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Captions for cover photos can be found on the back cover.
La légende des photos de la couverture se situe sur la couverture arrière.

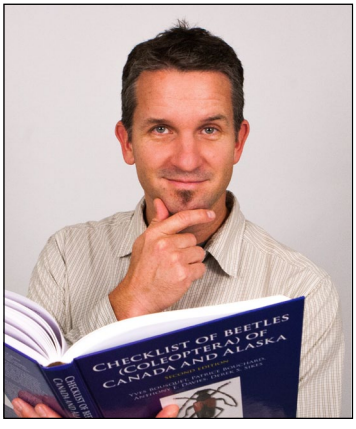
In 2017, this automated pest monitoring system was used to record the abundance of armyworm moth (*Mythimna unipuncta*; Lepidoptera: Noctuidae). It enables us to catch insects and to take pictures that are automatically sent to the user [St-Mathieude-Beloeil, Québec, Canada].

En 2017, ce système de surveillance automatisé des ravageurs a été utilisé afin d'enregistrer l'abondance de la légionnaire uniponctuée (*Mythimna unipuncta*; Lepidoptera : Noctuidae). Il permet d'attraper des insectes et de prendre des photos qui sont automatiquement envoyées à l'utilisateur. [St-Mathieu-de-Beloeil, Québec, Canada].

[Photo: Julien Saguez]

Up front / Avant-propos

Patrice Bouchard, President of ESC / Président de la SEC



Building on a strong foundation

I remember attending the sesquicentennial anniversary of the Entomological Society of Canada at the joint annual meeting in Guelph a few years ago. It was a special moment to reflect that the Society dates back to very modest beginnings in 1863! For those who could not attend, the long history of the Society was nicely summarized by Laura Timms in her 2013 Heritage Lecture (a slightly modified version of the contents of her presentation is available here http://esc-sec.ca/wp/wp-content/uploads/2017/02/Heritage_Laura__Timms_2014.2.pdf). Additional information and articles on interesting aspects of the Society in the last 150 years, assembled by Cedric Gillott and Neil Holliday, are also available on the expanded History and Heritage page of our website (http://esc-sec.ca/the-society/history-and-heritage/).

Another important milestone is being celebrated this year. *The Canadian Entomologist* (*TCE*), which has been published without interruption since 1868, is turning 150 years old! A series of papers, each presenting a historical overview and national perspective on a different aspect of entomological research in Canada, will be published throughout the year. The first article in this series entitled "*Congratulations to The Canadian Entomologist on this, its sesquicentennial*

Bâtir sur de solides fondations

Je me souviens avoir participé à l'anniversaire cent-cinquantenaire de la Société d'entomologie du Canada à la réunion annuelle conjointe à Guelph il y a quelques années. C'était un moment spécial de penser que la Société avait eu ses modestes débuts en 1863! Pour ceux qui n'ont pu y être, la longue histoire de la Société était habilement résumée par Laura Timms dans son Allocution du patrimoine 2013 (une version légèrement modifiée du contenu de sa présentation est disponible ici http://esc-sec.ca/wp/wp-content/uploads/2017/02/Heritage_Laura__Timms_2014.2.pdf). Des informations et des articles additionnels sur des aspects intéressants de la Société durant ses 150 dernières années, assemblés par Cedric Gillott et Neil Holliday, sont également disponibles sur la page Histoire et patrimoine de notre site web (http://esc-sec.ca/fr/the-society/history-and-heritage/).

Un autre jalon important est célébré cette année. *The Canadian Entomologist* (TCE), qui est publié sans interruption depuis 1868, aura 150 ans! Une série d'articles, chacun présentant un aperçu historique et une perspective nationale sur différents aspects de la recherche entomologique au Canada, seront publiés durant l'année. Le premier article de cette série, intitulé « *Congratulations to The Canadian Entomologist on this, its sesquicentennial anniversary!* », co-écrit par Kevin Floate et Dezene Huber, est sorti récemment dans le premier numéro de *TCE* en 2018. Quand vous aurez une chance, prenez le temps de lire cet intéressant aperçu de l'évolution de la revue durant sa longue histoire.

Au fil des années, la Société a grandi jusqu'à sa forme actuelle où des services sont rendus d'innombrables façons par des bénévoles

anniversary!" co-authored by Kevin Floate and Dezene Huber came out recently in the first issue of *TCE* for 2018. When you get a chance, please take the time to read this interesting look at the evolution of the journal over its long history.

Over the years, the Society has grown into its current form with service in innumerable ways by passionate and engaged volunteers, each building on the work that equally-dedicated volunteers had performed before them. While we are very happy to welcome our new Treasurer, Joel Kits, and new Editor-in-Chief of *TCE*, Dezene Huber (see page 37 for more details), we are equally thankful for the recent and very significant contributions of our previous Treasurer, Christopher Dufault, and the previous Editor-in-Chief of our journal, Kevin Floate. We sincerely appreciate all the time and effort provided by those who choose to contribute in various ways to our entomological community in Canada.

Another important change to highlight is the new Entomological Society of Canada website (http://esc-sec.ca/) which was officially launched on 3 November 2017 following a major overhaul by our Webmaster, Jordan Bannerman, in collaboration with Ryan Mayo from Strauss. The new slick-looking website uses a fully adaptive layout that is easily viewed on any device and includes a complete integration of the ESC blog. The site incorporates improved social media integration (twitter feed directly on main page) and all issues of the *Bulletin of the Entomological Society of Canada* are now available to download! As mentioned above, the expanded History and Heritage page provides a large number of cool facts about our Society's history. The newly-accepted Vision and Mission statements for the Society are also available at: http://esc-sec.ca/the-society/vision-mission-roles/. An updated page dedicated to ESC's Student & Early Professional Affairs committee contains important information on many topics including research and job opportunities. If you have any input regarding the website, you

passionnés et engagés, chacun construisant sur ce que des bénévoles tout aussi dévoués ont performé avant eux. Bien que nous soyons très content d'accueillir notre nouveau trésorier, Joel Kits, et notre nouveau rédacteur-en-chef du *TCE*, Dezene Huber (voir page 37 pour plus d'information), nous sommes tout aussi reconnaissants pour les contributions récentes et très importantes de notre précédent trésorier, Christopher Dufault, et du précédent rédacteur-en-chef de notre revue, Kevin Floate. Nous apprécions sincèrement le temps et les efforts fournis par ceux qui ont choisi de contribuer de différentes façons à notre communauté entomologique au Canada.

Un autre important changement à mentionner est le nouveau site web de la Société d'entomologie du Canada (http://esc-sec.ca/fr/) qui a été officiellement lancé le 3 novembre 2017 après une refonte majeure par notre webmestre, Jordan Bannerman, en collaboration avec Ryan Mayo de Strauss. Le nouveau site web épuré utilise une mise en page entièrement adaptative qui se voit facilement sur n'importe quel appareil et inclut une intégration complète du blogue de la SEC. Le site incorpore une intégration améliorée des médias sociaux (le fil twitter est directement sur la page principale) et tous les numéros du *Bulletin de la Société d'entomologie du Canada* sont maintenant disponibles pour téléchargement! Tel que mentionné ci-dessus, la page étoffée Histoire et patrimoine fourni un grand nombre de faits intéressants sur l'histoire de notre Société. Les énoncés de vision et mission nouvellement acceptés pour la Société sont également disponibles sur : http://esc-sec.ca/fr/the-society/vision-mission-roles/. Une page à jour dédiée au comité des affaires étudiantes et des jeunes professionnels contient des informations importantes sur plusieurs sujets incluant les opportunités de recherche et d'emploi. Si vous avez des commentaires sur le site web, vous pouvez me contacter moi, ou Jordan.

Finalement, je voudrais donner un bref aperçu de notre processus de révision stratégique. Le conseil d'administration et

can contact me or Jordan.

Finally, I would like to give a brief outline of our ongoing Strategic Review process. The Board of Directors and Trustees of the Society met for a special event in Winnipeg immediately before the last joint annual meeting. The goals of this discussion were to assess our Society's performance in serving the interests of the Canadian entomological community as well as to identify possible ways to increase our impact going forward. Results of several new activities associated with governance, membership, financial sustainability and communication will be provided at a later date but in the meantime do not hesitate to contact me if you have any suggestions on how we can thrive in the decades to come.

les administrateurs de la Société se sont rencontrés pour un évènement spécial à Winnipeg tout de suite avant la dernière réunion annuelle conjointe. Les objectifs de cette discussion étaient d'évaluer comment notre Société performe pour servir les intérêts de la communauté entomologique canadienne ainsi que d'identifier des façons possibles pour augmenter notre impact en avançant. Les résultats de plusieurs nouvelles activités associées avec la gouvernance, l'adhésion, la durabilité financière et la communication seront fournies à une date ultérieure, mais d'ici là, n'hésitez pas à me contacter si vous avez des suggestions sur la façon dont nous pouvons prospérer dans les décennies à venir.

2018 ESA, ESC and ESBC Joint Annual Meeting
Crossing Borders: Entomology in a Changing World
11–14 November | Vancouver, BC, Canada

Réunion annuelle conjointe ESA, SEC et SECB 2018
Au-delà des frontières: l'entomologie dans un monde en changement
11–14 novembre | Vancouver, Colombie-Britannique, Canada

The Entomological Society of British Columbia invites you to attend the 2018 ESA, ESC, and ESBC Joint Annual Meeting!

The 2018 Joint Annual Meeting will take place in beautiful Vancouver, British Columbia, from **11-14 November 2018**. With a theme of **Crossing Borders: Entomology in a Changing World**, this meeting represents a unique opportunity to share your research, gain exposure, and collaborate across borders and across Societies. Connect with over 3,000 scientists and researchers from around the globe over the 4 science-filled days.

Full meeting details, important deadlines and up to date information can be found on the meeting website: https://www.entsoc.org/events/annual-meeting

We look forward to seeing you in Vancouver!

La Société d'entomologie de Colombie-Britannique vous invite à assister à la réunion annuelle conjointe ESA, SEC et SECB 2018!

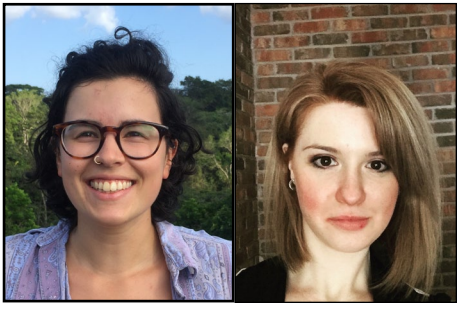
La réunion annuelle conjointe 2018 se tiendra dans la magnifique ville de Vancouver, Colombie-Britannique, **du 11 au 14 novembre 2018**. Avec le thème **Au-delà des frontières : l'entomologie dans un monde en changement**, cette réunion représente une chance unique de partager votre recherche, d'avoir de la visibilité et de collaborer au-delà des frontières et des Sociétés. Soyez en contact avec plus de 3000 scientifiques et chercheurs de tout le globe durant 4 journées remplies de science.

Les détails complets de la réunion, les dates limites importantes et de l'information à jour se trouvent sur le site web de la réunion : https://www.entsoc.org/events/annual-meeting/french

Au plaisir de vous voir à Vancouver!

STEP Corner / Le coin de la relève

Anne-Sophie Caron and Rachel Rix



Research Roundup

We continue to publicize graduate student publications to the wider entomological community through our Research Roundup initiative. Check out the ESC blog for the most recent featured articles. If you want your recently published article featured (or we missed yours last month!), send us an email at students@esc-sec.ca. For regular updates on new Canadian entomological research, you can join the ESC Students Facebook page or follow us on Twitter @ esc_students.

Getting involved with the ESC

The Student and Early Professional Affairs Committee (SEPAC) is looking for new members (especially Early Professionals). Volunteering for SEPAC is a great way to get involved with the Society and promote entomology to students across Canada. If you are interested in joining or just have suggestions for new initiatives in the coming year, email us at students@esc-sec.ca, or contact us personally at annesophie.caron.p@gmail.com or Rachel.Rix@dal.ca.

We look forward to hearing from you.
Anne-Sophie and Rachel

Aperçu de la recherche

Nous continuons à faire la publicité des publications des étudiants gradués auprès de la communauté entomologique via notre initiative Aperçu de la recherche. Consultez le blogue de la SEC pour les plus récents articles. Si vous voulez que votre plus récent article soit mis en vedette (ou si nous l'avons manqué le mois dernier!), envoyez-nous un courriel à students@esc-sec.ca. Pour des mises à jour régulières sur la recherche entomologique canadienne, adhérez à la page Facebook des étudiants de la SEC ou suivez-nous sur Twitter à @esc_students.

S'impliquer au sein de la SEC

Le comité des affaires étudiantes et des jeunes professionnels cherche de nouveaux membres (particulièrement des jeunes professionnels). S'impliquer bénévolement pour le comité est une excellente façon de s'impliquer avec la Société et promouvoir l'entomologie auprès des étudiants au Canada. Si vous êtes intéressés à joindre le comité, ou si vous avez des suggestions pour de nouvelles initiatives pour la prochaine année, écrivez-nous à students@esc-sec.ca. Vous pouvez aussi nous contacter personnellement à annesophie.caron.p@gmail.com ou Rachel.Rix@dal.ca.

Au plaisir d'avoir de vos nouvelles.
Anne-Sophie et Rachel

Thesis Roundup / Foisonnement de thèses

If you or a student you know has recently defended an entomology-related thesis at a Canadian University, and would like notice of this accomplishment published here and on the ESC website, please email students@esc-sec.ca with the relevant information (name, date, degree, thesis title, supervisor[s], and university).

Si vous, ou un étudiant que vous connaissez, avez récemment soutenu votre thèse dans un domaine lié à l'entomologie dans une université canadienne, et que vous voulez publier l'avis de cette réalisation ici et sur le site web de la SEC, merci d'envoyer les informations pertinentes (nom, date, diplôme, titre de la thèse, directeur[s] et université) à students@esc-sec.ca.

MacInnis, Courtney. MSc, 2017. *Nosema ceranae*: A sweet surprise? Investigating the viability and infectivity of the honey bee (*Apis mellifera* L.) parasite *N. ceranae.* Supervisors: Stephen F. Pernal & B. Andrew Keddie, University of Alberta.

Warren, Jodie A. PhD, 2017. Use of hyperspectral remote sensing to examine immature blow fly development. Supervisor: Gail S. Anderson. Simon Fraser University.

People in the news / Gens qui font les manchettes

Charles Vincent

Charles Vincent has been elected an Honorary Member of the Entomological Society of France.

The title of Honorary Member is bestowed by the Society on entomologists, French and foreign, in recognition of important services rendered to the science of Entomology. The number of Honorary Members cannot exceed 20 (12 French and 8 foreign) and currently stands at 8.

The Entomological Society of France is the oldest entomological society in the world, being founded on 29 February 1832, and currently has around 600 members.

Charles Vincent a été élu Membre honoraire de la Société entomologique de France.

Le titre de membre honoraire peut être décerné par l'Association à des entomologistes français ou étrangers en reconnaissance des services importants qu'ils auraient rendus à la Science. Leur nombre ne peut dépasser 20 (12 français et 8 étrangers) et il y en a actuellement 8.

La Société entomologique de France (SEF) est la plus ancienne société entomologique dans le monde; elle a été officiellement fondée le 29 février 1832. En 2017, environ 600 membres font partie de la SEF.

Gold Medal Address / Allocution du médaillé d'or 2017

Gerhard Gries

Learning the multi-modal language of insects... and how to talk back

I was genuinely touched when I learned that I was the 2017 recipient of the ESC Gold Medal but I was not sure whether I was truly deserving of joining the fine and accomplished group of colleagues who had received this prestigious honor before. I felt grateful to John Borden who had nominated me for the award, Elizabeth Elle [Departmental Chair of Biological Sciences at Simon Fraser University (SFU)] for having supported the nomination, and the ESC Achievement Awards Committee for their decision. I must admit, I was delighted and elated when Bernard Roitberg called me and conveyed the great news!

It was very clear to me, though, that this award was not the recognition of *my* work but that of the Gerhard and Regine Gries laboratory and all of its bright and enthusiastic graduate students and their helpful undergraduate research assistants. I consider the award also a recognition of all the expert and kind contributions that my SFU colleagues in Biological Sciences (Peter Belton, John Borden, Jenny Cory, Bernard Crespi, Lawrence Dill, Thelma Finlayson, Alton Harestad, David Lank, Carl Lowenberger, Manfred Mackauer, Jim Mattson, Margo Moore, Inigo Novales-Flamarique, Zamir Punja, Jim Rahe, Bernard Roitberg, John Webster, Mark Winston, Ronald Ydenberg), Chemistry (Robert Britton, Roger Linington, Cam Oehlschlager, Erika Plettner) and Physics (Anthony Arrott, Michael Hayden) have provided. Other colleagues at various university and government institutions in Canada and abroad (e.g., Paul Abram, Thomas Baker, Robb Bennett, Keith Bildstein, Herman Bogenschütz, Jörg Bohlmann, Kyung Boo, Wade Bowers, Jane Brockmann, Allan Carroll, Carlos Chinchilla, Man-Young Choi, Joan Cossentine, Silvia Dorn, Ezra Dunkelblum, Damian Elias, Annett Engelmann, Maya Evenden, Paul Fields, Sheila Fitzpatrick, John Folz, Wittko Francke, Robin Giblin-Davis, David Gillespie, Tadao Gotoh, Gary Grant, Tom Gray, Dieter Haarhaus, Roger Hahn, Rebecca Hallett, Dietrich Häußler, Kenneth Haynes, Yasutomo Higashiura, Kirk Hillier, Dezene Huber, Leland Humble, Murray Isman, Gary Judd, Petr Kapitola, Karl-Ernst Kaissling, Almut Kelber, Peter Kevan, Joseph Kirschvink, Wilfried König, Peter Landolt, Gerald Lanier, Carol Lauzon, Walter Leal, Anders Leufvén, Guo-Qiang Lin, Staffan Lindgren, Jan Liška, Chris Maier, Cafer Mart, Rory McIntosh, Jeremy McNeil, Jocelyn Millar, Nicholas Mills, Katrin Möller, Kenji Mori, Hanna Mustaparta, Patrik Nosil, Sean O'Donnell, Owen Olfert, Thomas Payne, Alice Perez, John Pickett, Ronald Prokopy, Kenneth Raffa, David Raworth, Rüdiger Riesch, Wendell Roelofs, Les Safranyik, Chris Sanders, Paul Schaefer, Coby Schal, Tanja Schwander, Roy Shepherd, Anton Stapentheiner, Ward Strong, Zhong-Xing Tan, Jeffery Tomberlin, Bjørn Åge Tømmerås, Miklós Tóth, Tom Unruh, Wim van Herk, Bob Vernon, Neil Vickers, Lester Wadhams, Rick West, Horst Wittmann, and Mesmer Zebeyou) have provided equally helpful support. Our good friend Paul Schaefer (United States Department of Agriculture), for example, has worked with us on many (forest) insect projects in Japan, Taiwan, Korea, Australia and India, and has co-authored more than 30 publications with us. On the path giving rise to this award, some folks that I will highlight below have made particularly valuable contributions.

That path really started, I think, when I was 2 or 3, an age at which experiences are easily imprinted (*sensu* Konrad Lorenz) on a very young mind. My mom (Figure 1, left) took me to a zoo in Germany, where one of the exhibits featured a black bear sow with two tiny cubs chasing

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Gerhard Gries (gries@sfu.ca) is a Professor of Biological Sciences at Simon Fraser University.

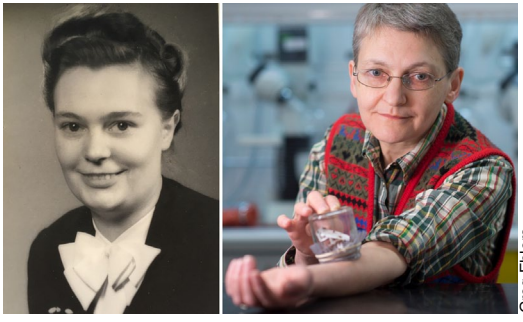

Figure 1. Left: My mom Right: My wife and collaborator Regine feeding bed bugs on her arm for bed bug pheromone research.

each other all over the place. I was so intrigued and fascinated that my mom – not being prepared to deal with a small boy crying his heart out at any attempt to coax him to another exhibit – had no choice but to let me watch the bear cubs until the zoo closed that day. I am convinced this bear watching event implanted my passion for wild critters. I am eternally grateful for everything my mom has done for me, for my brother Thomas and my sister Annette — raising the three of us as a single mom because my father died early from an illness not diagnosable at the time. My mom supported all my (sometimes crazy) endeavors, supported my ever growing interest in nature and my passion for soccer. She allowed me to spend my high school vacations making money by working for various companies so that I could purchase my first "Spiegelreflexkamera" and a telephoto lens. She also endured my long, often nocturnal, stints in the forest where I observed and photographed wild life. Being 94 years of age now, my mom still has a razor-sharp mind and continues to enjoy our brief but sweet annual meetings on the occasion of her birthday in October, a day that has often collided with the Annual Meeting of the ESC.

Neidhardt Paul (Figure 2), my soccer coach during high school, has played another instrumental role in my personal and professional development. He taught me many things, most importantly perhaps teamwork and an unwavering will to win. It was only many years later that I fully comprehended his selfless contributions, his time on weekends away from his family, driving us ambitious young soccer players to our next game and coaching us expertly to two vice-championships.

Figure 2. Our soccer team during high school with coach Neidhardt Paul (top row, second from the left) and GG (top row, fourth from the right).

The day I replaced my 640-mm telephoto lens with a macro lens and aimed at ants opened my eyes to the wonderful world of insects and started my lifelong journey of studying their alien empire – a journey that I thoroughly enjoy. Werner Sanders (Figure 3), my doctoral advisor, greatly helped pave the way for that journey. Not only did he have a thorough understanding of his research field and provide ample feedback and guidance, he inspired by example, personal greatness and integrity. He engaged me in discussions on environmental and conservation topics that went far beyond my specific research project. As a passionate conservationist, he always took public transportation. On one particular trip home, he was carrying his briefcase with some 12 frogs inside that I had rescued during road construction and that he wanted to release into his garden pond. All of a

sudden, possibly triggered by a bump in the road, the frogs started their chorus, making Werner Sanders and "his" frogs the focal point for all the puzzled passengers. I still laugh whenever I picture that funny scene in my mind. On the day of my PhD defense, but never before or after, did Werner Sanders wear a tie. Inspired by that gesture, I vowed to adopt that tradition, should I manage to attain a faculty position and guide my own graduate students. To date, I have lived up to my vow on 55 occasions.

Figure 3. Gathering of the examining committee immediately following my PhD defense. Werner Sanders, my doctoral advisor, is second from the left.

It was during my doctoral studies that I met my future wife and soul mate Regine (Figure 1, right), who was studying agriculture at the time. On our first date, yes, we did talk about plant-aphid interactions! Surprised that she agreed to see me again, we went to my favourite wetland habitat on our second date where – in the pouring rain – we listened to the courtship songs of European grass frogs (*Rana temporaria*). It did not take long, a couple more "natural sciences" outings with Regine, to realize that she was a keeper, and to this day I'm still puzzled that she felt the same way about me. In our research program (see below), Regine is the key contributor and most immediate go-to person for our graduate and undergraduate students in all aspects of electrophysiology and analytical chemistry.

Shortly before the end of my doctoral studies, I met John Borden at a conference in Göttingen, Germany, where I studied. He attended my talk but I had never met him before. As he was one of the few attendees carefully listening to my "genglish" presentation, I made an attempt to figure out who he might be, realizing that – while giving the talk – I had to apply rather crude and stereotypic ID criteria. Based on his clothing – a scarlet shirt, blue jeans and running shoes – he was more likely North American than European. I could tell he was wearing running shoes because one foot was on his auditorium seat and one was off, a behavior that seemed to fit my tentative North American assignment. Because he was not chewing any gum, I settled for Canadian. When I met him in person after my talk, I was pleased to learn that my deduction was correct, and even more pleased when I learned that he was John Borden, a professor whom I had envisioned as a potential postdoctoral advisor. I pleaded for a postdoctoral position in John's lab but he turned me down explaining that his lab was already "full to bursting". Undaunted, I applied for and was awarded a prestigious DFG (Deutsche Forschungsgemeinschaft) postdoctoral fellowship, and John had no choice but to accept a "free" postdoctoral fellow.

John became a great teacher, advisor and mentor to me, and literally launched my career. His boundless energy, enthusiasm and eternal optimism were truly inspiring. Joining his laboratory and Chemical Ecology Research Group (CERG) at SFU provided unparalleled opportunities to learn and to diversify my "toolbox". Frequently interacting with the CERG chemists, Keith Slessor, Cam Oehlschlager, Harold Pierce and Skip King, Regine and I picked up many analytical chemistry skills that later served us well. Moreover, when one of John's other postdocs, Staffan Lindgren, showed me my first black bear in the wild, I strongly felt that I had arrived at my "destination" in Canada.

When John Borden became an NSERC-Industrial Research Chair, a new faculty position was added, for which I applied, winning the competition and joining SFU's faculty in 1990. At first, our newly established lab devoted a significant body of work to the discovery and application

of new semiochemicals (message bearing chemicals). Concurrently, I discovered my passion for teaching, lecturing about the fascinating world of insect chemical ecology and weaving our own research endeavors into my undergraduate classes.

The scope of our research program began to broaden when Stephen Takács (a PhD student of mine who studied clothes moths) discovered that male moths wing fan on dry animal pelts and that the wing fanning sound had a signal function during sexual communication (Takács et al. 2003). Steve's discovery prompted a phase of soul-searching in our lab. Of course, we had heard about "multi-modal communication", but would we really want to embrace the "alien world" of sound communication in our research portfolio? We decided to expand our portfolio and as we progressed, the "Takács phenomenon" emerged repeatedly in many more projects. At each crossroad, we decided to include the new modality into our evolving program of multi-modal animal communication ecology, whether the non-chemical signal or cue was infrared (e.g., Takács et al. 2009), vibratory (e.g., Vibert et al. 2014), visual (e.g., Eichorn et al. 2017), microbial (e.g., Lam et al. 2007) or even magnetic (Lambinet et al. 2017). The broadening of our research program required a never-ending process of learning, with me becoming the oldest student in the lab! To avoid the risk of becoming a "jack of all trades but master of none" and to make sure that all students have the best possible guidance irrespective of their projects, we routinely invite (inter)national experts to join advisory committees.

Studying multi- instead of uni-modal foraging cues or communication signals has obvious benefits. As Thomas Baker (1993) put it, you are truly *Learning the Language of Insects* (or animals) – *and How to Talk Back*. If a species is a multi-modal signaller, as many insects are, and we study just one signal of their complex communication system, we are bound to learn, in effect, merely a single word of that long sentence. In turn, our "talking back" would not be very effective and we may not be "understood" at all. For example, to effectively "talk" to stink bugs, we would need to reproduce their long-range pheromone signal (e.g., Millar 2005) and their short-range, substrate-born vibratory signal (e.g., Čokl et al. 2007). Either signal alone would be insufficient to "engage" them in a conversation (Gries 2014).

Some of our research findings have the potential to be developed for sophisticated control of insects in urban, agricultural and forestry settings. This is why we attract funding from industrial sponsors. In June 2004, our lab obtained an NSERC-Industrial Research Chair (IRC) in Multimodal Animal Communication Ecology, with Scotts Canada Ltd. as the current main sponsor. In my judgement, this NSERC-IRC is a triple gain because: (1) it offers a perfect training and research environment for many graduate and undergraduate students, and helps push the frontiers of science; (2) it provides society with earth-friendly solutions for pest problems; and (3) it generates new products and technologies for the industrial sponsor who then has incentive to continue funding our lab.

As academics, we are privileged with the freedom to pursue our interests and passion for science as a career. In my opinion, that privilege comes with an obligation to give something back for the betterment of our planet. Typically, this would happen within our main field of study, but sometimes there is a need to step outside our comfort zone to get things done.

One of the most atrocious and widespread pest management practices is the control of rat and mouse populations through poison bait stations. Poisoned and behaviorally impaired, these rodents then become easy and obvious targets for rodent predators such as owls, raptors, foxes and coyotes, resulting in secondary poisoning of entire food chains. Determined to replace these poison bait stations with effective and earth-friendly methods of rodent control, we have added rodent research to our portfolio. For many years now, we have been studying food preferences as well as pheromonal and sound communication of brown (Norway) rats, *Rattus norvegicus*, and house mice, *Mus musculus*, two important rodent pests worldwide. Our studies have led to

vastly more effective trap baits (Takács et al. 2016a,b, 2017a,b; Musso et al. 2014, 2017) which, together with self-resetting traps, have the potential to make rodent trapping as effective as rodent poisoning.

I would like to close with a quote from the German philosopher and entomologist Ernst Jünger: "Dass ist das Mass unseres Wertes, das Wachstum der anderen durch uns" (the measure of our value is our contribution to the personal and professional development of others). I have benefitted immensely from the many contributions and opportunities my mentors have provided. I was fortunate to have had the unconditional and unwavering support of my dear mom, and my dear wife, soul mate and expert collaborator Regine. We hope to have provided, and to continue to provide, opportunities for our students so that they can make their mark on the natural sciences and become fit stewards of our planet.

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References

Baker, T.C. 1993. Learning the language of insects — and how to talk back. American Entomologist, **39**: 212–220.

Čokl, A., Zorović, M., and Millar, J.G. 2007. Vibrational communication along plants by the stink bugs *Nezara viridula* and *Murgantia histrionica*. Behavioural Processes, **75**: 40–54.

Eichorn, C., Hrabar, M., Van Ryn, E., Brodie, B., Blake, A., and Gries, G. 2017. How flies are flirting on the fly. BMC Biology, doi 10.1186/s12915-016-0342-6.

Gries, G. 2014. From chemical to communication ecology. Journal of Chemical Ecology, **40**: 309.

Lam, K., Babor, D., Duthie, B., Babor, E.-M., Moore, M., and Gries, G. 2007. Proliferating bacterial symbionts on house fly eggs affect oviposition behavior of adult flies. Animal Behaviour, **74**: 81-92.

Lambinet, V., Hayden, M.E., Reigl, K., Gomis, S., and Gries, G. 2017. Linking magnetite in the abdomen of honey bees to a magnetoreceptive function. Proceedings of the Royal Society B, **284**: 20162873; doi: 10.1098/rspb.2016.2873.

Millar, J.G. 2005. Pheromones of True Bugs. *In*: The Chemistry of Pheromones and Other Semiochemicals II. Topics in Current Chemistry, Vol 240. *Edited by* S. Schulz. Springer, Berlin, Heidelberg. pp. 37-84.

Musso, A.E., Takács, S., Gries, R., and Gries, G., 2014. New compositions and methods for attracting and stimulating feeding by mice and rats, Patent Data Base, Publication Number WO 2014186885 A1.

Musso, A., Gries, R., Zhai, H., Takács, S., and Gries, G. 2017. Effect of male house mouse pheromone components on behavioural responses of mice in laboratory and field experiments. Journal of Chemical Ecology, doi 10.1007/s10886-017-0819-y.

Takács, S., Mistal, C., and Gries, G. 2003. Communication ecology of webbing clothes moth: attractiveness and characterization of male-produced sonic aggregation signals. Journal of Applied Entomology, **127**: 127–133.

Takács, S., Bottomley, H., Andreller, I., Zaradnik, T., Schwarz, J., Bennett, R., Strong, W., and Gries, G. 2009. Infrared radiation from hot cones on cool conifers attracts seed-feeding insects. Proceedings of the Royal Society B, **276**: 649–655; Featured as a Research Highlight in Nature 455, 1153; doi:10.1038/4551153c.

Takács, S., Gries, R., Zhai, H., and Gries, G. 2016a. The sex attractant pheromone of male brown rats: identification and field experiment. Angewandte Chemie International Edition, **55**: 6062–6066.

Takács, S., Kowalski, P., and Gries, G. 2016b. Natural and synthetic vocalizations of brown rat pups, *Rattus norvegicus*, enhance attractiveness of bait boxes in laboratory and field experiments. Pest Management Science, **72**: 1873–1882, doi 10.1002/ps.4219.

Takács, S., Gries, R., and Gries, G. 2017a. Sex hormones function as sex attractant pheromones in house mice and brown rats. ChemBioChem, **18**: 1391–1395, doi: 10.1002/cbic.201700224.

Takács, S., Musso, A.E., Gries, R., Rozenberg, E., Borden, J.H., Brodie, B., and Gries, G. 2017b. New food baits for trapping house mice, black rats and brown rats. Applied Animal Behavior Science; doi, 10.1016/j.applanim.2017.11.011

Vibert, S., Scott, C., and Gries, G. 2014. A meal or a male? The 'whispers' of black widow males do not trigger a predatory response in females. Frontiers in Zoology, **11**:4. doi:10.1186/1742-9994-11-4.

A Brief History of Biting Fly Research in Manitoba

Many people have studied biting flies in Manitoba, and I wager that every one of them at one time or another relished the thoughts of being in one of the best places in the world to conduct such research. The landscape and topography of the province favour diversity and abundance of biting flies as in few other places. There are of course species of introduced biting flies, such as horn flies and stable flies, but I don't intend to address these in this review. I want to focus on the species for which Manitoba has gained its reputation: mosquitoes (47 species – Wood et al. 1979; Stuart 2007; Iranpour et al. 2009), ceratopogonids (5 species – Borkent 2017, personal communication), black flies (40 species – Crosskey 1993; Adler et al. 2004) and tabanids (Teskey 1990). The larvae of all species in these families develop in aquatic ecosystems, whether standing water (Fig. 1; mosquitoes), running water (black flies and tabanids) or wetlands (mosquitoes, ceratopogonids and tabanids). A survey of any topographical map of Manitoba yields an impression of a province of limited relief, but with vast and varied aquatic habitats. In the north, permanent and intermittent permafrost impede drainage, providing large areas of biting fly habitat. The boreal forest lays down an insulating groundcover that can retard the rate of thaw in the soil, holding standing water throughout. Natural prairies and human modification allow for accumulation of spring snowmelt and periodic summer floodwater. Over much of the province, groundwater tables are close to the surface, and wetlands abound. Water flows along streams and rivers of all sizes as it makes its way through the Arctic watershed to Hudson Bay. These resources add up to the perfect storm for biting flies. I want to provide a brief overview, covering what I call the three generations of biting fly research: Generation One – the Northern Biting Fly Project, 1947–1955; Generation Two – The Heyday, 1966–2013; Generation Three – Modern Times, 1999–present.

Figure 1. Mosquito larvae collected in one dip from a snowmelt pool near Churchill, Manitoba.

Generation One – The Northern Biting Fly Project, 1947–1955

Certainly biting flies were an important component of investigation for the Northern Insect Survey (1947–1962), but the most intense research in Manitoba was conducted in the interests of military support at Fort Churchill during the Northern Biting Fly Project. Post WWII North America was immersed in the Cold War and the fight against communism. A small part of this preoccupation was the concern of warfare in the far north. In response, scientists from the federal Division of Entomology were deployed in collaboration with the Defence Research Board to Fort Churchill in 1951. Alongside their American counterparts, some of Canada's future best known biting fly researchers (A.E.R. Downes, W.O. Haufe, B. Hocking, D.G. Peterson, C.R. Twinn, A.S.

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West, to name a few) took to the field with objectives to investigate the biology and control of biting flies, along with the search for the perfect repellent. Riegert (1999) provided a detailed and colourful account of activities during this period in Churchill, and I refer you to his publication so I can focus more fully on Generation Two.

I cannot fail to mention important work that took place in southern Manitoba during this time. Winnipeg is renowned as the mosquito capital of Canada. Consider Dixon and Brust's (1972) estimates of 10,000,000 (July, 1967) and 9,000,000 (July, 1968) mosquito larvae per survey area around Winnipeg. John McLintock studied the mosquito fauna of the Greater Winnipeg area and published his landmark paper in 1944. This publication stood as the baseline for later research and mosquito abatement efforts in the city.

Generation Two – The Heyday, 1966–2013

There are three elements to The Heyday of biting fly research in Manitoba, each significant in their own right. The first was the arrival of A.J. Thorsteinson in the Department of Entomology at the University of Manitoba in 1959. The second was the return of Reiny Brust to the same department in 1965; the third was the establishment of the Canada Biting Fly Centre in 1979.

The Arrival of A.J. ("Thor") Thorsteinson, 1959

"Thor" can best be described as a physiological behaviourist whose early work focussed on the chemical cues responsible for stimulation and deterrence of feeding in herbivores (Galloway and Thorsteinson 2017). He had a very wide range of interest and curiosity about what he observed around him. His family owned a cottage in southeastern Manitoba, the tabanid heartland of the province, where he found that when he left their vehicle in the sun with the windows rolled down, the vehicle literally filled with horse flies. Speculation about this led him to develop a hypothesis that the flies were attracted to the heat emanating from the open windows. He devised what he initially called the heliothermal trap, one with a spherical black target, a target that would warm with the sun's energy (Thorsteinson 1958). As is so often the case, initial hypotheses are modified by additional data. Several graduate students in Thor's lab further investigated the nature of the trap, including targets of various shapes and colours. This work ultimately led to the understanding that the horse flies were most attracted not to heat, but to a black sphere (Bracken et al. 1962; Bracken and Thorsteinson 1965a, 1965b). Targets of other colours, colour patterns and shapes were less attractive. The Manitoba Horse Fly Trap (Thorsteinson *et al*. 1964), as it became known, is now used over much of the world as the standard trap for horse flies.

The development of the Manitoba Horse Fly Trap, and the early survey work undertaken in the province, formed the basis for more recent work on the biology and impact of horse flies on livestock. In 1978, Dave Smith, one of the Provincial Entomologists at the time, took me, a newly hired faculty member in the Department of Entomology, to a Manitoba Agriculture co-operative project near Whitemouth Lake in southeastern Manitoba. Livestock specialists were investigating agricultural diversification in the region, one component of which was to expand the beef and dairy industries there. Early trials were hampered by intense biting fly pressure (Fig. 2), and Dave Smith's introduction

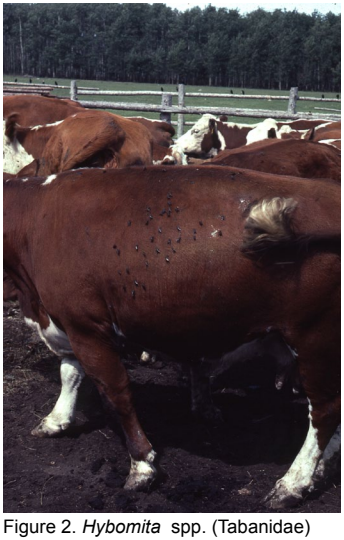

Figure 2. *Hybomita* spp. (Tabanidae) feeding on a cow, southeastern Manitoba.

Figure 3. Application of a synthetic pyrethroid insecticide to cattle near Seven Sisters, Manitoba.

to the problem led to long-term investigations and collaboration with Manitoba livestock specialists and producers, eventually moving the study to a more permanent location near Seven Sisters. The newly developed synthetic pyrethroids were applied to pastured cattle (Fig. 3) and their behaviour was compared with untreated control animals in adjacent paddocks. This involved long, sometimes tedious, hours in the field, monitoring grazing and fly-avoidance behaviours (Ralley et al. 1993). Typically, animals begin activity early in the morning, generally relaxed and well-spaced from one another. As the temperature rises and horse fly activity increases, animals often form grazing lines, where animals on the ends attempt better positions within the line, and the line begins to move faster and faster. Forage is trampled and passed over in the process. Eventually, during the heat of the day, animals bunch together, with those on the outer fringe expending energy to force their way into the better-defended centre of the bunch. The bunch seems in constant motion, and since bunches occur when temperature and horse fly pressure are at their highest, heat stress becomes an issue. Over prolonged periods of attack, sometimes lasting weeks, animals suffer secondary infections such as pink-eye, hoof rot and respiratory complications. This research was extended to investigate biting fly pressure which was causing problems in a wood bison re-introduction project in the Waterhen area of Manitoba (Morgan 1987). Similar, though less convenient observations were conducted on the pastured bison. Animals on the project suffered intense horse fly attack, but the reproductive failures in the herd were eventually identified as having multiple sources, including herd composition, pasture management and herd nutrition, as well as biting fly attack. Throughout all these investigations, the Manitoba Horse Fly Trap was the stalwart for assessing species composition and relative abundance of horse flies (McElligott and Galloway 1991a, 1991b).

The Return of R. A. (Reiny) Brust, 1965

Reiny grew up in Manitoba and did his undergraduate degree in the Department of Entomology at the University of Manitoba. He conducted his MSc research in Thorsteinson's lab on mosquito ecology and travelled to the University of Illinois for his PhD under the supervision of the legendary William Horsfall. Reiny's PhD research took him to the northern regions of Manitoba to study various spring snowmelt mosquitoes. He eventually returned to the University of Manitoba in 1965, where he immediately waded into a new career centred on the many aspects of mosquito ecology (e.g., Brust 1968; Brust and Costello 1969; Tauthong and Brust 1976). Reiny and his students spent time in the north at Churchill and Baker Lake; he explored and developed a mosquito control strategy for Pinawa, Manitoba, and examined mosquitoes in artificial containers and rock pools. Research on reproduction and diapause was a running theme through much of his research, in snowmelt mosquitoes was well as important summer floodwater species. *Aedes vexans* (Meigen), a multivoltine summer floodwater species, is one of the most serious pest species in Manitoba. An often asked and relevant question for mosquito abatement efforts was how far could *Ae. vexans* fly. Reiny initiated the most ambitious and successful dispersal

experiments conducted in Canada (Brust 1980). He supported an army of summer students who collected hundreds of thousands of *Ae. vexans* and *Ochlerotatus sticticus* (Meigen) larvae to be held in metre-square pools. When adults emerged, they were marked with coloured dyes and released. Adults were later collected in New Jersey Light Traps placed in concentric rings around the point of release and marked individuals identified from the piles of mosquitoes in the trap catch. This research formed the basis for extension of City of Winnipeg abatement efforts beyond the Perimeter Highway. Reiny and his students provided major contributions to the understanding of mosquito vectors of western equine encephalitis (WEE) virus, an agent that had historically contributed to the deaths of thousands of horses and caused serious disease in humans. He played an important role in managing the WEE outbreaks of 1975, 1977, 1981 and 1983 as an advisor (e.g., Bowen et al. 1976; Fraser and Brust 1976; Brust and Ellis 1976), and by providing solid research support on mosquito populations and ecology and control of the primary vector, *Culex tarsalis* Coquillett. Many students in his lab followed the gonotrophic, and seasonal and transmission cycles of *Cx. tarsalis* as related to vector potential and risk assessment for the public health sector (e.g., Henderson et al. 1979; Brust 1990; Buth et al. 1990; Fox and Brust 1994; Anderson and Brust 1995). Reiny collaborated extensively with staff at the Cadham Provincial Health Laboratory and the Laboratory Centre for Disease Control to investigate not just WEE virus, but other mosquito-borne viruses (Artsob et al. 1985; Sekla et al. 1991). This led to the discovery and description of a new virus isolated from *Cx. tarsalis* collected in Morris, Manitoba (Artsob et al. 1991). A series of projects conducted by Reiny and his colleagues involved a species of mosquito that was of no pest status at all, one that didn't even bite, *Wyeomyia smithii* (Coquillett) (Smith and Brust 1971a, b; O'Meara et al. 1981; Farkas and Brust 1985, 1986). *Wyeomyia* are found in sphagnum bogs where the eggs are laid in leaves of the purple pitcher plant, *Sarracenia purpurea* Linnaeus. No aspect of *Wyeomyia* biology was overlooked, even its overwintering strategy as larvae in frozen pitcher plant leaves (Evans and Brust 1972). When I arrived in Reiny's lab in 1973, the benches were covered by black electrical tape-covered glass chimneys occupied by his *Wyeomyia* cultures. Many aspects of its biology had been investigated by some of Reiny's earlier graduate students, but by that time, Reiny was exploring taxonomic relationships among different populations of pitcher plant mosquitoes in North America, and he maintained populations collected from as far north as The Pas in Manitoba to Holt, Florida. Natural enemies of mosquitoes and their potential for biological control (Fig. 4) also ran as a theme through Reiny's research career (e.g., Dixon and Brust 1971; Taylor et al. 1980; Galloway and Brust 1985).

Figure 4. *Culex* larvae infected by mermithid nematodes, *Romanomermis culicivorax*.

Reiny didn't limit his research to mosquitoes. He and two graduate students became involved in black fly outbreaks on the Souris River. During sequential flood years, black flies emerged from the river in enormous numbers, their feeding having serious impact on domestic poultry and livestock. Recording species composition and impact on cattle were important outcomes of this early research (Van Deveire 1981; Westwood and Brust 1981), research that laid the groundwork for examination of the environmental impact of insecticide applications to running water for control of black fly larvae in Manitoba. It had been common practice to apply DDT, and later methoxychlor, for black fly control in Canada. There was considerable controversy over the environmental impact of this approach, especially in western Canada, where these insecticides were being applied to large rivers such as the Athabasca in Alberta and the North Saskatchewan in Saskatchewan. Bob Sebastien, under Reiny's supervision, treated a riffle with methoxychlor on the Souris River at Bunclody and monitored the non-target impact on aquatic invertebrates and fish (Sebastien et al. 1989).

The Canada Biting Fly Centre, 1979–1989

The concept for the Canada Biting Fly Centre (CBFC) arose in the late 1960s to early 1970s, in part the notion of E.J. Leroux and P.S. Corbet. There was a recognized need for co-ordination of biting fly research being carried out across the country. The Canadian Agriculture Services Co-ordinating Committee and the Expert Committee on Pesticide Use in Canada supported the concept, and tenders were requested from across the country. Partly because of the strong research programme of Reiny Brust, and partly because of its central location, the University of Manitoba was chosen as the home of the new CBFC. Mary Galloway was hired as the head of the Centre, in conjunction with the CBFC Advisory Committee. The initial objectives of the CBFC were 1) to compile an inventory of biting fly specialists in Canada, 2) to determine the demand for biting fly information services, and 3) to determine the need for a nationally recognized extension and technology training facility. It is interesting to note that, in the initial survey of expertise, Mary identified 159 biting fly specialists and 74 abatement personnel, numbers that vastly exceed current resources in this country. Bernice McLeod and Randy Gadawsky soon joined the CBFC as office support and research associate, respectively, and the Centre quickly surpassed its initial objectives by beginning research activities to assess control options and carry out repellent trials. Assessment and development of bacterial agents for control of black fly larvae became an important component of CBFC research, which also engaged graduate student involvement (Burton 1984; Galloway and Burton 1984). Lloyd Dosdall succeeded Randy Gadawski as research associate when Randy left the CBFC to take on responsibilities as City Entomologist for Winnipeg. The CBFC attracted researchers from other parts of the world. For example, British entomologist, Roger Crosskey, visited Manitoba several times, when he would travel about the province collecting black flies (Crosskey 1993). Unfortunately, the gradual reduction in contract research support in Canada meant the CBFC was no longer sustainable and it closed its doors in 1989.

Generation Three – Modern Times (1999–present)

As you will notice, there is a period of overlap between the end of Generation Two (1966–2013) and Generation Three (1999–present). 2013 marked the departure of the last of the biting fly researchers from the Heyday of biting fly research, but Modern Times had already taken over. In 1999, Harvey Artsob and his staff arrived in Winnipeg to establish the new home for the Field Studies, Zoonotic Diseases and Special Pathogens section in the Canadian Science Centre for Human and Animal Health. Although Dr Artsob has since retired, Robbin Lindsay and Mike Drebot maintain an active research programme, especially on vector-borne pathogens, including

activities of Research Associate, Mahmood Iranpour. There are many young scientists in Manitoba pushing back the frontiers of biting fly research today. Robert Anderson at the University of Winnipeg studies mosquito vectors, while Steve Wyard and Kateryn Rochon in the Department of Biological Sciences and Department of Entomology, respectively, at the University of Manitoba are working on various aspects of vector biology and control. Bryan Cassone is the most recent addition to the biting fly arsenal, setting up his new programme at Brandon University.

It's likely there will always be a great diversity and abundance of biting flies in Manitoba. Despite the overall reduction in resources to address biting fly problems in Canada, Manitoba still seems well positioned to tackle related issues in the future.

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References

Adler, P.H., Currie, D.C., and Wood, D.M. 2004. The Black Flies (Simuliidae) of North America. Royal Ontario Museum, Toronto.

Anderson, R.A., and Brust, R.A. 1995. Field evidence for multiple host contacts during blood feeding by *Culex tarsalis*, *Cx. restuans*, and *Cx. nigripalpus* (Diptera: Culicidae). Journal of Medical Entomology, **32**: 705–710.

Artsob, H, Doane, F, Sekla, L., Stackiw, W., and Brust, R.A. 1991. Manitoba Virus, a new rhabdovirus isolated from *Culex tarsalis* mosquitoes collected in Manitoba, Canada. Canadian Journal of Microbiology, **37**: 329–332.

Artsob, H., Spence, L.P., Calisher, C.H., and Brust, R.A. 1985. Isolation of California encephalitis serotype from mosquitoes collected in Manitoba, Canada. Journal of the American Mosquito Control Association, **1**: 257–258.

Bowen, W.G., Gavin, H.C.R., and Brust, R.A. 1976. Environmental monitoring of insecticide applications during the emergency mosquito control operation in Manitoba, 1975. Canadian Journal of Public Health, **67 (Supplement 1)**: 63–68.

Bracken, G.K., and Thorsteinson, A.J. 1965a. The orientation behavior of horse flies and deer flies (Tabanidae: Diptera). III. The use of traps in the study of orientation of tabanids in the field. Entomologia Experimentalis et Applicata, **8**: 189–192.

Bracken, G.K., and Thorsteinson, A.J. 1965b. The orientation behavior of horse flies and deer flies (Tabanidae: Diptera). IV. The influence of some physical modifications of visual decoys on horse flies. Entomologia Experimentalis et Applicata, **8**: 314–318.

Bracken, G.K., Hanec, W., and Thorsteinson, A.J. 1962. The orientation behavior of horse flies and deer flies (Tabanidae: Diptera). II. The role of some visual factors in the attractiveness of decoy silhouettes. Canadian Journal of Zoology, **40**: 685–695.

Brust, R.A. 1968. Temperature-induced intersexes in *Aedes* mosquitoes: comparative study of species from Manitoba. The Canadian Entomologist, **100**: 879–891.

Brust, R.A. 1980. Dispersal behavior of adult *Aedes sticticus* and *Aedes vexans* (Diptera: Culicidae) in Manitoba. The Canadian Entomologist, **112**: 31–42.

Brust, R.A. 1990. Oviposition behavior of natural populations of *Culex tarsalis* and *Culex restuans* (Diptera: Culicidae) in artificial pools. Journal of Medical Entomology, **27**: 248–255.

Brust, R.A., and Costello, R.A. 1969. Mosquitoes of Manitoba. II. The effect of storage temperature and relative humidity on hatching of eggs of *Aedes vexans* and *Aedes abserratus* (Diptera: Culicidae). The Canadian Entomologist, **101**: 1285–1291.

Brust, R.A., and Ellis, R.A. 1976. Assessment of the emergency mosquito control operation in Manitoba, 1975. Canadian Journal of Public Health, **67 (Supplement 1)**: 69–71.

Burton, D.K. 1984. Impact of *Bacillus thuringiensis* var. *israelensis* in dosages used for black fly (Simuliidae) control, against target and non-target organisms in the Torch River, Saskatchewan. Unpublished MSc thesis, University of Manitoba. xi + 129 pp.

Buth, J.L., Brust, R.A., and Ellis, R.A. 1990. Development time, oviposition activity and onset of diapause in *Culex tarsalis*, *Culex restuans* and *Culiseta inornata* in southern Manitoba. Journal of the American Mosquito Control Association, **6**: 55–63.

Crosskey, R.W. 1993. The Manitoban blackfly fauna with special reference to prospections made in 1983–1985 in central and southern Manitoba (Diptera: Simuliidae). Journal of Natural History, **28**: 87–107.

Dixon, R.D., and Brust, R.A. 1971. Predation of mosquito larvae by the fathead minnow *Pimephales promelas*. Manitoba Entomologist, **5**: 68–70.

Dixon, R.D., and Brust, R.A. 1972. Mosquitoes of Manitoba. III. Ecology of larvae in the Winnipeg area. The Canadian Entomologist, **104**: 961–968.

Evans, K.W., and Brust, R.A. 1972. Induction and termination of diapause in *Wyeomyia smithii* (Diptera: Culicidae), and larval survival studies at low and subzero temperatures. The Canadian Entomologist, **104**: 1937–1950.

Farkas, M.J, and Brust, R.A. 1985. The effect of a larval diet supplement in the development in the mosquito *Wyeomyia smithii* (Coq.) under field conditions. Canadian Journal of Zoology, **63**: 2110–2113.

Farkas, M.J., and Brust, R.A. 1986. Phenology of the mosquito *Wyeomyia smithii* (Coq.) in Manitoba and Ontario. Canadian Journal of Zoology, **64**: 285–290.

Fox, A.S., and Brust, R.A. 1994. Rogue ovarioles and criteria for parity diagnosis in *Culex tarsalis* (Diptera: Culicidae) from Manitoba. Journal of Medical Entomology, **31**: 738–746.

Fraser, H.M, and Brust, R.A. 1976. Weather conditions affecting mosquito populations in southern Manitoba during 1975. Canadian Journal of Public Health, **67 (Supplement 1)**: 40–46.

Galloway, M.M., and Burton, D.K. 1984. *Bacillus thuringiensis*: evaluation as a black fly control agent. Proceedings of the Entomological Society of Manitoba, **40**: 22.

Galloway, T.D., and Brust, R.A. 1985. The effects of parasitism by *Romanomermis culicivorax* (Nematoda: Mermithidae) on growth and development of *Aedes vexans* (Diptera: Culicidae) in laboratory and field tests. Canadian Journal of Zoology, **63**: 2437–2442.

Galloway, T.D., and Thorsteinson, O.J. 2017. In Memory. Ásgeir Jónas Thorsteinson (1917-1998). Bulletin of the Entomological Society of Canada, **49**: 16–18.

Henderson, L.P., Brust, R.A., and Wong, F.C. 1979. Biological transmission of western equine encephalomyelitis virus by *Culex tarsalis* (Coquillett). Mosquito News, **39**: 385–390.

Iranpour, M., Lindsay, L.R., and Dibernardo, A. 2009. *Culiseta melanura* (Diptera: Culicidae), a new record for the Manitoba mosquito fauna. Proceedings of the Entomological Society of Manitoba, **65**: 21–25.

McElligott, P.E.K., and Galloway, T.D. 1991a. Seasonal distribution and parity of host-seeking horse flies (Diptera: Tabanidae) from a pasture near Seven Sisters, Manitoba. The Canadian Entomologist, **123**: 361–370.

McElligott, P.E.K., and Galloway, T.D. 1991b. Daily activity patterns of horse flies (Diptera: Tabanidae: *Hybomitra* spp.) in northern and southern Manitoba. The Canadian Entomologist, **123**: 371–378.

McLintock, J. The mosquitoes of the Greater Winnipeg area. The Canadian Entomologist, **76**: 89–104.

Morgan, S.B. 1987. The effects of Tabanidae (Diptera) in the behavior of wood bison at Waterhen, Manitoba. Unpublished MSc thesis, University of Manitoba. viii + 84 pp.

O'Meara, G.F., Lounibos, L.P., and Brust, R.A. 1981. Repeated egg clutches without blood in the pitcher-plant mosquito. Annals of the Entomological Society of America, **74**: 68–72.

Ralley, W.E., Galloway, T.D., and Crow, G.H. 1993. Individual and group behaviour of pastured cattle in response to biting flies. Canadian Journal of Zoology, **71**: 725–734.

Riegert, P.W. 1999. The Northern Biting Fly Project 1947-1955. Entomology Series No. 8. Rampeck Publishers, Regina.

Sebastien, R.J., Brust, R.A., and Rosenberg, D.M. 1989. Impact of methoxychlor on selected nontarget invertebrates in a riffle of the Souris River, Manitoba. Canadian Fisheries and Aquatic Sciences, **46**: 1047–1061.

Sekla, L., Gadawski, R, Nayar, G., and Brust, R. 1991. A compilation of data on arbovirus surveillance in Manitoba: 1975-1991. Proceedings of the Entomological Society of Manitoba, **47**: 30–43.

Smith, S.M, and Brust, R.A. 1971. Photoperiodic control of the maintenance and termination of larval diapause in *Wyeomyia smithii* (Coq.) with notes on oogenesis in the adult female. Canadian Journal of Zoology, **49**: 1065–1073.

Stuart, T.D.T. 2007. A new record of *Uranotaenia sapphirina* (Diptera: Culicidae) in Manitoba, Canada. Proceedings of the Entomological Society of Manitoba, **63**: 5–7.

Tauthong, P., and Brust, R.A. 1976. The effect of temperature on development and survival of two populations of *Aedes campestris* Dyar and Knab (Diptera: Culicidae). Canadian Journal of Zoology, **55**: 135–137.

Teskey, H.J. 1990. The Horse Flies and Deer Flies of Canada and Alaska. Diptera: Tabanidae. The Insects and Arachnids of Canada. Part 16. Agriculture Canada Publication 1838.

Thorsteinson, A.J. 1958. The orientation behavior of horse flies and deer flies (Tabanidae: Diptera). I. The attractance of heat to tabanids. Entomologia Experimentalis et Applicata, **1**: 191–196.

Thorsteinson, A.J., Bracken, G.K., and Hanec, W. 1964. The Manitoba horse fly trap. The Canadian Entomologist, **96**: 166.

Taylor, B.T., Harlos, J.A. and Brust, R.A. 1980. *Coelomomyces* infection of the adult female mosquito *Aedes trivittatus* (Coquillett) in Manitoba. Canadian Journal of Zoology, **58**: 1215–1219.

Van Deveire, P.J. 1981. Flight and host seeking behaviour of adult black flies in the Souris River area, Manitoba. Unpublished MSc thesis, University of Manitoba. xii + 133 pp.

Westwood, A.R., and Brust, R.A. 1981. Ecology of black flies (Diptera: Simuliidae) of the Souris River, Manitoba as a basis for control strategy. The Canadian Entomologist, **113**: 223–234.

Wood, D.M., Dang, P.T. and Ellis, R.A. 1979. The Mosquitoes of Canada. Diptera: Culicidae. The Insects and Arachnids of Canada. Part 6. Agriculture Canada Publication 1686.

Bugs within Bugs

Angela E. Douglas

Introduction

Most animals are insects and, like most other animals, most insects bear microorganisms that are benign or beneficial. Indeed, many insects are absolutely dependent on microbial partners. Termites die when the community of microorganisms in their hindgut paunch is eliminated, aphids fail to grow and produce no offspring when treated with antibiotics, and mosquito larvae do not develop beyond the first larval stadium when provided with sterile food. Other insects can be reared under germ-free conditions over multiple generations, as was first demonstrated for *Drosophila melanogaster* by Delcourt and Guyent over a century ago, in 1910.

Through the twentieth century, research on insect-microbial interactions was dominated by studies of pathogens, with applications both to control insect pests (e.g., Bt toxins of the bacterium *Bacillus thuringiensis*) and to protect insects that we favor, for example, honey bees, from pathogens. The study of beneficial microorganisms in most insects remained at the fringe of entomological science, largely because these microorganisms could not be cultured or studied. Everything changed with the advent of high throughput DNA sequencing, enabling us to identify and study many aspects of these microorganisms without isolating them from their insect hosts. Just as we are learning that the health and vitality of people depend on good relations with our microbes, especially our gut microbes, so we are coming to understand how and why insects benefit from their "friendly" microbes.

This article provides two vignettes of Bugs within Bugs, taken largely from our research experience. The first concerns recent discoveries about the interactions between *Drosophila* fruit flies and their gut microorganisms, including insights that may have relevance to you and me. The second vignette concerns bacteria that live in insect cells and these interactions have no parallel in humans or other vertebrates.

The *Drosophila* fruit fly and its gut microbes

We can study how gut microbes affect *Drosophila* because, as mentioned in the Introduction, we can grow *Drosophila* under microbiologically-sterile conditions. The best way to obtain germ-free *Drosophila* is to remove the chorion and all surface microorganisms from eggs using bleach, and then aseptically transfer the eggs to sterile food. The eggs develop normally and, provided the diet is nutrient-rich (with plenty of yeast), the larvae grow and develop, and the resultant flies reproduce, generating germ-free cultures that can be maintained indefinitely. But there are two problems for these germ-free flies.

The first problem is that germ-free flies need a dietary supply of B vitamins. Insects generally need these micronutrients for the same reasons as other animals: they are coenzymes required for the function of enzymes central to metabolism. If the diet is depleted in any B vitamin, the germ-free insects will die, but the insects with gut microbes are healthy. We know that the bacteria,

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especially *Lactobacillus* species, are a source of B vitamins for *Drosophila*, but we don't yet know whether the vitamins are released from bacteria living in the gut or harvested from bacterial cells that are killed by the enzymes and harsh conditions in the gut environment.

The second problem with germ-free *Drosophila* is evident when the insects are maintained on nutrient-rich diets. The flies are inordinately fat. Their lipid content is 4-5 times greater than in *Drosophila* with an unmodified community of gut microorganisms (the latter are called conventional flies). We initially suspected that the germ-free flies were over-eating, but that wasn't true: we found that they get fat, even though they eat less than the conventional flies. Their problem is two-fold. Some of the bacteria in the conventional flies consume sugars. In essence, the bacteria compete with the insect for calories, so keeping the flies lean. In addition, these sugar-consuming bacteria release acetic acid which, by mechanisms we still don't fully understand, influences insulin signaling in the insect tissues and, thereby, controls lipid deposition. Although much remains to be done to understand the underlying mechanisms, these studies provide a proof of principle – from the humble fruit fly – that microbes can have profound effects on the energy balance of animals.

We extended our study of "fat flies" from the one *Drosophila* strain in our initial studies to many *Drosophila* genotypes. We were surprised to discover that different genotypes responded differently to elimination of the gut microbes. Some genotypes became super-fat, others were a little fatter, and a few were leaner without their microbes. Fly genotype matters greatly. We were able to use this variation to identify candidate genes that influence the *Drosophila* response to germ-free conditions. Some of the genes are expressed in the gut epithelium and function to maintain the gut barrier. Is it possible that genotypes with a genetic predisposition for a "leaky gut" suffer a more extreme response to loss of the gut microbes? But many of the candidate genes are not expressed in the gut but in neurons. These results fit to the growing realization that gut microbes interact with the gut-brain axis, with likely consequences for many aspects of physiological homeostasis and also behavior.

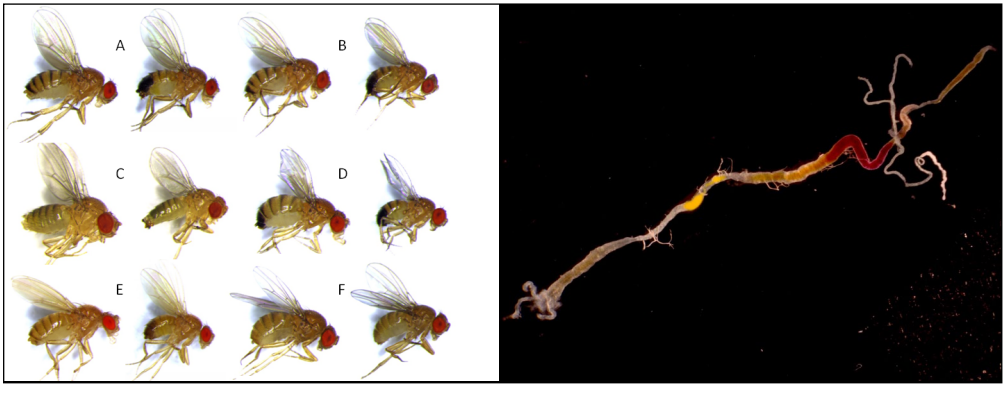


Figure 1. *Drosophila* species A) *D. melanogaster* B) *D. simulans* C) *D. sechellia* D) *D. yakuba* E) *D. santomea* F) *D. ananassae* (female on left of each pair). Dissected gut of *D. melanogaster* larva (proximal midgut [left]) to distal hindgut [right]) that had fed on diet containing pH-sensitive dye, revealing acidic (yellow) and basic (red) regions of the midgut. Figures by S. Franzenburg and A. Wong.

There is still much to do, to understand how gut microbes shape the health and fitness of animals, including people. There are indications – for flies and people – that the composition and activity of gut microbes can be modulated by diet, but the extent to which these diet-induced effects on the gut microbes affects health and vigor remains to be established. We can make a fat fly lean by providing it with certain bacteria, but it won't be that easy for humans.

The bacteria that are with you always: bugs in plant sap-feeding bugs

My second vignette concerns the estimated 10-20% of all insect species that bear microorganisms within insect cells, whose sole function appears to be to house and maintain the microorganisms. Most of these bugs-within-bugs are bacteria (with a few instances of yeasts), and the insect cells bearing them are known generically as bacteriocytes (or mycetocytes harboring yeasts). As Paul Buchner observed in his magisterial volume *Animal Endosymbiosis with Plant Microorganisms*, published in 1953 with an English translation in 1965, most insects bearing these symbiotic microorganisms live on nutritionally-inadequate diets. In particular, all insects feeding through the life cycle on the B vitamin-deficient diet of vertebrate blood (e.g., cimicid bedbugs and tsetse flies), and the essential amino acid-deficient diet of plant sap (e.g., aphids, whiteflies and cicadas), as well as many xylophagous beetles, including the Anobiidae and Bostrychidae, and all cockroaches investigated to date have bacteriocyte or mycetocyte symbioses. Undoubtedly, these associations have evolved independently in the different insect groups and involve taxonomically diverse microorganisms.

Multiple nutritional and genomic studies have confirmed Paul Buchner's expectation that the bacteriocyte symbioses have a nutritional role. Some of the best evidence comes from aphids whose bacteriocytes are localized to the hemocoel and bear bacteria, aptly named *Buchnera aphidicola*. The bacteriocytes of aphids were first reported by none other than Thomas Huxley (Darwin's Bulldog) in 1858, but Huxley erroneously described the bacteria that pack the cytoplasm of these cells as lipid droplets and the bacteriocytes as a "pseudovitellus" or accessory fat body. Indeed, the Merriam-Webster dictionary persists to this day in describing the pseudovitellus and mycetome as synonyms for "a mass of fatty cells in the abdomen of an aphid". The microbial nature of the intracellular structures was established by Buchner and colleagues in a series of papers from 1912, and the bacteria were identified as γ-Proteobacteria and a moderately-distant relative of *Escherichia coli*, in 1991 by Nancy Moran and colleagues.

Buchnera has never been cultured and probably never will be because it has a very small genome, just 20% of the size of the *E. coli* genome, and its metabolic function is intimately entwined with that of the insect. The nature of the entwined insect-bacterial metabolism comes in two parts. First, *Buchnera* overproduce essential amino acids, that is, the 10 of the 20 amino acids that contribute to protein but cannot be synthesized by these insects (and other animals). Budget analyses suggest that living *Buchnera* cells selectively release 20-50% of essential amino acids that they synthesize (varying among the different essential amino acids) to the insect host. These *Buchnera*-derived nutrients are required for sustained aphid growth and reproduction because the aphid diet of plant phloem sap is deficient in these nutrients. Second, *Buchnera* cannot synthesize some of these amino acids on its own. Its genome lacks one or more genes coding for the biosynthesis of 5 of the 10 essential amino acids, and the aphid provides the enzymes that are missing from the *Buchnera* with perfect complementarity. These aphid enzymes are not translocated into the *Buchnera* cells. Rather, the metabolic intermediates are shuttled back and forth between the bacterial cells and the surrounding insect cell with each metabolic reaction mediated in its "home" compartment (Figure 2). The shared metabolic pathways in the aphid-*Buchnera* symbiosis are a remarkable instance of metabolic coevolution. Studies on other symbioses in phloem-feeding insects, notably whiteflies, psyllids and mealy bugs, indicate

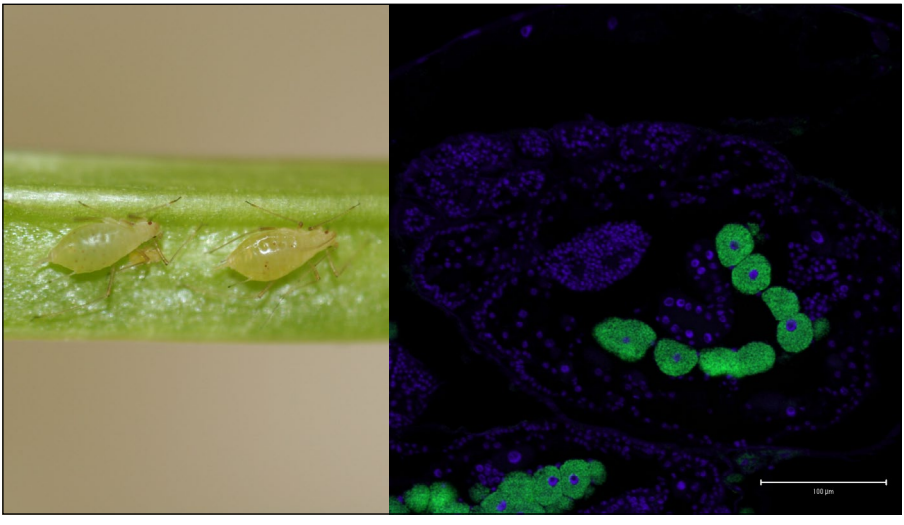


Figure 2. Pea aphids *Acyrthosiphon pisum* (left) feeding on bean plants, and bacteriocytes (right) localized to the hemocoel, with the cytoplasmic bacteria *Buchnera aphidicola* stained green (insect nuclei are stained blue). Figures by J. Searle and S. Chandler; scale bar indicates 100 µm.

that shared metabolic pathways have evolved independently multiple times among these insect symbioses.

There has been plenty of time for the metabolic coevolution of insects and their intracellular microorganisms. Phylogenetic analyses reveal that many of these associations are very ancient, likely present in the common ancestor of various insect taxa, for example, 10-20 million years for tsetse flies (Glossinidae), 100 million years for whiteflies (Aleyrodidae) and 280 million years for the Auchenorrhyncha (the suborder of Hemiptera that includes the cicadas, leafhoppers, planthoppers and spittlebugs). These inferences about the antiquity of these associations comes from two lines of evidence: that the microbial partners are invariably transmitted vertically from mother insect to offspring via the ovary, and that the phylogenies of the microorganisms and their insect hosts are congruent, indicating that obligate vertical transmission is an ancient and conserved trait. In other words, the phylogenetic relationship between the microbial taxa in two cockroach species or two whitefly species matches the phylogenetic relationship between their cockroach or whitefly hosts. In the great majority of associations, the microbial partners are transferred from the bacteriocytes in the maternal insect to the developing oocyte in the ovaries, and then become incorporated into the bacteriocytes that differentiate in the developing embryo. The molecular mechanisms underlying this remarkable process are largely unknown. Exceptionally, the entire bacteriocyte with its complement of bacteria is transferred to each egg and, in one whitefly investigated in detail, *Bemisia tabaci*, it is retained through embryo development from one insect generation to the next. As a consequence the genome of the bacteriocyte is different from that of other cells in the insect body. This instance of inheritance of a somatic cell violates Weismann's rule of separation of the germ line from the soma, raising many questions about the cellular mechanism and evolutionary process that have yet to be answered.

Conclusions

As for so many aspects of the biology of insects, the microbiology of healthy insects provides exemplars of both fundamental biological processes common to all animals and unparalleled diversity of function. *Drosophila* is emerging as a valuable biomedical model for the impact of gut microorganisms on the metabolic health of humans and other animals, while research on the intracellular microorganisms in bacteriocytes is providing insights into the evolutionary processes underlying genome reduction and the evolution of bacteria-derived organelles (mitochondria and chloroplasts) and the impact of microbial symbioses on the evolutionary diversification of insects. In parallel, our growing understanding of bugs within bugs has important practical applications. The discovery of a distinctive gut microbiota in honey bees raises questions about the wisdom of a widespread bee keeping practice of prophylactic antibiotic treatment against bee pathogens; and analyses of the molecular basis of bacterial function in bacteriocytes is yielding promising molecular targets for novel strategies to control major insect pests. Further progress will be facilitated by interdisciplinary research combining the disciplines of microbiology and entomology.

Further reading and references

I recommend the classic text of Paul Buchner and two review articles which provide both overviews of the subject and an entry point to the primary literature. The reference for the article of Luan et al. (2018) demonstrating the inheritance of bacteriocytes in the whitefly *Bemisia tabaci* has been published more recently than these reviews, and is also provided here.

Buchner, P. 1965. Endosymbiosis of Animals with Plant Microorganisms. John Wiley and Sons, Chichester, UK.

Douglas, A.E. 2015. Multiorganismal insects: diversity and function of resident microorganisms. Annual Review of Entomology, **60**: 17–34.

Engel, P., and Moran, N.A.(2013. The gut microbiota of insects - diversity in structure and function. FEMS Microbiology Reviews **37**: 699–735.

Luan, J., Sun, X., Fei, Z. and Douglas, A.E. 2018. Maternal inheritance of a single somatic animal cell displayed by the bacteriocyte in the whitefly *Bemisia tabaci*. Current Biology **28**: 459–465.

Wider aspects of a career in entomology. 1. Winter in Canada

Hugh V. Danks

This series of articles outlines some ancillary aspects of my entomological career, for the potential amusement of readers. It reports the sometimes unexpected challenges of working in new places and in the real world, an approach that serves also to expose some conclusions about research activities and some information about insects and their environments.

I arrived in Canada from England in early November 1968 as a postdoctoral fellow, to study ecological aspects of insect cold hardiness as part of a new program in Ottawa at the Entomology Research Institute of the Department of Agriculture (although this program was then supported for a relatively short period).

Severe winters, North American faunas, and studies of cold hardiness were all new to me. An initial orientation from the available entomological literature showed that there had been a focus on laboratory experiments to assess the physiological and biochemical adaptations to cold, whereas ecological work was very limited and most studies in nature consisted of informal explorations and anecdotal reports. The existing work nevertheless suggested that research might be particularly informative on species that survive these cold continental winters in the most severe habitats. Consequently, I began by trying to find specimens of species overwintering in extreme and variable habitats exposed above the protective cover of snow, especially under the loose bark of dead trees (Fig. 1). This habitat is occupied by adults of some very cold-hardy insects, including species of beetles and parasitic wasps as well as oecophorid moths, some of which are capable of movement even at very low temperatures.

H. Danks

Fig. 1. Loose bark above the snow on a dead tree, a preferred overwintering habitat of some particularly cold-hardy insects.

Starting my work in a new institution was interesting. For example, I discovered that many of the scientists insisted on being addressed by junior staff using their full titles, the system I thought that I had left behind in England. When I was dealing with one of the ladies in the typing pool, for example, I addressed her by her first name of Lynne, and invited her to use my first name in return instead of addressing me as “Dr Danks”. However, the system there was still so ingrained that henceforth she called me not “Hugh” but “Dr Hugh”.

Hugh Danks (hughdanks@yahoo.ca) retired in 2007 after many years as head of the Biological Survey of Canada. In that role, he helped to coordinate work on the composition and characteristics of the arthropod fauna of the country, and to summarize the results. In addition, his research studied cold-hardiness, diapause, and other adaptations to seasonality in northern regions.

The gentleman in charge of the institute stores ran the operation in the same manner as an army quartermaster, carefully protecting his storeroom and the products in it, and insisting that proper and methodical procedures be followed to obtain even the most minor items. This pattern of behaviour was somewhat discordant with mine as a new postdoctoral fellow anxious to obtain supplies as quickly as possible in order to begin my studies before too much of the winter had passed. One of my lists of requests included a hand tool with a sharp screw at the tip (sometimes referred to as a gimlet) that would be useful for exposing beetles and insect larvae in bark and dead wood. The "quartermaster" telephoned me to seek more details about this tool, and I explained that it resembled an awl with a screw at the end. When I later saw the purchase order, the item was listed as a "screw-all"!

Suitable dead trees were not especially common, so exploring the forest for hours on end to find them was an unusual experience in the cold; a British winter cardigan would by no means be sufficient! Without undue cost I acquired a large parka (in the days when heavy kapok was more prevalent than down or polyester fibre, for example), a wool tuque, and heavy mitts (again, before the days of warm but lighter materials). Even in these warm clothes, prolonged exposure to cold eventually reduced my body-core temperature, and after each lengthy foray it might take hours in a hot laboratory to warm back up. My tuque had ear flaps, held down by a tie under the chin, which kept my ears much warmer than in their absence but also delivered an unwanted cute appearance. The tuque also bore an apical tassel, which in due course started to shed lengths of green wool; these reminders of my early work in the winter could be found in obscure crannies throughout my accommodation for years afterwards. After coming very close to having frostbitten cheeks while sampling in the depth of winter at very low temperatures and in a brisk wind, I adopted a full face mask for fieldwork. This was a striking brown knitted covering likely to frighten passersby through its resemblance to a monkey.

Snow that has accumulated on the ground is frequently layered in Ottawa, sometimes packed by the wind, but most often because air masses that pass through the city at intervals during the winter differ widely in temperature. Therefore, intervals of freezing rain or warm sunshine between snowfalls may create a crust on top of the snow pack. Giant over-boots were sometimes useful in these circumstances as the snow built up during winter, because the likelihood of breaking though the surface crust was much lower than in a smaller boot. Eventually, however, snowshoes were necessary to avoid plunging down into thigh-deep snow, although some practice was required to discover an effective gait especially on some types of crusted snow coated with a layer of freezing rain (Fig. 2). In these conditions the snowshoes would break slightly though the crust, and then the leading edge would catch on the just-fractured crust during the next stride, making progress especially tiring and hard on muscles.

H. Danks

Fig. 2. A coating of freezing rain on top of the snow pack, on a field near Ottawa.

H. Danks

Fig 3. A snowshoe of the traditional form, as used for the fieldwork mentioned here.

In those years, snowshoes had a hardwood frame laced with rawhide (Fig. 3), to which a simple toe strap was attached. During mild spells and in the spring, the webbing had an unfortunate tendency to turn gluey when wetted, even when regularly waxed, especially during the course of a long journey in poor conditions; at the same time, the wet snow tended to compact into ice under the front of the foot, reducing the efficiency of the stride. At first I used a broad style (as in the figure) that is best for deep, soft snow. I made a few unplanned snow angels while learning to use these snowshoes in more difficult situations, such as undergrowth and steep slopes. I later acquired narrow snowshoes, which are more easily manoeuvred and allow a much faster pace. Modern snowshoes are much easier to use: they consist of lighter and more durable materials, such as aluminum or carbon fibre and neoprene or other artificial fibres, and have a more complex and stable harness. Therefore, the old wooden snowshoes are now regarded as "antique", and many people use them for thematic decoration rather than for winter travel!

I also learned during snowshoeing to read the terrain and to stay off corridors and large clearings, a learning process accelerated by discovering a stream flowing underneath me as I broke through the overlying ice and snow. After that experience I assumed that Canadians already knew that running water limits the formation of ice and erodes the undersurface after it forms, only to discover later from the number of spring mishaps that many of them do not.

Another lesson I learned was that it is best to abandon hopeless causes in research, no matter their potential interest. I failed to find enough insects under bark to ensure that the habitat features selected by these species could be adequately assessed, and nor was there enough material to support properly designed experiments to test responses to cold. Even if samples of sufficient size could be generated by combining limited results from several successive seasons, this would not be appropriate for most purposes because of marked differences from year to year in the occurrence and variable timing of low temperatures, snowfall, sunshine, and other elements. Therefore, a new target for research was required, and I decided to study the cold hardiness of insects in small aquatic habitats. Not only should such habitats create great difficulties for insect survival because they are frozen in winter, but also material for potential experiments would generally be abundant there, including the larvae of chironomid midges and other insects.

The year-to-year variations in weather that would have hindered a project on species overwintering in scattered locations above the snow also hindered the alternative project on aquatic species. Weather patterns were exceptional that first winter. Sizeable falls of snow arrived weeks before the typical date, extending the period of seasonal snow cover. This pattern removed the possibility of examining most aquatic habitats while they were still unfrozen, easy to find, and more easily assessed for relevant features such as depth and permanence, even though some potentially suitable sites could be discovered by examining aerial photographs taken in summer (and that were available from the Geological Survey of Canada). The unusual weather that year reinforced the lesson that field research cannot always be completed under tight deadlines. In fact, most of those early years had greater snowfall than more recent seasons. The winter of 1970–1971 in particular was an exceptional one, bringing a record total snowfall to Ottawa of 441 cm, which then persisted for an unusually long 139 days. Piles of accumulated snow could not be cleared away fast enough by the municipality and rose in front of apartment buildings past

the tops of the windows in lower units. After each heavy snowfall (for example, 20 or 30 cm in a single storm), minor roads in the city were often blocked by multiple cars (Fig. 4), stuck to varying degrees in the snowy and slippery conditions, and sometimes arrayed along the road at peculiar angles. In these conditions, only the centre of the road might be usable (compare Fig. 5a and Fig. 5b). For sampling insects, snowshoes were essential very early in the winter of 1970–1971.

H. Danks

Fig 4. Cars, some spinning their tires, on a minor road in Ottawa during the snowy winter of 1970-1971.

H. Danks

Fig 5a. A suburban road in Ottawa only partly cleared after a heavy snowfall the previous day.

H. Danks

Fig.5b. The same road in spring, showing its full width.

I undertook to drive in the snow as well as walk over it, but was surprised that despite the annual recurrence of winter, many people had not bothered to learn how to drive in these conditions. For example, on my way to work during the first winter I came across someone stuck in a parking lot, and unable to push out his vehicle unaided. I already knew that minimizing power to the wheels was the key to a successful extraction because it avoided digging them in deeper, but concluded that it would take a long time to free this particular individual when he declared, as we walked towards the car after my offer to assist: “No problem, my Pontiac has 325 horsepower”! He was indeed able to demonstrate that he could spin his wheels very easily to embed them even more deeply into the substantial slippery troughs he had created already.

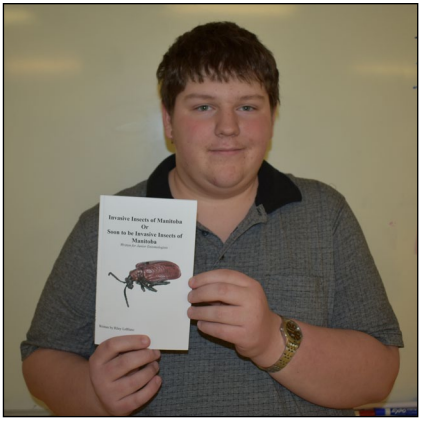
My own car, bought with a postdoctoral stipend, was smaller and cheaper. I soon discovered that it was not well adapted to snowy winters when most local vehicles were heavy North American land barges with wheels of impressive diameter. After substantial falls of snow, these wheels were able to grip the road as they dug deep ruts whilst compacting or shaving off the intervening snow to the height of the chassis. As a result, my relatively small car often scrabbled

on top of the base so produced because its smaller wheels gave insufficient purchase. Fortunately, I was able to borrow a large vehicle for fieldwork, thereby reducing the likelihood of becoming stuck in the snow during sampling expeditions, even though on country roads the front-heavy rear-wheel-drive cars then in vogue had a propensity for rear-wheel skids and fishtailing.

In any event, having come to terms with winter conditions, I could begin in earnest to study the cold hardiness of aquatic insects, as introduced in the next article in this series.

My Road to Entomology

Riley LeBlanc



I started to study entomology with my Dad when I was 7. This started when my Dad found his old spreading boards in the basement. The first time I went out to collect insects was just going around my Winnipeg neighbourhood at night to find the beetles that were attracted to lights. After that experience, I knew this is what I wanted to pursue. All I was using to collect when I started were plastic bottles that I had around the house and basically anything I had to put insects in. My net was still a children's net with a small metal loop and bamboo handle. I eventually upgraded the net I was using to a broom handle with a copper connector at the top of it and for the ring, copper pipe with a copper connector to connect to the handle. I used the copper connectors so the net and the handle could be taken apart and put together quickly. Because the net was copper it was heavy. I eventually switched the copper net to an aluminum fishing net and still use the connectors.

When I was in grade 9, I started attending Maples Met School, a new Project-Based Learning School in the Seven Oaks School Division, Winnipeg. This school is different because they start internships in Grade 9 instead of Grade 12. Students develop projects based around their interests. This gave me an opportunity to follow what I wanted to do - Entomology. I started an internship with Dr Terry Galloway at the University of Manitoba Fort Garry Campus every

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Editor's note: We are delighted to include this short special feature by Riley LeBlanc (rleblanc@maplesmet.org), a new and surely the youngest member of the Society. Riley is currently a Grade 10 student at Maples Met School, Winnipeg. His book on invasive insects of Manitoba, published by McNally Robinson in May 2017, was written for junior students who are new to entomology.

Thursday. Working with Dr Terry Galloway has proven good because I soon undertook a project to investigate goldenrod fly galls (*Eurosta solidaginis* [Fitch]).

When I went to collect the galls the first time, I went to Birds Hill Park. I went there because I knew I had seen them there in the past. The first time, I collected goldenrod spindle galls instead. When I showed them to Dr Galloway, I was told that these galls were made by a moth, not a fly. Since I was working in the winter, they would have already emerged. Instead of just getting rid of them, Dr Galloway suggested that it might be interesting if I opened the galls, just in case there was anything still alive in them. It was a long process opening 100 goldenrod spindle galls. There were some that I decided to leave and see if anything would emerge. Dr Galloway was right with having suggested to open the galls anyway. I found live caterpillars and parasitoid larvae. No moths emerged but I did get adult parasitoids. During the time I was opening the 100 goldenrod spindle galls, I went out again and collected goldenrod fly galls. Dr Galloway and I had a lot of luck with the goldenrod fly galls. We had many flies and parasitoids emerge. One of the parasitoids had not been previously recorded in Manitoba. I was amazed that this had not been discovered in Manitoba because it only takes someone going out to collect and raise them. Then I remembered there is not a lot of funding for projects that may seem insignificant and not a lot of people wonder about goldenrod galls. It would take someone who works on their own to find these insects. This was the perfect opportunity for me to learn more about gall makers.

While I was working with Dr Galloway every Thursday, I was also working on my school project on Invasive Insects of Manitoba. With the help of Dr Galloway, I turned this into a book, called *Invasive Insects of Manitoba or Soon to be Invasive Insects.* After 4 months of hard work, I finally participated in a book launch at McNally Robinson Booksellers, where I released my first book. Writing this book has helped me connect with other entomologists and helped me prepare for university, because I already started to learn about scientific writing.

Later that year, I was told about the Entomological Society of Canada/Entomological Society of Manitoba (ESC-ESM) Joint Annual Meeting that was happening in Winnipeg. I decided that it would be worth going. While I was at the conference, I got to meet many people, including Dr Kevin Floate who suggested I write an article about what I do in Dr Galloway's lab and about the book I wrote. I also received advice about what to do while in university and some things that I should be looking at while I am still in high school. I also met Dr Joe Shorthouse, who talked about spiny rose galls and the rose stem girdler. I have now gone out and collected spiny rose galls and what I believe is the rose stem girdler. I am now trying to raise both with the help of Dr Galloway and trying to find how long it takes for both galls to break diapause.

I plan to continue to study and collect insects in Manitoba and elsewhere. I am planning on writing a paper on my discoveries with the goldenrod fly galls.

T. Galloway

Goldenrod fly galls

Winston Jan Anthony Volney
(3 March 1946 – 24 November 2017)

The Canadian forest entomology community lost a highly talented and creative member in November 2017 with the passing of Dr W. 'Jan' A. Volney, after his courageous 5-year battle with cancer. Jan is remembered by his colleagues for his warm heart and his respectful, compassionate treatment of people. His sense of fair-play won him many friends and contributed significantly to much successful collaboration over his career. His well-developed understanding of nature, insightful vision of natural processes, and highly principled approach to science and its application will be sorely missed by those who had the good fortune to know and work with him. Jan was born on the island of Aruba and took his grammar and secondary school studies at Knox College in the mountains of Jamaica. He fondly recollected his time in the Caribbean, and those years doubtlessly contributed to his generally happy, uncomplicated attitude, his mischievous sense of humour, his love of sharing spicy food with others, and his knowledge of good rum and its applications. Jan's parents moved their family to New Brunswick in 1961. As a young man in a new home, Jan was enthusiastic about exercising his expanded opportunities for learning, and soon after coming to Canada, he enrolled at McGill University to study math and physics. While studying in Montreal he made regular excursions to Mont Ste. Hilaire, and during these forays his passion for nature convinced him that he'd not enjoy a career that kept him inside and away from the living world. Thus, he transferred to the University of New Brunswick to study forestry, earning a BScF in 1970. He continued his education to earn a MSF in Forest Ecology at Yale University in 1972, and both a PhD in Forest Entomology at SUNY-Syracuse and an MA in Statistics at the University of New Brunswick in 1977. Entomology, ecology and mathematics, as applied in forestry, were his passions. Jan was a highly independent thinker and a prodigious reader, especially of history, biographies and conceptual mathematics. He often delighted his colleagues with sparkling insights drawn from lateral thinking that linked his academic passions to his reading in other areas. Although Jan's formal education as a university student ended in 1977, he continued to learn and grow intellectually throughout his life

Jan's work career included experience in management, teaching and both pure and applied research. He worked briefly as an entomologist practising in forest protection in New Brunswick before moving onto a university position at the University of California at Berkeley (1977-85). At Berkeley, Jan pursued fascinating work on ecology and evolution of species within the California budworm complex, and guided a number of successful graduate students through their degrees. In 1985, he responded to the call of the North and returned happily to his adopted country to take up a position with the Canadian Forest Service (CFS) where he spent most of his career. After a year as an Insect and Disease Specialist at the Winnipeg lab, Jan moved to the Northern Forestry Centre (NoFC) in Edmonton where he spent the next 25 years, retiring as a Senior Research Scientist in 2012.

At NoFC, Jan worked in the context of a variety of themes. These included the general population biology of several Lepidoptera defoliator species and innovative approaches to

their management, development of effective sampling programs to characterize forest insect populations and communities, understanding the effect of industrial emissions on Canadian forests, and integration of a suite of productivity and conservation goals in the context of the evolving Canadian approach to Sustainable Forest Management. He designed, implemented and managed the large Zama Spruce Budworm Management Experiment to explore the promise of new spruce harvesting designs to better manage budworm impacts. He was a dedicated co-founder and strong advocate of the Ecosystem Management Emulating Natural Disturbance (EMEND) project in northwestern Alberta, and invested much of the latter part of his career in hands-on field work at EMEND and in ensuring that this visionary project was successfully developed. The energy, enthusiasm and big-picture organization that he brought to these tasks was most impressive and inspirational to those around him.

Jan followed a sound, no-nonsense program for conducting research in forest entomology and forest management, and through his determined example helped collaborators and students to see the wisdom of his straight-forward approach. Folks charged with managing forests knew that they could trust Jan to deliver sound science to help them evaluate, improve, and achieve management objectives. Jan's determination to make his science relevant to evolving needs should be noted. Much of his research was motivated in direct response to industry and/or government interest, but took a biologically well-informed approach to solving the problems identified by forest managers. Numerous useful discoveries resulted from this basic application of the scientific method. Jan authored or co-authored over 70 peer-reviewed publications in the primary scientific literature and a large number of other useful publications directed at scientists, practitioners, forest policy-makers and the public at large. He improved much additional scientific work through his advice about design and analysis or the thoughtful application of his editor's and reviewer's pen.

Jan was also an active Adjunct Professor at the University of Alberta for the last 20 years of his career, and from that stage he contributed enormously to the development of students, both as an undergraduate instructor and graduate supervisor. His well-prepared and passionately delivered lectures shone with the light of his enthusiasm for insects and his practical hands-on experience with their biologically-based management. They were much appreciated by the students. Some of those students went on to summer jobs with the CFS, putting their formal education to work before they had finished it. Many of Jan's graduate students have themselves gone onto excellent careers in forest entomology and forest science, and Jan's significant influence on their lives and careers is well-known. Jan held students to high standards but, as a paragon of respectful encouragement, made it possible for students to attain them. And, in the end, students learned to reach high and for the deepest understanding possible.

In addition to his direct and continuing contributions as a practicing scientist, Jan effectively took on administrative tasks in support of a large number of other scientists. In his work as a Project Leader, Team Leader, and Acting Director at the Northern Forestry Centre he reviewed, evaluated, assessed, and supported projects of other researchers. His colleagues remember him fondly as a friend first, and hold him in high esteem for his boundless encouragement, mentorship, and inspirational leadership. His sage advice, practical approach to problem solving and humour helped many colleagues find their way through stressful times. As an effective Co-Editor of the *Canadian Journal of Forest Research* from 1998-2002, his evaluation, advice, and decisions about scientific publication affected a broad cadre of forest scientists conducting research, both in Canada and internationally and, of course, contributed to the high quality and excellent reputation of forest science in Canada. As an active member of the Canadian Institute of Forestry, he served the national organization and his home section in a number of capacities, bringing an appropriate level of attention to the importance of entomological considerations in effective forest management.

Jan was a highly gregarious person, who involved himself in the scientific community. He loved to travel and interact with old friends and make new ones. He participated regularly in the International Congresses of Entomology and the Western Forest Insect Work Conferences, and Chaired the Organizing Committee for the 3rd North American Forest Insect Work Conference held in Edmonton in 2001. For his contributions to research in forest science and entomology, Jan was recognized by the following awards: Canadian Forest Service Award of Merit, Natural Resources Canada Departmental Award, Alberta Emerald Award for Environmental Excellence, Alberta Science and Technology (ASTech) Award, and a Scientific Achievement Award from the Canadian Institute of Forestry.

Jan's deep interest in both insects and the natural history that surrounded him was apparent to all who worked with him. For example, those who accompanied him in the field often found him tasting the foliage being consumed by the insects that he was charged with controlling and remarking about what tasted good to him and what did not. We note that he also tasted the insects themselves to investigate the conversion of biomass characteristics, and because he advocated that one should taste what they studied. Days in the field spent executing sampling routines were brightened by lively discussion that often began when Jan observed some natural history phenomenon that piqued his interest. He was as good as anyone we've known at imagining himself in an insect's world. At NoFC, Jan was an enthusiastic participant in social events, Corporate Challenge activities and United Way fundraising events. Etched in the NoFC corporate memory is the vision of Jan, outfitted in a tight-fitting pink tutu, duct-taped to the wall as part of a United Way fundraising activity.

Jan is survived by his wife of 47 years, Patricia, son Peter (Ottawa), and sisters Shelley McBrearty and Phonda Elizabeth Cormier, both of Saint John, as well as many cousins scattered throughout the world. In addition, many colleagues and former students will carry Jan's influence into the future, gratefully remembering with a smile the uncommon man that was its source.

John Spence, David Langor and Colin Bergeron (Edmonton)

Ron Hodges
7 August 1934 –
10 December 2017

Ronald William Hodges, 83, died at his home in Eugene, Oregon, on 10 December 2017. He was preceded in death by his wife, Elaine Rita Snyder Hodges, after 39 years of marriage.

Ron was born on 7 August 1934, in Lansing, Michigan, an only child to parents Elma and Lester Hodges, and became interested in Lepidoptera at age six upon finding a freshly emerged luna moth in the backyard of his Michigan home. He stated his intent to update Holland's "Moth Book" as a ninth grader. He received his BS degree in 1956 and his MS degree in 1957 from Michigan State University, where he was strongly influenced by Roland Fischer. He went to Cornell University to work with John (Jack) Franclemont. During this period he did extensive field work in New York, North Carolina, Florida, Arizona, and Ecuador. He became deeply interested in the microlepidoptera, particularly the Gelechioidea, and was awarded a PhD degree in 1961. He received a National Science Foundation Postdoctoral Fellowship and commenced work on genera of Gelechiidae. This project was interrupted when he accepted a position with the Systematic Entomology Laboratory at the U.S. Department of Agriculture, Agricultural Research Service located in the Smithsonian National Museum of Natural History, Washington, DC. He had several roles in the Laboratory, including laboratory chief. He stepped down from this position to continue field and laboratory research on gelechioid moths. At the Smithsonian, he met Elaine, a scientific illustrator, and they married in 1967; Ron adopted her two sons, Steven and Larry.

He was a member of the American Association for the Advancement of Science, American Association for Zoological Nomenclature (President 1993-95), American Entomological Society, Entomological Society of America, Entomological Society of Canada, Entomological Society of Ontario, Entomological Society of Washington (Honorary Member, 1999), Michigan Entomological Society, the Lepidoptera Research Foundation, the Lepidopterists' Society (President 1975-76), Maryland Entomological Society (President 1973-74), Ohio Lepidopterists, Northwest Lepidoptera Society, Sigma Xi, and Societas Europaea Lepidopterologica. He received the Thomas Say Award from the Entomological Society of America for his editorial oversight of Moths of North America in 1990, the Karl Jordan Medal from the Lepidopterists' Society for research on gelechioid moths in 1997, and he was elected an honorary member of the Entomological Society of Washington in 1999.

Ron was active until retirement in the Washington Biologists' Field Club since being elected in 1963. He was President from 1976 to 1979 and participated on various committees and work and field days. He was for many years the lead cook in the kitchen. In 1997, Ron and Elaine retired to Eugene, Oregon, where he continued to work on moths (an illustrated, annotated key to genera of North American Gelechiidae) and, until 2011, to edit and publish *The Moths of America North of Mexico*. Gardening with a highly diverse array of plants and developing and maintaining a collection of mainly pleurothallidine orchids also interested him in retirement. In his spare time, Ron gardened a highly diverse array of plants, enjoyed classical music and paired gourmet meals and wonderful wines.

Survivors include Steven and Susan Hodges of Santa Barbara, California, and Lawrence Hodges of Germantown, Maryland; two grandchildren; two great-grandchildren; his cousin Ann Haseltine of Ishpeming, Michigan; and Elaine's siblings and their families. Ron will be remembered for his big heart and generosity. He loved to share his garden, food, wine, music passions with his many friends and family. Sensitive to every dangling participle, "can I?" and "may I?" were distinguished, as were the salad and dinner forks. He is missed.

Steven Hodges
(based on various sources)
Santa Barbara, California

Books available for review / Livres disponibles pour critique

The ESC frequently receives unsolicited books for review. A list of these books is available online (http://esc-sec.ca/publications/bulletin/#toggle-id-2) and is updated as new books are received.

If you wish to review one of these books, please send an email to the Chair of the Publications Committee (Maya Evenden, mevenden@ualberta.ca).

You should briefly indicate your qualifications to review the topic of the book, and be able to complete your review within 8 weeks.

Preference will be given to ESC members.

Guidelines

Book reviews should be approximately 800-1200 words in length. They should clearly identify the topic of the book and how well the book meets its stated objective. Weaknesses and strengths of the book should be described.

Formatting of the review should follow that of reviews in recent issues of the Bulletin. A scan of the book cover (jpeg or tiff format, about 500 kb) should be submitted with the review.

La SEC reçoit fréquemment des livres non demandés pour des critiques. Une liste de ces livres est disponible en ligne (http://esc-sec.ca/publications/bulletin/#toggle-id-2) et est mise à jour lorsque de nouveaux livres sont reçus.

Si vous souhaitez critiquer un de ces livres, veuillez envoyer un message au président du comité des publications (Maya Evenden, mevenden@ualberta.ca).

Vous devez brièvement indiquer vos qualifications pour critiquer le sujet du livre, et être en mesure de terminer votre critique en 8 semaines.

La préférence est donnée aux membres de la SEC.

Lignes directrices

Les critiques de livre doivent compter entre 800 et 1200 mots. Elles doivent clairement identifier le sujet du livre et si le livre rencontre bien les objectifs énoncés. Les forces et faiblesses du livre devraient être décrites.

Le format des textes doit suivre celui des critiques des récents numéros du Bulletin. Une version numérisée de la couverture du livre (en format jpeg ou tiff, environ 500 kb) devra être soumise avec la critique.

Books available for review

Pohl, G.R. et al. 2018. Annotated checklist of the moths and butterflies (Lepidoptera) of Canada and Alaska. Pensoft *Series Faunistica* No 118. ISBN: 978-954-642-909-4 [e-book]

Saguez, J. 2017. Guide d'identification des vers fil-de-fer dans les grandes cultures au Québec. Centre de recherche sur les grains. ISBN: 978-2-9813604-5-8 [e-book]

Danks, H.V. 2017. The Biological Survey of Canada: A Personal History. Biological Survey of Canada. ISBN: 978-0-9689321-9-3 [e-book]

Kirk-Spriggs, A.H. and B.J. Sinclair [Eds.]. 2017. Manual of Afrotropical Diptera, Volumes 1 & 2. South African National Biodiversity Institute.

Allison, J.D. and R.T. Cardé [Eds.]. 2016. Pheromone communication in moths: Evolution, behavior and application. University of California Press. ISBN: 978-0-520-27856-1 [hard cover].

Appel, E. and S.N. Gorb. 2015. Comparative Functional Morphology of Vein Joints in Odonata. Zoologica Vol. 159. ISBN: 978-3-510-55046-3 [paperback]

Cárcamo, H.A, and D.J. Giberson [Eds.]. 2014. Arthropods of Canadian Grasslands. Vol. 3: Biodiversity and Systematics, Part 1. Biological Survey of Canada. ISBN: 9780968932162 [soft cover]

Giberson, D.J., and H.A. Cárcamo [Eds.]. 2014. Arthropods of Canadian Grasslands. Vol. 4: Biodiversity and Systematics, Part 2. Biological Survey of Canada. ISBN: 9780968932179 [soft cover]

68th Annual Meeting of Members and Board of Directors Meetings

The Annual Business Meeting of Members of the Entomological Society of Canada will be held at the Vancouver Convention Centre, 1055 Canada Place, Vancouver, British Columbia, on Tuesday, 13 November 2018, from 2:30 pm to 3:30 pm, in Meeting Room 109. The Board of Directors Meeting will be held at the Pan Pacific Hotel, 300-999 Canada Place, Vancouver, British Columbia, on Sunday, 11 November 2018, from 8:00 am to 3:00 pm, in the Oceanview Suite 3. The incoming Board of Directors will meet immediately following the Annual Business Meeting of Members, also in Meeting Room 109 at the Vancouver Convention Centre, on Tuesday, 13 November 2018, from 3:30 pm to 4:00 pm. Matters for consideration at any of the above meetings should be sent to Vincent Hervet, Secretary of the Entomological Society of Canada (see inside back cover for contact details).

68e assemblée annuelle et réunions du conseil d'administration

L'assemblée annuelle des membres de la Société d'entomologie du Canada se tiendra au Vancouver Convention Centre, 1055 Canada Place, Vancouver, Colombie-Britannique, le mardi 13 novembre 2018 de 14h30 à 15h30 dans la salle Meeting Room 109. La réunion du conseil d'administration se tiendra au Pan Pacific Hotel, 300-999 Canada Place, Vancouver, Colombie-Britannique, le dimanche 11 novembre 2018 de 8h00 à 15h00 dans la salle Oceanview Suite 3. Le nouveau conseil d'administration se réunira immédiatement après l'assemblée annuelle des membres le mardi 13 novembre 2018 de 3h30 à 4h00 dans la salle Meeting Room 109 au Vancouver Convention Centre. Les sujets à aborder pour n'importe laquelle de ces réunions doivent être envoyés à Vincent Hervet, secrétaire de la Société d'entomologie du Canada (voir le troisième de couverture pour les coordonnées détaillées).

Call for nominations: Societal Director (Second Vice-President), Director at Large

The Society will hold an online ballot to select candidates for a Societal Director and Director at Large. The selected candidates will then be presented as a slate for formal election by members at the Annual Meeting in Vancouver in November. Nominations for these positions must be signed by three active members of the Society and be received by the Secretary of the Entomological Society of Canada, Vincent Hervet, by 20 April 2018 (see inside back cover for contact details).

Appel à candidatures : Directeur sociétal (second vice-président), conseiller

La Société tiendra un vote en ligne afin de sélectionner des candidats pour les postes de directeur sociétal et de conseiller. Les candidats sélectionnés seront ensuite présentés à la réunion annuelle à Vancouver en novembre pour une élection formelle par les membres. Les nominations pour ces postes doivent être signées par trois membres actifs de la Société et être reçues par le secrétaire de la Société d'entomologie du Canada, Vincent Hervet, au plus tard le 20 avril 2018 (voir le troisième de couverture pour les informations de contact).

The Society's New Treasurer

The Society is delighted to announce that Joel Kits assumed the duties of Treasurer on 5 February 2018, taking over the reins from Christopher Dufault.

Joel is currently a research scientist with Agriculture and Agri-Food Canada in Ottawa. He studies leafhopper systematics at the Canadian National Collection of Insects, Arachnids, and Nematodes. Previously, he was a postdoc with AAFC in Ottawa and did his PhD at the University of Guelph. He is also currently a director of the Entomological Society of Ontario (2017-2020). For his contact details, please see the List of Officers on the inside of the back cover.

Nouveau trésorier de la Société

La Société est ravie d'annoncer que Joel Kits assume les fonctions de trésorier depuis le 5 février 2018, prenant le relais de Christopher Dufault.

Joel est présentement chercheur scientifique à Agriculture et Agroalimentaire Canada à Ottawa. Il étudie la systématique des cicadelles à la Collection nationale canadienne d'insectes, d'arachnides et de nématodes. Il était précédemment post-doctorant avec AAC à Ottawa et a fait son doctorat à l'Université de Guelph. Il est également directeur de la Société d'entomologique d'Ontario (2017-2020). Pour ses informations de contacts, veuillez consulter la liste des dirigeants à l'intérieur de la couverture arrière.

New Editor-in-Chief, *The Canadian Entomologist*

The Board of Directors has appointed Dezene Huber as the new Editor-in-Chief of *The Canadian Entomologist*. Dezene is a professor in the Ecosystem Science and Management Program at the University of Northern British Columbia in Prince George. Much of the research in his lab over the years has been on forest insects, particularly bark beetles. However, more recently, some of his focus has shifted towards regional insect – especially aquatic insect – biodiversity. For his contact details, please see the List of Officers on the inside of the back cover.

Nouveau rédacteur-en-chef, *The Canadian Entomologist*

Le conseil d'administration a nommé Dezene Huber comme nouveau rédacteur-en-chef de *The Canadian Entomologist*. Dezene est professeur dans le programme Ecosystem Science and Management à l'Université du Nord de la Colombie-Britannique, à Prince George. La majorité des recherches dans son labo durant les années ont portées sur les insectes forestiers, particulièrement sur les scolytes. Cependant, plus récemment, une partie de ses intérêts s'est tournée vers la biodiversité régionale des insectes – particulièrement des insectes aquatiques. Pour ses informations de contact, veuillez consulter la liste des dirigeants à l'intérieur de la couverture arrière.

Members' discounts

Entomological Society of Canada members can enjoy discounts on publications from Annual Reviews, Elsevier, Cambridge University Press, and the Entomological Society of America. Details of how to benefit from these discounts are available on the member's area of the Entomological Society of Canada website at: https://esc-sec.site-ym.com/.

Remise pour les membres

Les membres de la Société d'entomologie du Canada peuvent bénéficier d'une remise lors d'achats de publications de : Annual Reviews, Elsevier, Cambridge University Press et de la Société d'entomologie d'Amérique. Les informations nécessaires pour profiter de ces remises sont disponibles dans la section des membres du site de la Société d'entomologie du Canada à : https://esc-sec.site-ym.com/.

Fourteenth Annual Photo Contest

The Fourteenth Annual Photo Contest to select images for the 2019 covers of *The Canadian Entomologist* and the *Bulletin of the Entomological Society of Canada* is underway. The cover images are intended to represent the breadth of entomology covered by the Society's publications. Insects and non-insects in forestry, urban or agriculture; landscapes, field, laboratory or close-ups; or activities associated with physiology, behaviour, taxonomy or IPM are all desirable. A couple of 'Featured Insects' (for the spine and under the title) are also needed. If selected, your photo will grace the cover of both publications for the entire year. In addition, winning photos and a selection of all submitted photos will be shown on the ESC website.

Contest rules:

Photos of insects and other arthropods in all stages, activities, and habitats are accepted. To represent the scope of entomological research, we also encourage photos of field plots, laboratory experiments, insect impacts, research activities, sampling equipment, etc. Photos should, however, have a clear entomological focus.

Digital images must be submitted in unbordered, high-quality JPG format, with the long side (width or height) a minimum of 1500 pixels.

Entrants may submit up to five photographs. A caption must be provided with each photo submitted; photos without captions will not be accepted. Captions should include the locality, subject identification as closely as is known, description of activity if the main subject is other than an insect, and any interesting or relevant information. Captions should be a maximum of 40 words.

The entrant must be a member in good standing of the Entomological Society of Canada. Photos must be taken by the entrant, and the entrant must own the copyright.

The copyright of the photo remains with the entrant, but royalty-free use must be granted to the ESC for inclusion on the cover of one volume (6 issues) of *The Canadian Entomologist*, one volume (4 issues) of the *Bulletin*, and on the ESC website.

The judging committee will be chosen by the Chair of the Publications Committee of the ESC and will include a member of the Web Content Committee.

The Photo Contest winners will be announced on the ESC website, and may be announced at the Annual Meeting of the ESC or in the *Bulletin*. There is no cash award for the winners, but photographers will be acknowledged in each issue in which the photos are printed.

Submission deadline is **31 August 2018**. Entries should be submitted as an attachment to an email message; the subject line should start with "ESC Photo Contest Submission". Send the email message to: photocontest@esc-sec.ca.

Quatorzième concours annuel de photographie

Le quatorzième concours annuel de photographie visant à sélectionner des images pour les couvertures de *The Canadian Entomologist* et du *Bulletin de la Société d'entomologie du Canada* pour 2019 est en cours. Les images sur la couverture doivent représenter l'étendue entomologique couverte par les publications de la Société. Des photos représentant des insectes ou autres arthropodes forestiers, urbains ou agricoles, des paysages, du travail de terrain ou de laboratoire, des gros plans, ainsi que montrant des activités associées à la physiologie, au comportement, à la taxonomie ou à la lutte intégrée seraient souhaitées. Deux « insectes vedettes » (pour le dos et sous le titre) sont également recherchés. Si elle est sélectionnée, votre photo ornera la couverture des deux publications pour l'année entière. De plus, vos photos gagnantes et une sélection de photos soumises seront montrées sur le site Internet de la SEC.

Règlements du concours :

Les photos d'insectes et autres arthropodes à n'importe quel stade, effectuant n'importe quelle activité et dans n'importe quel habitat sont acceptées. Afin de représenter les sujets de la recherche entomologique, nous encourageons également les photos de parcelles de terrain, expériences de laboratoire, impacts des insectes, activités de recherche, équipement d'échantillonnage, etc. Les photos doivent, cependant, avoir un intérêt entomologique clair.

Les images numériques doivent être soumises sans bordure, en format JPG de haute qualité, avec le plus grand côté (largeur ou hauteur) d'un minimum de 1500 pixels.

Chaque participant peut soumettre jusqu'à cinq photographies. Une légende doit être fournie pour chaque photo soumise : les photos sans légendes ne seront pas acceptées. La légende doit inclure la localisation, l'identification du sujet le plus précisément possible, la description de l'activité si le sujet n'est pas un insecte, et toute information intéressante ou pertinente. Les légendes doivent avoir une longueur maximale de 40 mots.

Les participants doivent être membres en bonne et due forme de la Société d'entomologie du Canada. Les photos doivent avoir été prises par le participant, et le participant doit en posséder les droits d'auteur.

Le participant conserve les droits d'auteur de la photo, mais l'utilisation libre de droits doit être accordée à la SEC afin de l'inclure sur la couverture d'un volume (6 numéros) de *The Canadian Entomologist*, un volume (4 numéros) du *Bulletin*, et sur le site Internet de la SEC.

Le comité d'évaluation sera choisi par le président du comité des publications de la SEC et inclura un membre du comité du contenu du site Internet.

Les gagnants du concours de photographie seront annoncés sur le site Internet de la SEC et pourront être annoncés à la réunion annuelle de la SEC ou dans le *Bulletin*. Il n'y a pas de prix en argent pour les gagnants, mais les photographes seront remerciés dans chaque numéro où les photos seront imprimées.

La date limite de soumission est le **31 août 2018**. Les soumissions doivent être faites en pièces jointes d'un courrier électronique. L'objet du message doit débuter par « Soumission pour le concours de photographie de la SEC ». Envoyez vos courriels à : photocontest@esc-sec.ca.

Meeting announcements / Réunions futures

2nd International Conference "Insects to Feed the World" (IFW 2018)
Wuhan, China, 15-20 May 2018
http://ifw2018.csp.escience.cn/dct/page/1

The XV International Conference on Ephemeroptera and XIX International Symposium on Plecoptera
Aracruz, Brazil, 4-8 June, 2018
http://ephemeroptera.com.br/jointmeeting/

ICAE 2018: 20th International Conference on Advances in Entomology
Vienna, Austria, 14-15 June 2018
https://www.waset.org/conference/2018/06/vienna/ICAE

XI European Congress of Entomology
Naples, Italy, 2-6 July 2018
http://www.ece2018.com/

XV International Congress of Acarology
Antalya, Turkey, 2-8 September 2018
http://www.acarology.org/ica/ica2018/

Joint Meeting of the Entomological Society of Canada, the Entomological Society of British Columbia and the Entomological Society of America
Vancouver, 11-14 November 2018
https://www.entsoc.org/events/annual-meeting
https://www.entsoc.org/events/annual-meeting/french

Joint Meeting of the Entomological Society of Canada, the Acadian Entomological Society and the Canadian Society for Ecology and Evolution
Fredericton, 18-21 August 2019
For more information: Twitter @CSEE_ESC2019; email csee.esc.2019@gmail.com

26th International Congress of Entomology (Entomology for our planet)
Helsinki, Finland, 19-24 July 2020
http://www.ice2020helsinki.fi/

Readers are invited to send the Editor notices of entomological meetings of international, national or Canadian regional interest for inclusion in this list.

Les lecteurs sont invités à envoyer au rédacteur en chef des annonces de réunions entomologiques internationales, nationales ou régionales intéressantes afin de les inclure dans cette liste.

Bulletin of the Entomological Society of Canada

Editor: Cedric Gillott
Assistant Editor: Donna Giberson

The *Bulletin of the Entomological Society of Canada*, published since 1969, presents quarterly entomological news, opportunities and information, details of Society business, matters of wider scientific importance and book reviews.

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The Entomological Society of Canada was founded in 1863 primarily to study, advance and promote entomology. It supports entomology through publications, meetings, advocacy and other activities.

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Bulletin de la Société d'entomologie du Canada

Rédacteur: Cedric Gillott
Rédactrice adjointe: Donna Giberson

Le *Bulletin de la Société d'entomologie du Canada*, publié depuis 1969, présente trimestriellement des informations entomologiques, des occasions, des renseignements sur les opérations de la Société, des dossiers scientifiques d'importance et des analyses d'ouvrages.

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La Société d'entomologie du Canada a été établie en 1863 principalement pour promouvoir l'étude et l'avancement de l'entomologie. Elle soutient l'entomologie par l'entremise de publications, de réunions et d'autres activités.

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Editor's note: *Society Directors and Officers are reminded to check these lists, and submit corrections, including the names and positions of new officers.*

The last word / Le dernier mot

Cedric Gillott, Editor / Rédacteur

Across the spectrum

What struck me particularly as I edited the materials for this issue of the Bulletin was the wide spectrum of both contributors and entomological perspectives that it contains. In our special features, for example, now-retired Hugh Danks, a long-standing member and Fellow of the Society since 1982, gives an amusing account of some of his early field adventures. At the other end of the scale, one of the Society's newest members (and surely the youngest!), Riley LeBlanc, a Grade 10 high school student who has already published his first book, offers a short perspective on how/why he became an entomologist.

Among the range of topics covered, the fascinating history of medico/veterinary entomology (with special reference to biting flies) in Manitoba, summarized in Terry Galloway's Heritage Lecture, is in sharp contrast to the modern molecular studies of some interrelationships between insect hosts and the microbes occurring within their bodies described in the article by Angela Douglas.

These examples are, of course, but a reflection of the immense range of opportunities for studies of the largest and most diverse taxon of animals, and therefore the range of interests of our Society's members. For me, one of the benefits of attending our joint annual meetings (in addition to the chance to enjoy samples from local craft breweries!) is to see first-hand the spectrum of investigations being undertaken by Canadian entomologists ranging in experience from students (some even undergraduate) to senior researchers. See you all in Vancouver!

Le long du spectre

Ce qui m'a particulier frappé en éditant le matériel pour ce numéro du Bulletin est la vaste gamme des contributeurs entomologiques et des perspectives entomologiques. Dans notre article spécial, par exemple, le maintenant retraité Hugh Danks, un membre de longue date et membre associé de notre Société depuis 1982, donne un récit amusant de certaines de ses aventures sur le terrain. À l'autre bout du spectre, un des plus récents membres de la Société (et probablement le plus jeune!), Riley LeBlanc, un étudiant du secondaire au niveau 10 qui a déjà publié son premier livre, offre une courte perspective sur comment/pourquoi il est devenu entomologiste.

Parmi la gamme de sujets couverts, l'histoire fascinante de l'entomologie médicale/vétérinaire (avec une référence spéciale aux mouches piqueuses) au Manitoba, résumée par l'allocution du patrimoine de Terry Galloway, est en contraste frappant avec les études moléculaires modernes de certaines interrelations entre les insectes hôtes et les microbes dans leurs corps décrites dans l'article d'Angela Douglas.

Ces exemples sont, évidemment, une réflexion sur l'immense gamme d'opportunités pour des études sur le taxon le plus grand et divers d'animaux, et donc sur la gamme d'intérêts des membres de notre Société. Pour moi, un des avantages à assister à la réunion annuelle conjointe (en plus de la chance de goûter un échantillon des micro-brasseries locales!) est de constater en personne le spectre des investigations entreprises par les entomologistes canadiens variant en expérience, des étudiants (certains au premier cycle) aux chercheurs séniors. On se verra donc à Vancouver!

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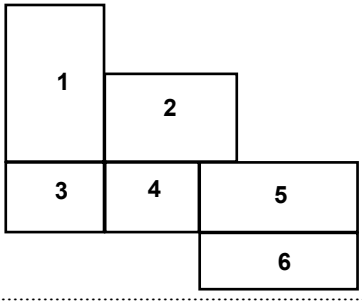

Front cover/Plate supérieur:

1 *Glyptapanteles militaris* (Hymenoptera: Braconidae). In 2017, many armyworm moth (*Mythimna unipuncta*; Lepidoptera: Noctuidae) larvae were parasitised by *Glyptapanteles militaris*. Cocoons were collected in wheat fields and reared until adult emergence. This photograph shows the head of an adult of the beneficial insect [Shawville, Québec, Canada]

Glyptapanteles militaris (Hymenoptera : Braconidae). En 2017, de nombreuses chenilles de la légionnaire uniponctuée (*Mythimna unipuncta*; Lepidoptera: Noctuidae) ont été parasitées par le parasitoïde *Glyptapanteles militaris*. Les cocons ont été récoltés dans des champs de blé à Shawville et ont été élevés jusqu'à l'émergence des adultes. Cette photo montre la tête d'un adulte de cet insecte bénéfique [Shawville, Québec, Canada]

[Photo: Julien Saguez]

2 Eight-spotted skimmer (*Libellula forensis*; Odonata: Libellulidae), perching on a twig near the outflow to a large marsh pond [Sergeant Bay Provincial Park, British Columbia, Canada]

La libellule *Libellula forensis* (Odonata : Libellulidae) posée sur une brindille près de l'écoulement d'un grand étang marécageux [Parc provincial Sergeant Bay dans le sud-ouest de la Colombie-Britannique, Canada]

[Photo: Donna Giberson]

3 A *Hybomitra* (Diptera: Tabanidae) [Kokanee Glacier Provincial Park, British Columbia, Canada]

Une *Hybomitra* (Diptera: Tabanidae) [Parc provincial de Kokanee Glacier en Colombie-Britannique, Canada]

[Photo: Ward Strong]

4. A foraging *Villa* (Diptera: Bombyliidae) [Kelly Lake, British Columbia, Canada]

Un *Villa* (Diptera: Bombyliidae) qui butine [Kelly Lake, Colombie-Britannique, Canada]

[Photo: Bernard Roitberg]

5. Flower longhorn, *Cortodera subpilosa* (Coleoptera: Cerambycidae), 21 June 2016 [Wagonwheel Road, Kootenay Boundary, British Columbia, Canada]

Le longicorne *Cortodera subpilosa* (Coleoptera : Cerambycidae), 21 juin, 2016 [Wagonwheel Road, Kootenay Boundary, Colombie-Britannique, Canada]

[Photo: Adam Blake]

6. When camouflage fails—a nymph of the stink bug *Palomena prasina* (Hemiptera: Pentatomidae) [Delémont, Switzerland]

Quand le camouflage échoue—une nymphe de la punaise verte, *Palomena prasina* (Hemiptera : Pentatomidae) [Délémont, Suisse]

[Photo: Tim Haye]

Back cover/Plate inférieur:

A live female Asian longhorned beetle (*Anoplophora glabripennis*; Coleoptera: Cerambycidae) [Insect Production and Quarantine Laboratory in the Great Lakes Forestry Centre, Sault Ste. Marie, Ontario, Canada]

Une femelle longicorne asiatique vivante (*Anoplophora glabripennis*; Coleoptera : Cerambycidae) provenant [Laboratoire de production d'insectes et de quarantaine au Centre de foresterie des Grands Lacs à Sault-Sainte-Marie en Ontario, Canada]

[Photo: Amanda Roe]

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