise labs discovered that mutations in *ARPC1B*, a spliced isoform produced from the *ARPC1* gene, cause microthrombocytopenia, eosinophilia and inflammatory disease. The product of this gene forms part of the Arp2/3 complex, which is required for the polymerization of actin fibres. This work could pave the way for novel therapeutic treatments for these patients.

Ernst lab discovers new way to crystallize membrane proteins (Structure 2017 25(2) 384-392)
The laboratory of Dr. Oliver Ernst has used X-ray crystallography to determine the structure of a membrane protein imbedded in a polymer-bounded lipid nanodisc. The new method expands the toolbox for membrane-protein crystallography and promises more structures of proteins that so far have not been amenable to treatment with conventional detergents. Their publication was featured on the cover of Structure.

The roles of protein dynamics and water networks in catalysis visualized by the Pai, Prosser and Pomès labs (Science 2017 355(6322):eaag2355)
The laboratories of Emil Pai, Scott Prosser, Régis Pomès and collaborators in the U.S. and Japan, used a combination of X-ray crystallography, NMR and computational techniques to delineate how inter-subunit interactions in the dimeric enzyme fluoroacetate dehalogenase contribute to enzymatic catalysis. This enzyme is one of only a handful of protein catalysts that can break the strongest bond in organic chemistry, the one between carbon and fluorine atoms, in the process transforming the highly toxic pesticide fluoroacetate into glycolate, a benign molecule. This work provides insights into how substrates modulate the structure and dynamics of an enzyme to facilitate catalysis.

Stagljar lab map interactions between receptor tyrosine kinases and protein tyrosine phosphatases (Mol Cell. 2017 65(2):347-360)
Featured on the cover of Molecular Cell, research led by Dr. Igor Stagljar used mammalian membrane two-hybrid (MaMTH) to map interactions between receptor tyrosine kinases and protein tyrosine phosphatases in human cells. This work provides a broad and deep view of receptor tyrosine kinase signalling, potentially leading to new and improved cancer therapies.

Faculty appointments:
The Department was pleased to welcome three new faculty members in 2017:


Dr. Hyun Kate Lee

Dr. Hyun Kate Lee joined the Department with a primary appointment as Assistant Professor. Kate trained in the lab of Tony Hyman, who has pioneered our understanding of biomolecular phase separation, which enables molecules to self-assemble into distinct organelles without membranes. Her work demonstrated that disordered domains (protein regions without defined secondary structure) function as a platform for phase separation. Because 30% of the proteome is predicted to have disordered regions, her finding is likely to have wide-spread implications in cellular organization and in disease. Moreover, she demonstrated that membraneless

organelles can convert from having liquid-like material properties to form solid protein aggregates, and that this liquid-to-solid transition is accelerated by mutations on disordered regions. Because protein aggregation is a key molecular defect in neurodegeneration, her finding has implications for elucidating how these cytotoxic structures arise in disease. Beyond the formation of pathological protein aggregates, deregulating the material properties of membraneless organelles likely influences their function and contributes to numerous cellular defects. Her new lab will identify cellular mechanisms that regulate the 'liquidity' of membraneless organelles and how deregulating this essential cellular process leads to degeneration of neurons.

Dr. Joshua Currie also joined the Department as Assistant Professor, with a primary appointment to the Department of Cell and Systems Biology. Josh received his Ph.D. at the University of North Carolina, Chapel Hill, with Steve Rogers, studying the role of microtubule plus end proteins in microtubule dynamics and cell migration. As a post-doctoral fellow, he worked in the lab of Elly Tanaka at the Center for Regenerative Therapies in Dresden, where he was an Alexander von Humboldt and EMBO Fellow. His new lab will utilize *in vivo* imaging and molecular cell biology of the highly regenerative axolotl to understand principles of tissue regeneration. Ultimately, this work in an organism that is capable of amazing feats of regeneration will give novel insights into increasing the regenerative potential of tissues in humans.

Dr. Joshua Currie

Dr. Nana Lee was hired by the Department as an Assistant Professor, teaching stream. Dr. Lee holds a Ph.D. in Biochemistry from U of Toronto, a visiting scholar experience from M.I.T., and a post-doctoral fellowship from the University of Michigan. She brings her years of experience and expertise from the biotech industry (Ellipsis Biotherapeutics, DNA Software) into the classroom with her internationally recognized graduate-level professional development curriculum-embedded course in the Departments of Biochemistry and Immunology at the University of Toronto. She has spoken to over 1,000 students, post-docs, faculty and curriculum administrators in empowering trainees in optimizing research productivity and professional/career development. Dr. Lee's work in professional development has been featured in *Science Careers*, the Council of Graduate Schools/NSF, and the Conference Board of Canada.

Dr. Nana Lee

Retirements (contributed by Jean-Philippe Julien and Angus McQuibban):

Dr. Emile Pai

Emil Pai will be retiring from the Department of Biochemistry in the summer of 2018 after an illustrious scientific career. Emil obtained his Ph.D. in Chemistry from Ruperto Carola University, Heidelberg, Germany in 1978. After post-doctoral studies in the Department of Biophysics at the Max Planck Institute for Medical Research, he became Group Leader at the same institute, where he headed a research group for over ten years. There, he remarkably determined the three-dimensional fold of the first oncoprotein, H-ras p21 (Nature, 1989; Nature, 1990; Cell, 1990), and solved the crystal structure of the muscle protein actin (Nature, 1990).

Emil was recruited to the Faculty of Medicine at the University of Toronto as an NSERC Industrial Research Chair in Protein Crystallography, where he became Full Professor in Biochemistry (1991), in Molecular Genetics (1991) and subsequently in Medical Biophysics (1996). During his career, Emil held a Tier 1 Canada Research Chair in Structural Biology, was Head of the Division of Molecular & Structural Biology at the Ontario Cancer Institute, and a Senior Scientist at the Ontario Cancer Institute/Princess Margaret Cancer Centre (University

Health Network). Emil contributed over 200 research publications during his career. Recently, he described a breakthrough in the role of dimer asymmetry in enzyme catalysis (Science, 2017). His impact into the structural determinants of protein function has been broad, including in the fields of molecular transport, antibody recognition, prion proteins, and flavoproteins. He has been an outstanding mentor to dozens of trainees, generous with his time serving on numerous committees, and has inspired many in his teaching at the university.

A scientific symposium in his honour and celebrating his career "Why Structure Matters" will be held at the University of Toronto on July 19th 2018. We look forward to this event, which will re-unite many of his colleagues and friends. Emil, many thanks for your inspiring work throughout your career. We wish you well on your retirement.

Peter Lewis will be retiring from our Department in summer 2018 after 44 years as a faculty member. He joined our Department as an Assistant Professor in 1974, following post-doctoral studies with Morton Bradbury in the UK. Over the years Peter has taught legions of undergraduates, graduate students and post-doctoral fellows in the intricacies of protein and chromatin structure, while delving into topics such as Alzheimer's Disease and aging. Since 1991, Peter has held a number of facilitative roles including Department Chair (1991-2001), CSBMCB President (1999), Vice Dean Research and International Relations in the Faculty of Medicine (2002-2010) and Associate VP Research - Global Research Partnerships in Simcoe Hall (2010-2016). He has been involved in the formation of many UofT entities including the Donnelly CCBR and the Structural Genomics Consortium. Centrally, he was involved in restructuring the UofT Tech Transfer Office (now IPO) and the creation of SOSCIP, CCRM and CCAB. Since returning to the Department in 2016 as a "plain professor", as Peter's wife Linda puts it, Peter has teamed up with Professor Angus McQuibban to create a start-up called Rosetta Therapeutics aimed at drug discovery for neurodegenerative diseases using experimental and deep learning approaches. Peter looks forward to transitioning into retirement by participating in the start-up, spending more time on his new hobby of power boating, and of course relaxing with Linda, and sons, Colin and Patrick and their children Arya and Kalise. Time to smell the roses!! Peter can be reached at http://biochemistry.utoronto.ca/person/peter-n-lewis/

Dr. Peter Lewis

Departmental events:

Department retreat

The second annual Biochemistry Departmental Retreat was held at the Kempenfelt Centre on August 30-31, 2017. The retreat not only allowed the Department to celebrate our newest scientific discoveries, but also allowed everyone to see old friends and meet new colleagues. It also allowed incoming graduate rotation students to sample all of the exciting science that is happening throughout the Department. This year, the retreat focussed on grad students and included scientific presentations from 21 trainees. In addition, we heard Professor Haley Wyatt talk about her exciting work in the field of DNA repair. Other highlights were the poster session where grad students, post-docs and undergrads got to show off their latest findings, the photo scavenger hunt which tested the ingenuity and creativity of the various participating teams, faculty reading Mean Tweets from their students, and of course the evening bonfire, which included a spectacular sunset.

Participants in the second annual Biochemistry Department Retreat

Golf Day

It was a dreary day on June 13th, but it would take more than a few showers to dampen the spirits of the 24 intrepid biochemists who headed out to the Flemingdon Park 9-hole Golf Course in midtown

Toronto for the annual Biochemistry Department Golf Day. Each team had its share of beginners and ringers playing a "best ball" format that allowed everyone to contribute to their team. Despite spending more than a little time under umbrellas, the competition remained fierce with the ERADicals squeaking out a birdie on the 9th hole to snatch the win from the Right Lefties and the Dead Ringers who were only a stroke behind!

The annual Biochemistry Department Golf Day at Flemingdon Park

Graduate student news:
Rotations
This past fall the Department instituted a rotation system for its incoming graduate students. The system works by students engaging in three five-week rotations during their first semester of study, from September to December. Then a lab is chosen with a mutual agreement between supervisor and student. As they rotate, all of the students are enrolled in an Effective Science Communication class coordinated by Alex Palazzo, Alex Ensminger and Nana Lee. Briefly, the students learn how to give an effective presentation, how to write a scientific report, how to provide effective feedback, and how to engage and network amongst their peers.

The overwhelmingly majority of both faculty and students agreed that the first implementation of the rotation system was a success. Interestingly, almost two thirds of all rotation students ended up joining a lab that was different from their original preference, and this was largely due to students making much more informed choices after having rotated in different environments.

University of Toronto

Department of Cell and Systems Biology
Correspondent: Tony Harris

We are a major contributor to research and teaching at the University of Toronto. Groups in the Department combine high-throughput, cell imaging, physiological and bioinformatics methods to understand cellular and physiological processes in both model (*Arabidopsis, C. elegans, Drosophila*, mouse, *Xenopus*, zebrafish, axolotl and cell culture) and non-model organisms. The Department's major strengths include its groups studying plant molecular biology, its labs focussed on animal cell biology and tissue morphogenesis, and its groups studying neurophysiology. The Department is also home to the Centre for the Analysis of Genome Evolution and Function, a CFI-funded centre for genomics and proteomics research, in addition to a state-of-the-art CFI-funded microscopy centre.

Two new faculty members started this year. **Dr. Arneet Saltzman** studies chromatin regulation underpinning *C elegans* development. **Dr. Joshua Currie** studies molecular and cellular mechanisms of axolotl limb regeneration.

Jennifer Mitchell was promoted to Associate Professor. **Chris Garside** was promoted to Associate Professor, Teaching Stream. **Belinda Chang, Eiji Nambara, Melanie Woodin**, and **Keiko Yoshioka** were all promoted to Full Professor.

Prof **Melanie Woodin** was appointed Associate Dean, Undergraduate Issues and Academic Planning. Prof. **Ashley Bruce** was appointed Director of the Human Biology Program. Prof. **Ulrich Tepass** is the new Canada Research Chair (Tier I) in Epithelial Polarity and Development. Prof. **John Calarco** has been awarded a Canada Research Chair (Tier 2) in Neuronal RNA Biology.

Notable publications included:

Evolution of nonspectral rhodopsin function at high altitudes.
Castiglione GM, Hauser FE, Liao BS, Lujan NK, Van Nynatten A, Morrow JM, Schott RK, Bhattacharyya N, Dungan SZ, **Chang BSW**.
Proc Natl Acad Sci USA 2017 Jul 11;114(28):7385-7390.

An actomyosin-Arf-GEF negative feedback loop for tissue elongation under stress.
West JJ, Zulueta-Coarasa T, Maier JA, Lee DM, **Bruce AEE, Fernandez-Gonzalez R, Harris TJC**.
Curr Biol 2017 Aug 7;27(15):2260-2270

Expanded type III effector recognition by the ZAR1 NLR protein using ZED1-related kinases.
Seto D, Koulena N, Lo T, Menna A, **Guttman DS, Desveaux D.**
Nat Plants 2017 Mar 13;3:17027

Specification and spatial arrangement of cells in the germline stem cell niche of the Drosophila ovary depend on the Maf transcription factor Traffic jam.
Panchal T, Chen X, Alchits E, Oh Y, Poon J, Kouptsova J, Laski FA, **Godt D**.
PLoS Genet 2017 May 19;13(5):e1006790

Selection maintains signaling function of a highly diverged intrinsically disordered region.
Zarin T, Tsai CN, Nguyen Ba AN, **Moses AM**.
Proc Natl Acad Sci USA 2017 Feb 21;114(8):E1450-E1459

ePlant: Visualizing and exploring multiple levels of data for hypothesis generation in plant biology.
Waese J, Fan J, Pasha A, Yu H, Fucile G, Shi R, Cumming M, Kelley LA, Sternberg MJ, Krishnakumar V, Ferlanti E, Miller J, Town C, Stuerzlinger W, **Provart NJ**.
Plant Cell 2017 Aug;29(8):1806-1821

Myosin II promotes the anisotropic loss of the apical domain during Drosophila neuroblasts ingression.
Simões S, Oh Y, Wang MFZ, **Fernandez-Gonzalez R, Tepass U**.
J Cell Biol 2017 May 1;216(5):1387-1404

Visual experience facilitates BDNF-dependent adaptive recruitment of new neurons in the postembryonic optic tectum.
Hall ZJ, **Tropepe V.**
J Neurosci 2018 Feb 21;38(8):2000-2014

Ingression-type cell migration drives vegetal endoderm internalisation in the Xenopus gastrula.
Wen JW, **Winklbauer R**.
Elife 2017 Aug 10;6

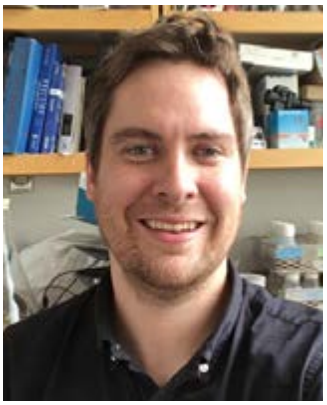
Restoring GABAergic inhibition rescues memory deficits in a Huntington's disease mouse model.
Dargaei Z, Bang JY, Mahadevan V, Khademullah CS, Bedard S, Parfitt GM, Kim JC, **Woodin MA**.
Proc Natl Acad Sci USA 2018 Feb 13;115(7):E1618-E1626.

University of Toronto

Department of Molecular Genetics
Correspondent: Barbara Funnell

Molecular Genetics had a banner year in 2017 for new recruits, both students and faculty, and new educational initiatives. We recruited over 75 new graduate students and 7 new faculty members to the core group, with our partner nodes at SickKids and the Donnelly Centre, and to support the new Masters degree in Medical Genomics that will begin in the Fall of 2018.

Welcome to new faculty:


Dr. Thomas Hurd

Dr. Thomas Hurd joined the Department as an Assistant Professor in January 2018, in the MoGen core at MaRS. His research program is focussed on determining how mitochondrial DNA is inherited through the female germline, and how mitochondria influence stem cell fate and differentiation in vivo, with a long-term interest in applying this knowledge to develop better protocols for reprogramming and differentiating human stem cells *in vitro*.

Dr. Aaron Reinke joined the Department as an Assistant Professor in September 2017, in the MoGen core at MaRS. His research program is focussed on a unique model system of microsporidial parasites that infect worms, specifically studying co-evolution of *Caenorhabditis* nematode hosts and *Nematocida* pathogens. His research encompasses


Dr. Aaron Reinke

interdisciplinary approaches with biochemistry, genetics, systems biology, and technology development.

Dr. Ryan Yuen

Dr. Ryan Yuen is a Scientist in Genetics and Genome Biology at the Hospital for Sick Children, and joined the Department as an Assistant Professor in 2017. Dr. Yuen studies how genetic and epigenetic variations contribute to human health, with a focus on neurodevelopmental and neurological disorders.

Dr. Hannes Röst joined the Department as an Assistant Professor in 2017, in the Donnelly Centre for Cellular & Biomolecular Research. His research interests are to understand biology on a personalized level and his lab uses next-generation mass spectrometry to analyze proteomic and metabolomic data in high-throughput.

Dr. Hannes Röst

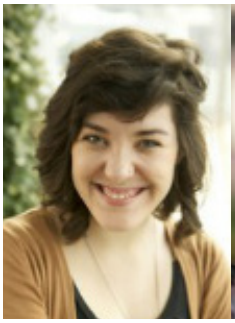
New Professional Master's Program in Medical Genomics: Molecular Genetics is launching a new M.H.Sc. in Medical Genomics, which will be the first of its kind in Canada. The program will target both clinically and laboratory-focussed students, and will provide a unique training and learning environment to teach practical and theoretical aspects of modern genetics and genomics with a strong focus on clinical application. This two-year course-based graduate program will consist of a core set of courses, comprising lectures, discussions, projects, and case studies, and will culminate in a hands-on Capstone Practicum. Students graduating from the program will obtain professional and practical skills that will help situate them in a world in which genetic and genomic data are routinely collected and analyzed across a wide range of patient populations and medical indications. We are currently recruiting our first cohort of students to start in September 2018.

In 2017, we recruited three faculty members as Assistant Professors, Teaching Stream, to design and implement the M.H.Sc program. Welcome to:

Dr. Erin Styles is the Director of the new Masters of Health Sciences program in Medical Genomics. She completed her Ph.D. with Brenda Andrews in Molecular Genetics at the U of Toronto.

Dr. Martina Steiner completed her Ph.D. at ETH Zurich, and holds a Master's degree in Secondary and Higher Education.

Dr. Johanna Carroll received her Ph.D. at the University of California Berkeley, and did post-doctoral training at the Dana Farber Cancer Institute and Harvard Medical School.



Dr. Erin Styles

Dr. Martina Steiner

Dr. Johanna Carroll

Faculty highlights and awards

Dr. Janet Rossant has been recognized by UNESCO and the L'Oréal Foundation as one of five outstanding women scientists from around the world, with a *2018 L'Oréal-UNESCO For Women in Science Award*. Dr. Rossant has also been honoured with a 2017 honorary Doctor of Science degree from Cambridge University. Dr. Rossant is being honoured for her contribution to the understanding of how tissues and organs are formed in the developing embryo.

Dr. Janet Rossant

Dr. John Dick is the 2017 recipient of the inaugural *CIHR Gold Leaf Prize for Discovery*, and has also been awarded the *2017 Keio Medical Science Prize* by Keio University in Japan. Dr. Dick is recognized for his contributions to the understanding of cancer stem cells and cancer.

Dr. John Dick

Dr. Lewis Kay

Dr. Lewis Kay has been recognized with a *2017 Canada Gairdner International Award* "For the development of modern NMR spectroscopy for studies of biomolecular structure dynamics and function, including applications to molecular machines and rare protein conformations."

Dr. Brenda Andrews

Dr. Brenda Andrews has been appointed to the rank of University Professor, the highest academic rank at the University of Toronto. Dr. Andrews is recognized for extraordinary scholarly achievement and leadership at the University. In addition, Dr. Andrews has been appointed to the governing council of the Canadian Institutes of Health Research (CIHR).

Dr. Stephen Scherer

Dr. Stephen Scherer has been honoured with a 2017 Honorary Doctor of Science from the University of Waterloo, for his "ground breaking contributions to the understanding of genetic variation, especially as it relates to human health and disease".

Canada Research Chairs:

Eight faculty members from Molecular Genetics have been named Canada Research Chairs in 2017:

Dr. John Dick - *Tier 1 Canada Research Chair in Stem Cell Biology*

Dr. C.C. Hui - *Tier 1 Canada Research Chair in Mouse Development and Disease Modelling*

Dr. Lucy Osborne - *Tier 1 Canada Research Chair in Genetics of Neurodevelopmental Disorders*

Dr. Frank Sicheri - *Tier 1 Canada Research Chair in Structural Principles of Signal Transduction*

Dr. Julie Claycomb - *Tier 2 Canada Research Chair in Small RNA Biology*

Dr. Ran Kafri - *Tier 2 Canada Research Chair in Quantitative Cell Biology*

Dr. Jason Moffat - *Tier 2 Canada Research Chair in Functional Genetics*

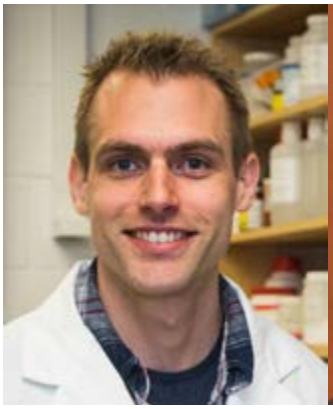
Dr. Jeehye Park - *Tier 2 Canada Research Chair in Molecular Genetics and Neurodegenerative Diseases*

Trainee awards:

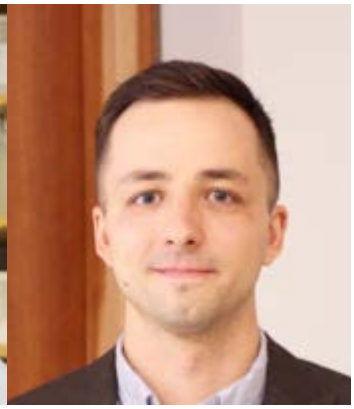
The Barbara Vivash Award for best Ph.D. Thesis: The Vivash award is given annually to a graduating student with the best Ph.D. thesis, and we have two recipients to report since the last CSMB newsletter.

Dr. Ryan Gaudet received the 2016 Barbara Vivash Award for his thesis, entitled TIFA-Mediated Innate Immune Recognition of the Bacterial Metabolite HBP and its Role in Host Defense". Ryan completed his Ph.D. with Dr. Scott Gray-Owen examining how cells respond to and promote immune responses to bacterial infection. Ryan is now a post-doctoral fellow at Yale University.

Dr. Serge Gueroussov was awarded the 2017 Barbara Vivash Award for his thesis, entitled "Functional Consequences of Mammalian-Specific Alternative Splicing Events in RNA Binding Proteins". Serge's Ph.D. studies, with Ben Blencowe, examined roles for alternative splicing in the brain. Serge is now a post-doctoral fellow at the Broad Institute of MIT and Harvard.



Dr. Ryan Gaudet



Dr. Serge Gueroussov

Molecular Genetics also has several competitive awards and fellowships, given annually to our graduate students. Congratulations to all recipients!! They are:
Harley Mount (Ensminger lab): L.W. Macpherson Award
Kaitlin Laverty (Hughes/Morris labs): Roman Pakula Award
Dustin Ammendolia (Brumell Lab): Norman Bethune Award
Elissa Currie (Gray-Owen lab): Eric Hani Fellowship
Brendan Innes (Bader lab): David Stephen Cant Graduate Scholarship in Stem Cell Research

Departmental and community events:
3rd Annual MoGen Career Development Symposium
Empowering trainees and engaging alumni are our primary goals for the Career Development symposia series started in 2015. The 3rd Annual MoGen Career Development Symposium was held on June 9, 2017, at the Chestnut Conference Centre, organized by Drs. Leah Cowen and Barbara Funnell. The mission of our symposia is to provide mentorship for our trainees in the many career options available to them by highlighting the paths followed by the many extraordinary alumni from Molecular Genetics. The afternoon included round-table discussions between alumni and trainees, networking sessions, and a panel discussion by six distinguished alumni: Dr. Jacques Archambault (Professor, McGill University), Dr. John Calarco (Assistant Professor, University of Toronto), Dr. Frédéric Sweeney (VP Business Development & Strategic Alliances, bioMérieux SA), Dr. Elizabeth Higgins (Analytical Development & Quality Control, GE Healthcare Life Sciences), Dr. Melanie Szweras (Partner, Bereskin & Parr LLP), and Dr. Jennifer Semotok (Senior Genetic Counsellor, Gene DX). We are already planning our 4th symposium, which will be held on June 4, 2018 at the Chestnut. Please join us!

MoGen Retreat 2017:
We gathered for our 2017 Molecular Genetics Retreat at Geneva Park YMCA, on September 20th-22nd. The retreat was organized by Dr. Jim Rini, Dr. Julie Lefebvre, and Dr. Leah Cowen, with the assistance of Eric Chapman, Samantha Esteves, Lauren Tracey, and their GSA team. Attendance was outstanding with almost 300 participants, including faculty and trainees. The retreat showcases research from across the entire department. It consisted of several short faculty talks, especially highlighting our newest faculty members, and a poster session with a record 137 presentations. The event always includes an evening of entertainment organized by the graduate students, followed by celebrations that go into the night at the fire pits, and with music and dancing in the Barn. Thanks to all for a successful retreat!

Participants at the 2017 Molecular Genetics Retreat

Move to MaRS!:
The move of a large number of MoGen core labs to the MaRS West Tower from the Medical Sciences Building is complete, and we are settling into our new space. Labs are on the 15th and 16th floors, and we share the space with colleagues from the departments of Biochemistry, Lab Medicine & Pathobiology, and Medicine. The two floors are differentiated approximately by theme: MaRS 15 is Gene-Protein Regulation, and MaRS 16 is Molecular Microbiology & Infectious Disease.

March for Science:
Thousands of science fans took to the streets of Toronto on April 22 for the "March for Science Toronto" rally, one of over 600 such marches across the globe in support of scientific research. Many students, post-docs, professors and staff from MoGen were evident. As a nationwide event, the March for Science was not only a celebration of scientific achievements, but was also a demonstration of all the important contributions that science has made to society.

The "March for Science Toronto" rally

.University of Toronto Mississauga

Department of Chemical and Physical Sciences

Correspondent: Voula Kanelis

New faculty member:

Dr. Sarah Rauscher

Sarah Rauscher joined the department in August 2017. Sarah completed her Ph.D. in Biochemistry at the University of Toronto and SickKids in the laboratory of Régis Pomès. She then moved to the Max Planck Institute for Biophysical Chemistry in Göttingen to carry out post-doctoral work in the department of Helmut Grubmüller. Her lab is currently developing accurate and efficient simulation methods to study disordered proteins and protein dynamics in all-atom detail. https://www.utm.utoronto.ca/cps/faculty-staff/rauscher-sarah

Professor Rauscher joins other UTM colleagues on the organizing committee for the Biophysical Society of Canada meeting, which will be held at UTM in late May 2019.

Faculty news:

Andrew Beharry's research is at the interface of biochemistry and medicinal chemistry. His lab has grown since he obtained his own lab space in May 2017, and now comprises 14 personnel. This past year his group has synthesized a series of small molecule probes for fluorescence-guided photodynamic therapy, which they are currently testing in cancer cells. Andrew's mug was featured on the cover of ACS Biochemistry in a special issue titled, "*The Future of Biochemistry*" and he was invited to write a review on the field of small molecule fluorescent sensors for ACS Chemical Biology. He is super-eager to publish his first set of research-based papers this year!

Professor **Patrick Gunning** and his group continue to make strides in the generation of drugs against cancer. For more information on the Gunning group, please see: http://www.gunninggroup.ca/home.

Cover for the special issue of Biochemistry; Professor Andrew Beharry's mug is in the top row, 5th from the left.

Professor **David McMillen** received his third Grand Challenges Canada Stars in Global Health grant, "Locally-produced algae for protein, iron, and vitamin supplementation in children". The project seeks to develop practical methods of deploying the cyanobacterium *Arthrospira platensis* (commonly known as *Spirulina*) as a source of nutrition in low-resource areas in the Philippines. *Spirulina* is a photosynthetic organism that produces all essential amino acids, has a high protein and vitamin content by mass, and delivers significant quantities of bioavailable iron, which is particularly significant in the Philippines where anaemia is common in children. Prof. McMillen spent a portion of his sabbatical year in the Philippines, working with local partners to set up *Spirulina* growth facilities using locally-available resources and conduct preliminary investigations of distribution mechanisms, such as incorporating the cells into noodles. Though the McMillen lab mainly works on more "high tech" projects involving engineered microbes in therapeutic or sensing contexts, this work reflects Prof. McMillen's changing focus when it comes

to problem-solving in the developing world: "If there's a natural organism that does what we need, let's not engineer it just because we can. If it later turns out that we need to tweak it somehow, we can do that, as required. Whatever works!"

Photos of Spirulina growing in jugs. Note that Prof. McMillen acknowledges that the chicken in the photo on the left is not a member of the team and has yet to sign a photo release form.

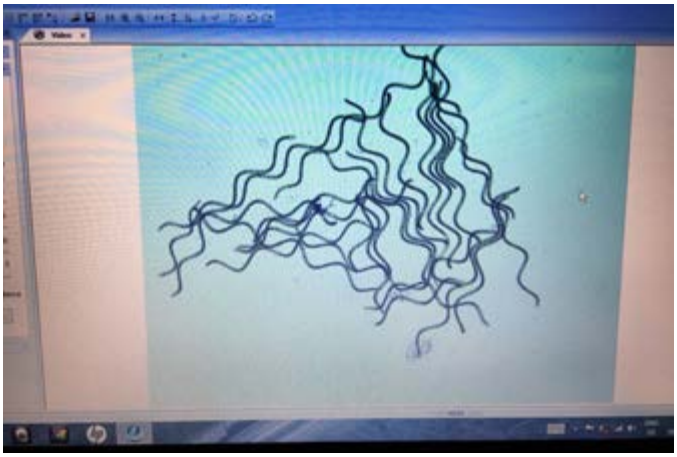
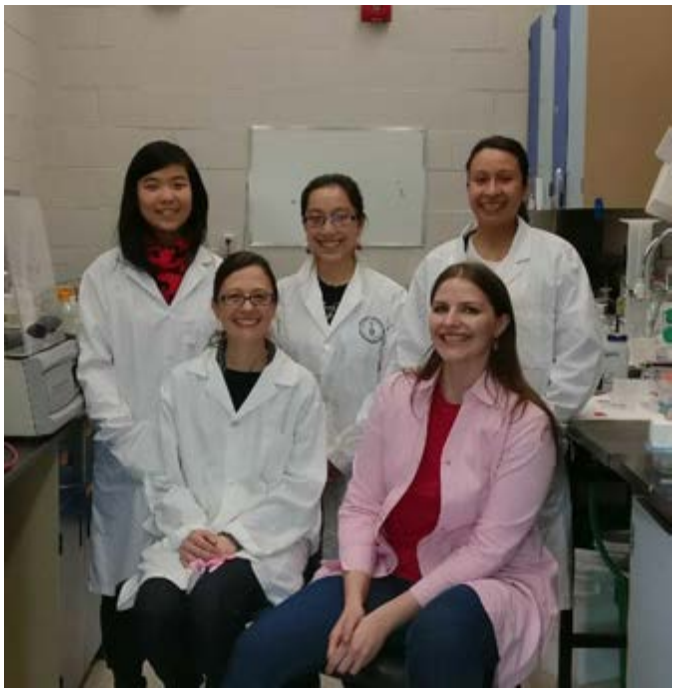


Image of Spirulina under the microscope. Spirulina associates as multicellular structures that form long spirals, making them easy to harvest from solution with a nylon mesh.

Voula Kanelis and her group study ABC proteins and HNH endonucleases. Their work on the SUR proteins, which are ABC proteins that form the regulatory subunits in KATP channels, was presented (by V. Kanelis) at the University of Alberta as part of the Walter MacKenzie Visiting Speaker Fund, and at the CSMB 61st Annual Conference on Membrane Proteins in Health and Disease. Highlights from the group also include the graduation of **Miriam Park** with an M.Sc. degree and **Dr. Claudia Alvarez** with a Ph.D. degree. **Sasha Weiditch**, a Ph.D. candidate, received the UTM Graduate Student Leadership Award and continues her outreach activities promoting science and scientists. Notably, Sasha was selected to speak about her outreach activities on social media at the U of T TEDx Deconstruct conference.



Female structural biologists from the Kanelis, Prosser, and ABE groups at UTM on the International Day of Women and Girls in Science

The year 2017 saw the lab of **Scott Prosser** advancing their studies in enzymes and GPCRs, and picking up new students (Jerome Gould and Chris Di Pietrantonio) who are taking the lead on allosteric networks in enzymes, and in the design of new chemical probes for NMR. After receiving the 2017 Jeremy Knowles Award from the Royal Society for Advances in Chemistry at the Interface with Biology, Scott travelled to the U.K. to give lectures on GPCR and enzyme allosteric mechanisms. Unfortunately, Mother Nature had other plans and a freak snow storm kept him from ever making it past Cambridge and Oxford. The lab later received a JELF CFI award which they will make use of to refurbish their protein expression capacity for receptor research. **Kate Huang** (Prosser Lab) received news that she will

be receiving an NSERC Alexander Graham Bell Canada Graduate Doctoral Scholarship. Her work has so far focused on allosteric players in the cell that regulate GPCR signal transduction.

Jumi Shin's group continues to make strides in designing DNA binding proteins. The Shin group's designed minimalist protein ME47 is an anti-proliferative against a triple negative breast cancer tumor xenograft in a mouse model. This was published in Oncogene, doi: 10.1038/onc.2017.275. ME47 can be delivered to breast cancer cell nuclei and binds to the same DNA targets as does oncoprotein Myc/Max, a transcriptional activator involved in >50% of breast cancers. Thus ME47 is a competitive inhibitor. The Shin group also published a review article, "Peptide therapeutics that directly target transcription factors," for an issue of Peptide Science focusing on Canadian labs (doi: 10.1002/pep2.24048).

Outreach activities:
In keeping with the theme of outreach, **Voula Kanelis**, co-director Professor **Steven Chatfield** (UTM Biology) and technician **Kristina Han** successfully launched the Amgen Biotech Experience Canada site, which provides teachers with training, reagents, and equipment to conduct biotechnology experiments in their classrooms. In the first year, the program will have trained 20 teachers and provided greater than 300 students with hands-on biotech lab experience.

CSMB-Sponsored Events

Graduate events

The CSMB provides financial support to graduate student societies for a variety of activities related to biochemistry, molecular biology, cell biology or genetics. Examples of supported activities include (but are not restricted to) the following:

Scientific Symposium Days, with invited scientists speaking on subjects in the areas of biochemistry, molecular biology, cell biology or genetics.
Student Research Conferences, where students display their research as posters, or give oral presentations.
Career Fairs or Career Workshops in areas related to biochemistry, molecular biology, cell biology or genetics.

*The society will support **up to six** events each year, to a **maximum of $500** per event, on a competitive basis. Student organizations seeking financial support under this program should contact the society Secretary with a short description of the planned event, and the amount of funding requested. The request should also include a Regular Member of the Society as a Sponsor/Coordinator, working with the Student Organization. Requests will be accepted twice each year (up to 3 possible awards for each competition), with deadlines of **February 15** and **September 15**.*

McGill University

Annual McGill Biomedical Graduate Conference (AMBGC)

Correspondent: William Liu

For the last 16 consecutive years, the Experimental Medicine Graduate Student Society (EMGSS) of McGill University has hosted the Annual McGill Biomedical Graduate Conference (AMBGC). The EMGSS is a non-profit, studentrun, academic organization that represents graduate students and post-doctoral fellows registered in the Division of Experimental Medicine at McGill University.

The AMBGC is a oneday symposium which allows outstanding graduate and undergraduate students the opportunity to present their research. Students from universities across Quebec participate in the conference and participation is open to any student around the world. Attendees are given an opportunity to interact, present their work, and learn from fellow members of the scientific community. Post-doctoral fellows with expertise in the various programs listed below volunteer as judges to award prizes to attendees based on the merit of their presentations. One outstanding abstract from each of the categories below is also selected for an oral presentation, which is judged by principal investigators at McGill, who also volunteer their time. The goal of this conference is to provide training opportunities for graduate students from all labs, regardless of budgetary restrictions. In this vein, the AMBGC does not charge a registration fee. We rely for the most part on the generosity of academic and corporate sponsors to finance our conference.

The 17th AMBGC took place on Thursday, March 23rd, 2017 at the Omni Hotel, 1050 Rue Sherbrooke Ouest, Montreal. In recent years, the number of attendees has ranged from 150-200. Participants included undergraduate and graduate students, post-doctoral fellows, university faculty, corporate representatives, and community members.

Themes for the conference included:

- Cardiovascular and Respiratory Systems
- Genetics and Gene Expression
- Neuroscience
- Endocrinology and Metabolism
- Microbiology and Immunology
- Oncology
- Epidemiology, Bioethics and Medical Genetics
- Cellular and Molecular Biology

The keynote address this year was given by Dr. Keith Mostov from the University of California, San Francisco (UCSF). Dr. Mostov received his Ph.D. from Rockefeller University in 1983, and his M.D. from Cornell University Medical College just a year later in 1984. Dr. Mostov has made many extremely important contributions to the field of cellular biology. He uncovered many broad and widely accepted principles in polarized membrane trafficking. His lab went on to describe a detailed, multistep cellular and molecular mechanism to explain how epithelial tubes form and elongate. Afterwards, they worked out a detailed molecular pathway to explain how the cells in these tubes orient and develop polarity, and assemble the apical surface at the lumen. His keynote address focussed on the most recent project in his lab, studying the control of length of epithelial tubes in mammals; it was attended by about 150 students and post-doctoral fellows who thoroughly enjoyed his very interesting and interactive lecture.

The audience at one of the AMBGC sessions

Participants at this year's 17th AMBGC

Student organizers of this year's 17th AMBGC

McGill University

Goodman Cancer Research Centre Research Day

Correspondent: Paula Pinto Coelho

The GCRC is an internationally renowned institution committed to conducting basic cancer research, and has labs doing research in a wide range of topics in biochemistry, molecular biology, immunology, cell biology and genetics. Biannually, the Goodman Centre Student Society (GCSS) hosts the GCRC Research Day. GCSS is a non-profit student-run academic organization that represents graduate students registered across several different departments (Biochemistry, Experimental Medicine, Physiology and Immunology among others) who work within the Goodman Cancer Research Centre (GCRC) or in one of its affiliated laboratories.

The GCRC Research Day is a one-day symposium that aims to create a platform for interaction and networking across all members of the centre. During the Research Day, graduate students and post-doctoral fellows have the opportunity to participate and compete in a series of events such as mini-TED talks, poster presentations and short talks, which are judged by professors from the GCRC to award prizes based on the merit of their presentations.

The goal of the GCRC Research Day is to give the Goodman trainees the opportunity to make a

statement with their work, and to foster interaction and collaboration across members of the centre, promoting the exchange of new ideas and technologies, regardless of budgetary restrictions. Thus, the GCRC Research Day does not charge a registration fee, and instead relies on the generosity of academic and corporate sponsors to finance our conference.

The 3rd GCRC Research Day took place on October 27th, 2017 at the Rosalind and Morris Goodman Cancer Research Centre, 1160 Avenue des Pins Ouest Montreal. We had 100-150 attendees, and over 50 presenters, which included graduate students, post-doctoral fellows and research associates. In 2017, our student-invited keynote speaker was Dr. Rosa Puertollano, from the National Institutes of Health, who is renowned for her work on molecular mechanisms of intracellular trafficking and how this can contribute to human diseases. Dr. Puertollano has published over 50 research articles, reviews, and book chapters and is a member of the editorial board of several journals such as Traffic and ISRN Cell Biology. During the 2017 GCRC Research Day she presented a talk entitled: *Emerging new roles of lysosomes in health and disease.*

Overall the organization of the GCRC research day provides an occasion for trainees working in various sub-disciplines to come together and contribute to the concepts, knowledge and understanding of each other's work, ultimately leading to the advancement of cancer research for the benefit of our society.

Participants at one of the sessions at the GCRC Research Day

Poster sessions at the 3rd GCRC Research Day

Poster sessions at the 3rd GCRC Research Day

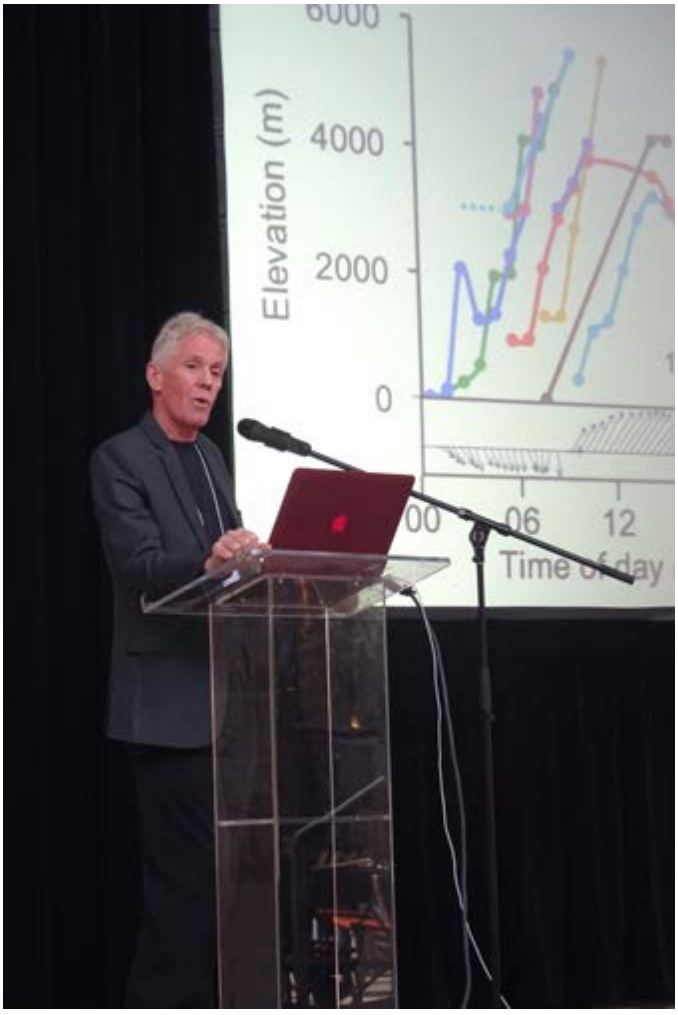
University of Guelph, College of Biological Sciences

Graduate Student Symposium 2017

Correspondent: Dita Moravek

The College of Biological Sciences Graduate Student Symposium is an annual student-run event that aims to encourage scientific communication between students, research fellows and professors within the three departments of the college, Molecular and Cellular Biology, Integrative Biology, and Human Health and Nutritional Sciences.

This year's event took place on April 27 2017 in the Summerlee Science Complex at the University of Guelph, and welcomed approximately 220 attendees, with representation from all our departments. More than 100 of these attendees presented their research either orally or with a poster, which provided a huge range of interesting topics to learn about.



Dr. William Milsom giving his keynote presentation

The event also includes a presentation from a keynote speaker about their research. This year featured a keynote address by Dr. William Milsom, from the Department of Zoology at the University of British Columbia. Dr. Milsom's research is directed at determining the physiological basis of biodiversity in vertebrates, and his lab studies the respiratory, cardiovascular, thermoregulatory and metabolic adaptations for life in environments with low/high levels of oxygen, carbon dioxide, temperature, food, and water. Dr. Milsom presented strategies that various avian species use to adapt to different oxygen levels, speaking to information relevant and interesting to all attendees, and giving an engaging and thought-provoking talk.

This day was a huge success, thanks to the participants, and the organizing committee composed of graduate students and faculty; Sarah Bates, Shawn Beaudette, Alison Berezuk, Liz Johnston, Dennis Larson, Gregory MacNeill, Sahar Mehrpooyan, Dita Moravek, Willem Peppler, Sarah Schorno, Katherine Suitor, Glen Van Der Kraak, Karen White.

University of Ottawa

Faculty of Medicine 9th Annual Post-doctoral Research Day

Correspondent: Ujval Anil Kumar

In collaboration with the Faculty of Medicine, the Faculty of Medicine Post-Doctoral Association organised its 9th Annual Post-doctoral Research Day on March 16th, 2017. The event was a huge success, and drew a large number of PDFs, research associates, faculty, and students from across the university. The day featured three oral presentations from post-docs on topics covering neural stem cells, polycystic ovarian syndrome and Alzheimer's disease, and were judged by the faculty. This was followed by a keynote presentation from Dr. Jim Woodgett (University of Toronto), and a poster session. The event showcased high quality research conducted at the institution in a variety of fields, and was attended by more than 60 people.

The poster session featured submissions from broad categories, ranging from emerging technologies,

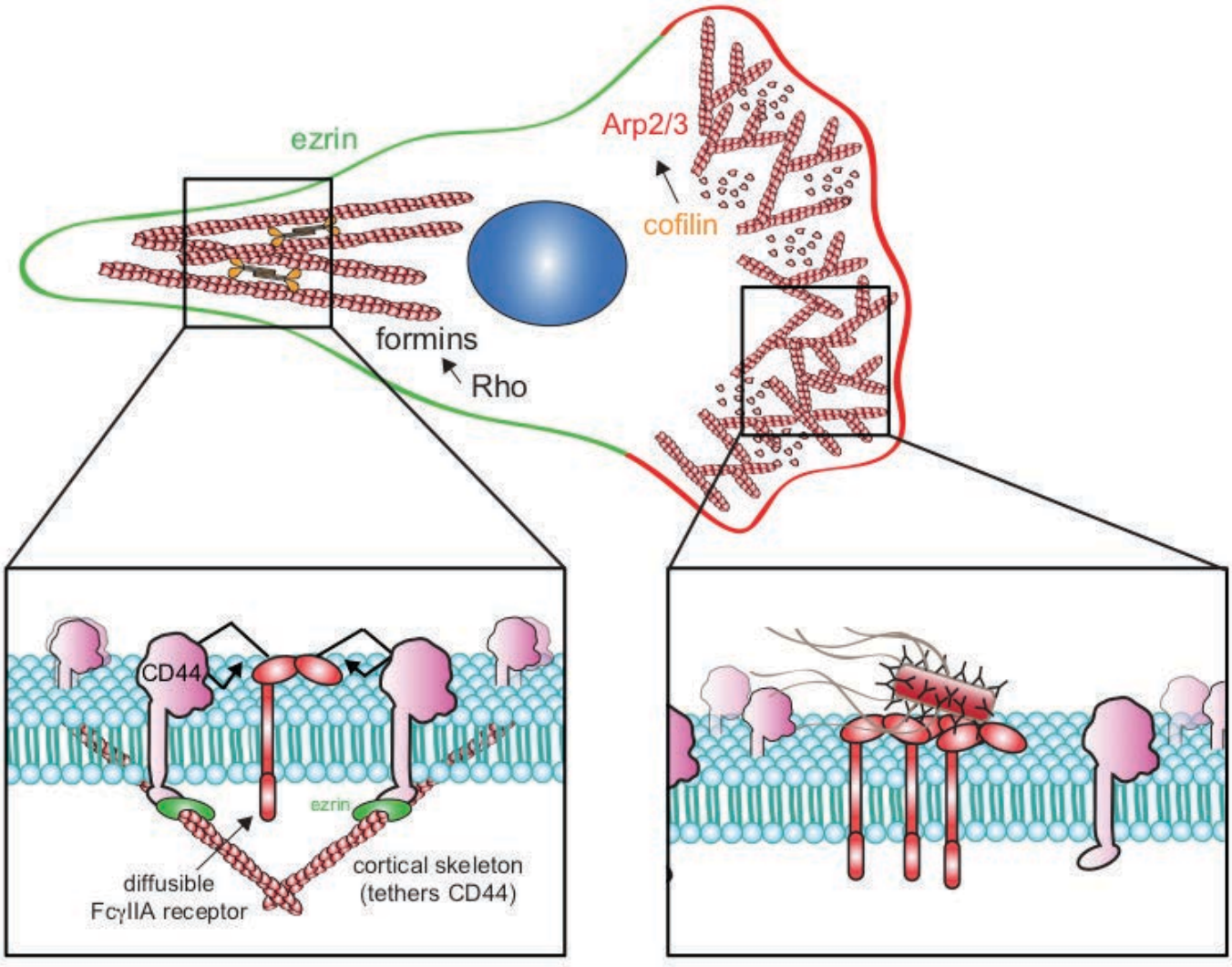
neuroscience, biochemistry, microbiology and immunology to health sciences. The event was organized with the support of a number of sponsors, including the Faculty of Medicine itself, the Ottawa Hospital Research Institute, and Canadian Society for Molecular Biosciences. Post-docs were awarded prizes for oral and poster presentations. We would like to thank all participants, especially the PDA executive team for making this event a huge success, the Faculty of Medicine, OHRI and CSMB for their generous support. We hope to see you next time!

Dr. Jim Woodgett delivering a keynote presentation

Post-docs at the Research Day enjoying a coffee break

Poster session

Poster session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