The Canadian Botanical Association Bulletin

Bulletin de l'Association Botanique du Canada

Vol. 51 Number 2, September/septembre 2018



Hemlock Varnish Shelf, *Ganoderma tsugae*. ©Hugues Massicotte

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The Canadian Botanical Association Bulletin

The CBA Bulletin is issued three times a year (March, September and December) and is freely available on the CBA website. Hardcopy subscriptions are available for a fee.

Information for Contributors

All members are welcome to submit texts in the form of papers, reviews, comments, essays, requests, or anything related to botany or botanists. For detailed directives on text submission please contact the Editor (see below). For general information about the CBA, go to the web site: www.cba-abc.ca

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Published in Ottawa, September 31th 2018
ISSN 0008-3046 (paper)
ISSN 1718-8164 (electronic)

Next issue

Texts for the next issue, 51(3), must be received by December 1, 2018

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Bulletin de l'Association Botanique du Canada

Le Bulletin de l'ABC paraît trois fois par année, normalement en mars, septembre et décembre. Il est envoyé à tous les membres de l'ABC.

Soumission de textes

Tous les membres de l'Association sont invités à envoyer des textes de toute natureconcernant la botanique et les botanistes (articles, revues de publication, commentaires,requêtes, essais, etc.). Tous les supports de texte sont acceptés. Pour des renseignements détaillés sur la soumission de textes, veuillez consulter le rédacteur (voir ci-dessous). Infos générales sur l'ABC à l'url suivant: www.cba-abc.ca

Rédacteur

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Publié à Ottawa, le 31 septembre 2018
ISSN 0008-3046 (papier)
ISSN 1718-8164 (électronic)

Prochain numéro

La date de tombée des textes du prochain numéro, le no 51(3), est le 1 decembre 2018

President's Message

READ ME! Dear members, in this inaugural address, I would like to say that I am honoured and humbled by the fact that you have chosen me as your President and with the goal of making our Association even better, I am asking for your **HELP!**

The first scientific societies were created by Kings and Queens and they were run by an elite clique of gentlemen scientists of private means that hired tireless assistants to prepare the experiments and design the instruments to make them possible (think Robert Hooke). This changed in the 19th century, and scientific societies started to appear where anyone could join, professionals and amateurs alike, for a subscription. The society offered its members the opportunity to practice and share their love for their science with like-minded persons, and the subscriptions offered them a place to publish their discoveries in a society journal with the possibility of compensation or prizes for contributions to their society and its science. We are the second sort of society, the type that was formed out of a love for our science and with the goal of promoting it to the benefit of all. We are a charity, so our goal should be, and always will be, to help and encourage you, maybe financially or maybe by expert advice, to do what you love to do, but better - study botany!

That's why I started my message with READ ME! How can we make our society better? In other words, how can we make CBA more relevant to you as a member as you study the development, ecology, and classification of photosynthetic organisms and the biology of the fungi, bacteria and viruses that affect their health and productivity? I want to know!

To start the discussion, I would like to tell you of a few of the goals and ideas for improving CBA over the next two years that were discussed at the 2018-2019 Incoming Board Meeting in Rochester, Minnesota. The participants in this discussion were Past President, Art Davis; Secretary, Deb Metsger; Bulletin Editor, Tyler Smith; Student Director, Dylan Johnston; Eastern Director, Nadia Cavallin; Western Director, Bruce Ford, and Systematics & Phytogeography Section co-chair, Gerry Allen.

First, we wanted to get a better understanding of the Association's finances. We are financially secure, but can we offer even more financial support to members? Could we implement new awards, like an award to promote aboriginal botany or to encourage women in botany? We lack a connection to a journal beyond the Bulletin, but could we make a stronger connection to *Botany* (formerly the *Canadian Journal of Botany*) to the benefit of all members? What about bling - visibility matters! The creation of the special projects fund was tied to this idea, and almost every society we know produces something from fridge magnets to posters to increase their visibility. Likewise, we need to encourage our local directors or any member willing to take on the responsibility to attend Regional Biology Days or Science Fairs to represent CBA and encourage students that enjoy studying plants to see botany as a viable pursuit and career. I would also like to see the Association increase its political profile. I suggest we join the Partnership Group for Science and Engineering (PAGSE) and we consider endorsing CBA members for NSERC panels like other societies do. How can we attract more members and how can we get existing members more involved and energized to participate in the society, promote it, and promote botany as a discipline? Should we be contacting local Naturalist clubs? Could a photo competition help energise the existing membership?



Incoming CBA president Julian Starr receiving the "President's Seal" from Past-President Art Davis at the AGM in Rochester, Minnesota.

Lastly, there was one point of discussion for which we were all in strong agreement - especially Deb Metsger! - we **MUST** improve our website. One way to increase our membership, to seek more donations, and to increase our visibility would be a modern website. Imagine being able to pay your memberships dues, to donate funds to the Association in the name of colleague or family member or simply become a new member all at the push of a button? Or imagine how we could increase our visibility nationally and internationally by offering the general public an easy link to ask us botany questions? This is easily a winning idea, so we need to do it, even if we must find the funds to do it.

As you can see there are so many possibilities and so much to do, so please send me your thoughts on where to start (beyond the website! That's a no-brainer).

At this point you are probably wondering what happened at the Annual Meeting if you were not there. Unfortunately, I cannot go into great detail because I thought discussing the future was just too important in my first message. However, I will say that we were few, but we were vocal, and our banquet of around 25 persons was truly wonderful – like coming home. As our President Art Davis named off the students' awards, like the Porsild-Consaul, Cinq-Mars, and Iain and Sylvia Taylor, there were high-fives all around the room as the recipients went to the podium to receive their awards, and for the major awards, like the Lawson, warm applause and heart-felt smiles for our colleagues that have contributed so much to our discipline. This is why I am a CBA member – it is simply too much fun! I literally cannot wait to see the same gang plus neophyte members next year!

Finally, I want to deeply thank both our past President, Art Davis, and our now past-past-President John Markham for all they have done for our society. Anyone that has sat on the CBA Board or has helped the Board on committees or has acted as judges for awards or has helped organise a meeting, etc., etc., knows that it takes time to make CBA a successful scientific organisation. And it was all done ***pro bono***, and with a finesse and grace that I can only hope to match. They have truly served us well on both a national and an international stage, and I am proud to follow in their footsteps. Big shoes to fill!

Yikes! One last thing, and it is important. I am delighted to tell you that we elected Dr. Nicole Fenton as President-Elect for 2018-2020. Two years from now, she will be our President, and I cannot think of a better and more qualified person to fill this role. Thank you Nicole and congratulations!

In an age where "interdisciplinary" is often described as "cutting edge" and the "ideal" of modern science, I would just like to say as President of the Association that represents the original interdisciplinary science, "Go botany!"

Julian Starr
University of Ottawa

Announcements

Ernie Small Invested into the Order of Canada

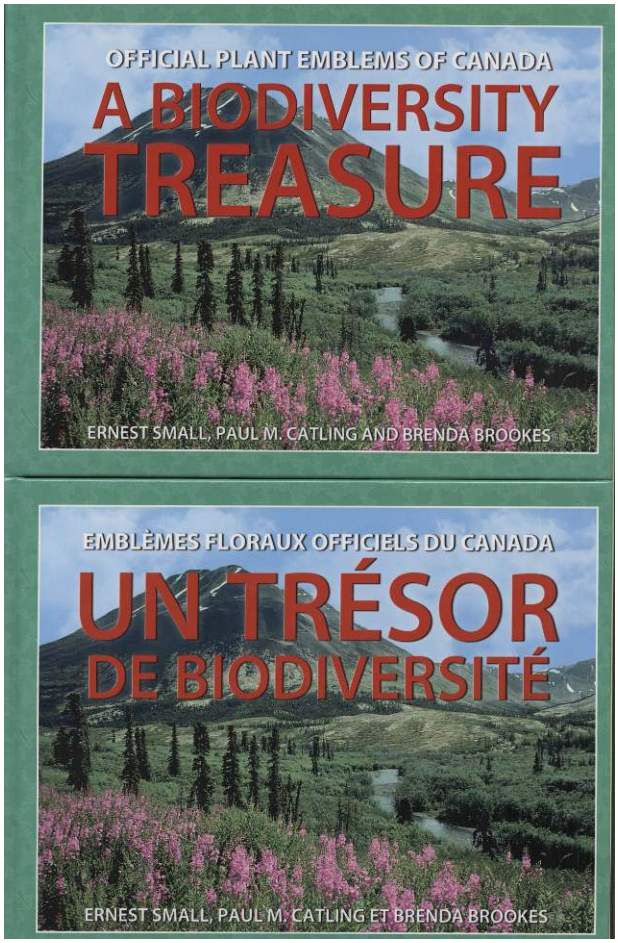


Her Excellency the Right Honourable Julie Payette, Governor General of Canada, investing Dr. Ernest Small into the Order of Canada on Thursday, September 6, 2018 at Rideau Hall.

Ernest Small has helped grow the field of botanical science in Canada. Principal scientist with Agriculture and Agri-Food Canada, he specializes in researching the evolution and classification of economically important plants, particularly food, forage and medicinal species. Highly sought after as an expert advisor, he is best known for his work on hemp and medicinal marijuana. A prolific communicator, he has shared knowledge with the general public and scientific audiences alike through his highly readable books and research papers on agricultural crops and plant biodiversity.

Ernest Small a contribué à l'avancement de la science botanique au Canada. Scientifique principal à Agriculture et Agroalimentaire Canada, il se spécialise dans la recherche sur l'évolution et la classification des plantes économiquement importantes, particulièrement des espèces à vocation alimentaire, fourragère et médicinale. Très sollicité comme expert-conseil, il est surtout connu pour son travail sur le chanvre et la marijuana thérapeutique. Communicateur prolifique, il a transmis son savoir au grand public tout comme à la communauté scientifique dans ses livres et rapports de recherche très limpides sur les récoltes agricoles et la biodiversité végétale.

Plant Emblems of Canada Book Free to Members



A Biodiversity Treasure

To members of CBA/ABC: If you would like a free copy of Ernie Small's: "Official Plant Emblems of Canada: a Biodiversity Treasure" (English version, 428 pages), please request one by e-mail, with full mailing address to: ernie.small@canada.ca.

Aux membres de l'ABC/CBA: Si vous désirez recevoir un exemplaire gratuity de: Emblèmes Floraux du Canada: un Trésor de Biodiversité (Version française, 430 pages), soumettez votre demande par courriel et indiquez votre adresse postale complète à: ernie.small@canada.ca.

New Co-Chairs for the Teaching Section

Dear fellow members of the CBA/chère collègues du ABC,

It is our pleasure to co-chair the Teaching Section of the CBA for the upcoming year. We hope to have many conversations with you about the strategies for good teaching and the impacts of good learning on topics related to plant science!

Teaching and learning are integral to any scientific study and are also crucial to being able to conduct effective outreach to the public in our attempts to broaden the appreciation for plant biology and plant chemistry in Canada.

A topic of interest to us is plant blindness, which has been defined by the American Botanical Society as the "inability to see or recognize plants in one's own environment, or one's own life". This blindness may lead to some of the attitudes we have seen in our classrooms, when students are unaware of the value and importance of plant biology, and the roles plants play in their own lives, and in the ecosystem. We want to find ways in our own courses to combat plant blindness and support students to learn about how amazing and integral plants are to all of us. In addition, we all share a motivation to bring this appreciation of plants to the Canadian public as well.

Over the course of the upcoming year, we wish to hear from you on any topic related to the communication and teaching plant science, whether to improve the learning experience of science students at any level, or to engage members of the public through outreach activities in media, online, museums or other venues.

Looking forward to a great year together!

Adam & Martha



Adam Oliver Brown

About Dr. Adam Oliver Brown

Dr. Brown has a Ph.D. in pollination ecology from Laval University and now holds a cross-appointed professorship between the faculties of Science (Biology) and Education at the University of Ottawa. Adam focusses his academic activities on curriculum, pedagogy and research in science education and is also considerably active in outreach through television shows, documentaries, news media and online blogs and vlogs.



Martha Mullally

About Dr. Martha Mullally

Dr. Mullally has a Ph.D. in plant secondary metabolites, and completed a post-doctoral fellowship in science education at the Carl Wieman Science Education Initiative at the University of British Columbia. Martha holds an instructor position in the Department of Biology and Institute of Biochemistry at Carleton University, and is the coordinator of the Biotechnology Program there. Martha's academic activities are focused on developing and disseminating teaching approaches that improve undergraduate biology teaching and learning.

Cyanobacteria Co-Occurrence Workshop

Dear CBA members,

Nicole Fenton and I are planning a workshop to analyze, from existing data sources, the co-occurrence patterns among species likely to host cyanobacteria in their tissue (i.e., cyanolichens, bryophytes, vascular plants). The goal is for this dataset to then guide molecular surveys of cyanobacteria in host tissues, to test the hypothesis according to which host species pairs that co-occur more frequently than expected by chance in the field also share more cyanobacterial partners, which could drive indirect facilitative interactions among hosts (i.e., whereby a given host could contribute to the local pool of beneficial cyanobacterial partners for another host).

The CBA has generously contributed to this initiative, which would take place as a workshop based on videoconferences among members across Canada and also in the US. We are seeking motivated candidates to get a final list of participants. Thus, ALL interested candidates (including the ones who already contacted us several months ago when we first mentioned this workshop) are invited to send an email to pierre-luc.chagnon@umontreal.ca mentioning their affiliation (in order to plan few strategic locations in Canada where participants could gather) and the way they intend in contributing to the workshop (i.e., data mining and formatting, statistical analyses, etc.).

We really look forward to getting this project going!

Best regards,

Pierre-Luc Chagnon
Université de Montréal

Chers membres de l'ABC,

Nicole Fenton et moi-même organisons un workshop visant à analyser, à partir de données existantes, les patrons de co-occurrences entre espèces potentiellement hôtes de cyanobactéries dans leurs tissus (i.e., cyanolichens, bryophytes, plantes vasculaires). Le but de ce projet est de mieux guider par la suite les efforts de caractérisation moléculaire des associations hôtes-cyanobactéries. Plus spécifiquement, nous cherchons à tester l'hypothèse selon laquelle les espèces qui co-occurrent plus souvent qu'attendu par hasard partagent aussi plus de partenaires cyanobactériens. Ceci pourrait médier des interactions indirectes entre ces espèces hôtes, où certaines hôtes pourraient contribuer au pool local de cyanobactéries, facilitant ainsi l'établissement d'autres espèces dépendantes de ces mêmes cyanobactéries.

L'ABC a généreusement contribué à cette initiative, qui prendrait la forme d'un workshop en mode vidéo-conférences, impliquant des membres de l'ensemble du Canada et aussi des États-Unis. Nous sommes maintenant à la recherche de chercheurs motivés, afin d'établir rapidement notre liste finale de participants. Nous invitons donc TOUTES les personnes intéressées (incluant celles qui ont déjà noté leur intérêt il y a quelques mois) à envoyer un courriel à pierre-luc.chagnon@umontreal.ca mentionnant leur affiliation (pour organiser des localisations géographiques stratégiques où certains membres pourraient se réunir pour les vidéoconférences) et la façon dont ils comptent contribuer au workshop (i.e., importation et formatage des données, analyses statistiques, etc.).

Nous avons bien hâte de conduire ce workshop avec vous!

Mes meilleures salutations,

Pierre-Luc Chagnon
Université de Montréal



Dimpled Lungwort, *Lobaria anthraspis* ©Troy McMullin

CBA-ABC Special Project Fund Inaugural Award Update

Established in 2017, the CBA-ABC Special Project Fund is intended to support botanists, promote botanical research and education, and to raise the profile of the CBA-ABC.

The inaugural award recipients, Denis Barabé (Université de Montréal / Institut de recherche en biologie végétale) and Christian Lacroix (University of Prince Edward Island) were announced at the 2017 annual meeting of the association which took place at Wilfrid Laurier University in Waterloo. They used their funding to secure the services of a graphic artist to produce illustrations and figures for their forthcoming book entitled "*Phyllotactic Patterns: a multidisciplinary approach*". A full draft of the book was submitted to Publisher World Scientific in May 2018 and is currently undergoing review. The authors are thankful to CBA-ABC for the support and hope to showcase their book at the Guelph meeting in 2019. The following is a short synopsis of the book and a preview of some of the figures that will be featured in the text.

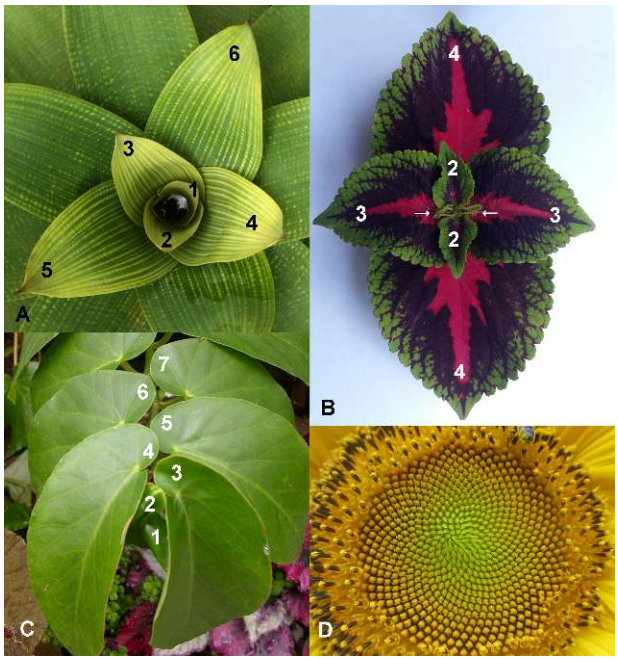
The term phyllotaxis, coined by German botanist K. Fr. Schimper in the 19th century, comes from the greek $\delta\upsilon\lambda\lambda o\upsilon$ (phullon) or leaf, and $\tau\alpha\xi\iota\sigma$ (taxis) or arrangement and refers to the disposition of leaves around a stem. Phyllotaxis was defined more comprehensively by Jean (1994) as the description, characterization, and generation of patterns made by similar elements (e.g. leaves, floral parts), and the study of growth processes leading to their formation. Initially, phyllotactic analyses were conducted mainly on mature plants, but gradually expanded to include the earliest stages of development of organs (leaves, flowers) that develop at the periphery of the shoot apical meristem (SAM), the site where specific phyllotactic patterns are established.

Phyllotaxis is certainly one of the most exciting biological phenomena to study because it is at the interface of many disciplines such as molecular biology, mathematics, physics, biochemistry, and botany. Given its importance in botany and theoretical biology, research in phyllotaxis has always oscillated between experimental and theoretical studies, two complementary approaches used historically to understand phyllotactic patterns.

The main goals of the book are: (1) to provide a survey of recent developments in the study of phyllotaxis, (2) to highlight significant advances within the discipline, and (3) to provide a comprehensive summary and some insight into the discipline for novice as well as experienced students of phyllotaxis. The book is divided into six chapters:

Chapter 1, entitled Phyllotactic Parameters, outlines a comprehensive list of parameters (mainly geometrical) that have been developed and used to describe and analyze phyllotaxis. These parameters, which are essential for the description and understanding of phyllotaxis, are discussed in the context of current models.

Chapter 2, entitled Dynamical Models covers theoretical models of phyllotaxis that are based on energetic principles as well as iterative processes and can generate regular phyllotactic patterns. For example, the dynamical models of Douady and Couder as well as Levitov will be presented and discussed as new foundational models on which other



Examples of phyllotactic patterns

approaches have been based.

Chapter 3, entitled Statistical and Probabilistic Approaches, explores the probabilistic features of models of phyllotaxis and their predictive value. This section will focus on the manifestation of irregular patterns that appear in several plants, including mutants, as well as statistical methods used to analyse the degree of order of these patterns.

Chapter 4, entitled Role of Genes in the Framework of Biochemical / Molecular Models, deals with recent molecular discoveries that attempt to explain the processes involved in pattern initiation, development, and establishment at the level of the SAM. We focus on theoretical models based on molecular data involving auxin and it's feedback mechanisms as well as genes implicated in phyllotactic patterning.

Chapter 5, entitled Biophysical Aspects of Phyllotaxis, covers the biophysical processes involved in the establishment of phyllotactic patterns. Recently developed biomechanical models in particular are described in detail. These models are based on physical laws linked to compressive and tensive forces on a metallic plate, and highlight the analogy between the appearance of primordia on a SAM and buckling on a plate. Joint models involving both biomechanical and biochemical processes are also presented.

Chapter 6, entitled Concluding Remarks: Critical Analysis and Critique of the State of the Discipline, summarizes the inter-relationships between various aspects and approaches discussed in the previous chapters. It also highlights problems that remain to be addressed in this particular field of research with regard to the wide variety of morphologies of the SAM and associated lateral organs that haven't been explored.

2018 Science Atlantic Botany Awards

Oral Presentation: Allison Ford, Memorial University



Allison Ford

Title: The ecology and effects of the bark beetle species, *Dryocoetes krivolutzkajae*, on roseroot populations in Newfoundland, Canada

Supervisor: Luise Hermanutz

Abstract: Plant pathogens and insect pests can have detrimental effects on plant populations by impacting growth, reproduction, and survival. *Rhodiola rosea* L. (Crassulaceae), commonly known as roseroot, is a culturally-important medicinal plant that grows in coastal ecosystems across the Northern Hemisphere. Since roseroot is endangered in parts of its range, studying the effects of pathogens and pests on this species is important for its conservation. *Dryocoetes krivolutzkajae* Mandelshtam (Coleoptera: Circulionidae: Scolytinae) is a bark beetle that infests the rhizomes of roseroot, forming galleries and causing belowground plant tissue loss. Prior to this study, *D. krivolutzkajae* had been found in roseroot in Labrador, but was unknown to the island of Newfoundland. The objective of this study was to determine the presence of *D. krivolutzkajae* on the island of Newfoundland, to gain insight into the ecology of this insect herbivore, and understand its effect on the growth and survival of roseroot. Sampling plants from coastal areas of Newfoundland, I tested whether *D. krivolutzkajae* exhibited an affinity for roseroot plants of different biomass, number of shoots, and sex, as well as plants growing in different sites, distances from the shore, and substrates. Substrate types consisted of organic soil, bedrock, soil over bedrock, limestone gravel, beach soil, and gravel. *D. krivolutzkajae* was found to be present in Newfoundland, and no apparent affinities to substrate, number of shoots, distance to shore, or plant sex were observed. Presence of beetle galleries and higher amounts of rhizome damage were associated with roseroot plants having significantly larger biomass.

Poster: Emma McDermott, University of PEI



Emma McDermott

Title: Effects of PEI Berries blueberry purée on renal oxidative stress

Supervisor: Marva Sweeney-Nixon

Abstract: Cardiovascular diseases are the leading worldwide cause of death and, along with many other chronic diseases, have been associated with high levels of oxidative stress. Blueberries have been shown to have powerful antioxidant properties, a characteristic crucial for neutralizing reactive oxygen species and reducing the overall level of oxidative stress. PEI Berries Ltd. has patented a new blueberry processing method, called hydrothermodynamic technology, which they claim will allow their purée to maintain more of the blueberries' natural antioxidant properties compared to other processing methods. The objective of my research is to evaluate the bioefficacy of the PEI Berries product. 28 Wistar-Kyoto rats were divided into four feeding groups: a control diet, a control diet with blueberry purée, a high fat diet to induce oxidative stress, and a high fat diet with blueberry purée. It was hypothesized that the blueberry purée would cause a significant decrease in renal oxidative stress, shown by increased levels of antioxidants and related enzymes. Spectrophotometric assays were used to measure glutathione levels and the activity of three antioxidant enzymes. Compared to the control group, the rats fed a control diet with blueberries had a 46.8% increase in superoxide dismutase activity, but this was not significantly significant (Two-Sample T-Test, $p=0.278$, $n=7$). Similarly, there was a 24.9% and 28.1% increase in glutathione reductase and catalase activities, but these were not statistically significant (Two- Sample T-Test, $p=0.118$ and 0.246, $n=7$). My study has not yet provided evidence that the product is effective at increasing endogenous antioxidants in rat kidneys.

2018 CBA Awards

Student Presentations

Lionel Cinq-Mars Award for Best Talk



CBA President Art Davis with Steven Richard Anderson

Winner: Steven Richard Anderson, M.Sc., Department of Biology, University of Manitoba, Winnipeg, Manitoba. "Changes in the floral community contribute to increased fruiting success in southern populations of a rewardless orchid, *Cypripedium candidum*", by S.R. Anderson, B. Ford, and A. Worley

Honourable Mention: Georgia Lee Denbigh, M.Sc. candidate, Department of Biology, Dalhousie University, Halifax, Nova Scotia. "Investigating the origin of the induction signal(s) involved in developmentally regulated programmed cell death in the lace plant (*Aponogeton madagascariensis*)" by G.L. Denbigh, A.N. Dauphinee, M.S. Fraser, C.R. Lacroix, and A. Gunawardena.

Judges: Nadia Cavallin, Royal Botanical Gardens, Burlington, ON; Christine Petersen, Thompson Rivers University, Kamloops, BC; Julian Starr, University of Ottawa, ON.

Iain and Sylvia Taylor Poster Award



CBA President Art Davis with Magdalena Olszewski

Winner: Ms. Magdalena Olszewski, M.Sc. candidate, Department of Biology, Wilfrid Laurier University, Waterloo, Ontario. "Diversity and evolution of seeds in *Cuscuta* (dodders, Convolvulaceae): Morphology and structure" by M. Olszewski, H. Adel El Miari, B. Behdarvandi, and M. Costea.

Judges: Art Davis, University of Saskatchewan, Saskatoon, SK; Christine Petersen, Thompson Rivers University, Kamloops, BC; Tyler Smith, AAFC, Ottawa, ON.

Student Travel Awards

John Macoun Graduate Travel Bursaries



CBA President Art Davis with Dylan Johnston, Rande Kanne and Étienne Léveillé-Bourret

- Mr. Dylan Johnston, M.Sc. candidate, University of Saskatchewan
- Ms. Rande Kanne, M.Sc. candidate, University of Victoria
- Dr. Étienne Léveillé-Bourret, University of Ottawa

Keith Winterhalder Undergraduate Travel Award



CBA President with Georgia Lee Denbigh

Ms. Georgia Lee Denbigh, M.Sc. candidate, Dalhousie University

Student Publication Awards

J. Stan Rowe Award for Ecology



Melina with her Supervisor Line Rochefort

Ms. Mélina Guêné-Nanchen, Ph.D. candidate, Centre for Northern Studies, Université Laval, Québec City, Québec.

M. Guêné-Nanchen, R. Pouliot, S. Hugron, and L. Rochefort. 2017/18. Effect of repeated mowing to reduce graminoid plant cover on the moss carpet at a sphagnum farm in North America. Mires and Peat 20(6): 1-12.

Selection Committee: André Arsenault, Atlantic Forestry Centre; Nicole Fenton, Université du Québec en Abitibi-Temiscamingue; John Markham, University of Manitoba.

Luella K. Weresub Award for Mycology



Sydney Morgan with her Supervisor Daniel Durall

Ms. Sydney C. Morgan, Ph.D. candidate, Department of Biology, University of British Columbia, Kelowna, British Columbia.

S.C. Morgan, C.M. Scholl, N.L. Benson, M.L. Stone, and D.M. Durall. 2017. Sulphur oxide addition at crush alters *Saccharomyces cerevisiae* strain composition in spontaneous fermentations at two Canadian wineries. International Journal of Food Microbiology 224: 96-102.

Selection Committee: Shannon Berch, Ministry of Envi-

ronment, BC; Jonathan Cale, University of Alberta; Sarah Hambleton, AAFC, Ottawa; Hugues Massicotte, University of Northern British Columbia; Greg Thorn, Western University, ON.

Porsild-Consaul Award for Systematics

Dr. Étienne Léveillé-Bourret, Department of Biology, University of Ottawa, Ottawa, Ontario.

É. Léveillé-Bourret, J.R. Starr, and B.A. Ford. 2018. Why are there so many sedges? Sumatroscirpeae, a missing piece in the evolutionary puzzle of the giant genus *Carex* (Cyperaceae). Molecular Phylogenetics and Evolution 119: 93-104.

Selection Committee: Tim Dickinson, University of Toronto / Royal Ontario Museum; Jeff Saarela, Canadian Museum of Nature; Jana Vamosi, University of Calgary.

CBA-ABC 2018 Special Project Fund

Dr. Pierre-Luc Chagnon, Université de Montréal / IRBV, Montréal, Québec

Dr. Nicole Fenton, Université du Québec en Abitibi-Témiscamingue, Québec

Title: Are the friends of my friends also my friends? Synthesizing co-occurrence data on bryophytes, lichens and vascular plants to identify priorities in host- cyanobacteria research. See page 23 for details.

Selection Committee: Geraldine Allen, University of Victoria, Victoria, BC; Art Davis, University of Saskatchewan, Saskatoon, SK; Moira Galway, St. Francis Xavier University, Antigonish, NS; Julian Starr, University of Ottawa, Ottawa, ON.

Jean Faubert, Recipient of the CBA George Lawson Medal

Outstanding Contribution to Botany



Jean Faubert (center), with Robert Gauthier (curator of the Louis-Marie Herbarium at Laval) and Line Rochefort (Plant Sciences Professor at Laval)

Jean Faubert of Saint-Valérien-de-Rimouski, Québec, is this year's recipient of the Lawson Medal in recognition of his monumental contribution entitled *La Flore des Bryophytes du Québec-Labrador*. Exceeding 1,200 pages and written in French, this outstanding treatise with three volumes describing over 900 Canadian taxa was published in consecutive years, devoted to liverworts and hornworts (2012), Mosses Part I (2013) and Mosses Part II (2014). On the whole, it represents the defining scientific milestone of Jean's career. Being richly presented with keys, descriptions, line drawings and photographs, plus distribution maps, it is regarded as the most comprehensive work on Canadian bryophytes to date. This botanical exposition has been acquired not only by botanists in Canada and the United States of America, but in a dozen other countries as well.

This work represents a ground-breaking achievement for Jean, who became a self-taught specialist of bryophytes without any formal affiliation with a university or other research institution. Trained as a marine-vessel navigator at the Institut maritime du Québec in 1976, Jean later earned a certificate in administration from the Université du Québec à Rimouski in 1988, followed by a B.Sc. degree in Biology from the same institution in 1991. He was employed as a botanical consultant, initially interested particularly in aquatic vascular plants but then specializing in the bryology of wetlands. Located far from major herbaria, he familiarized himself with botany of the Rimouski region and amassed a private herbarium of more than 10,500 specimens.

Among his other activities that number over 60 peer-reviewed publications and reports centering on bryology, Jean in 2007 published his *Catalogue des bryophytes du Québec et du Labrador*, followed 3 and 4 years later with significant, multi-authored publications about new, rare and remarkable bryophytes occurring in this same territory. Together with his bryophyte colleagues, Jean annually organized for over 12 years a series of walks and short-courses on bryophytes (introductory and advanced levels) attended by hundreds of college and university students, other biol-

ogists, and interested amateurs. He also founded the *Société québecoise de Bryologie* and in 2011, initiated an online scientific journal, *Carnets de Bryologie*, an outlet that has broadly transmitted the latest findings about bryophytes of Québec and Labrador. Moreover, Jean developed a globally significant website devoted to biodiversity, by production of a publicly accessible data bank of images (BRYOQUEL) pertaining to the bryophytes from boreal to Arctic in this vast peninsular region of Canada.

Among several recognitions for his distinguished research as a botanist and bryologist, Jean received Le Prix Georges-Préfontaine in 2012 from l'Association des Biologistes du Québec, and the Henry Allan Gleason Award in 2014 from the New York Botanical Garden. On June 11 2016, Jean was honoured with the distinction of *Doctorat Honoris Causa* from l'Université Laval.

This Lawson Medal nomination received from Prof. Line Rochefort was comprehensively supported further by 11 botanists who are professors and curators from Alberta, Ontario, and Québec. Among their tributes, they described this work as "a truly outstanding contribution to Canadian botany", and "as one that opens up the discipline to students of bryology at all levels of experience." *La Flore des Bryophytes du Québec-Labrador* "fills an enormous gap in the documentation of the flora of Canada" and represents "a remarkable achievement synthesizing the precious knowledge of an expert that has dedicated his life to the discovery of bryophytes."

It was a memorable telephone conversation with Jean when I informed him in May, 2018, about he being the 2018 recipient of the Lawson Medal. Jean is a gracious, humble individual with many talents outside bryology, including the mastery of six different types of saxophones which he played mostly with big-band jazz orchestras. Owing to his battle with a progressing terminal illness, it became clear that neither Jean nor his wife Cécile would be able to travel to the Botany 2018 conference in Rochester, Minnesota, U.S.A. in July. Accordingly, the CBA-ABC executive voted unanimously to break, in this instance, with the tradition of presenting the Lawson Medal at its annual summer meeting. I thank Prof. Emeritus Iain Taylor of U.B.C., Vancouver, BC, for expediting the engraving process for the medal and shipping it to l'Université Laval.

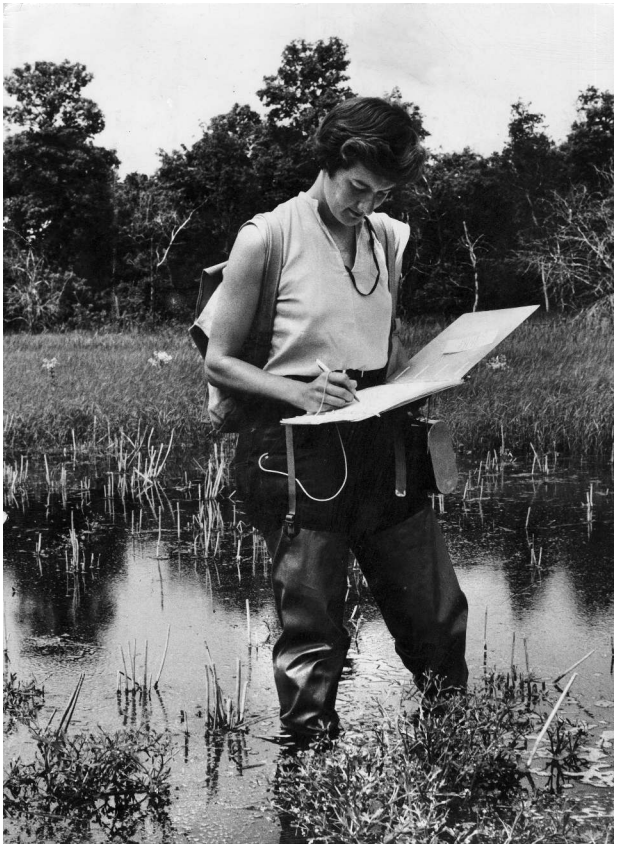
On behalf of the CBA-ABC, I also thank Prof. Line Rochefort and Prof. Robert Gauthier (former curator of l'Herbier Louis-Marie) of l'Université Laval who drove to Saint-Valérien-de-Rimouski, Québec on June 27, 2018. In a small ceremony, Jean was formally presented with the Lawson Medal at his home. We are also grateful to Cécile Faubert for the accompanying photograph of this event.

Respectfully submitted,

Art Davis, CBA Past-President

Jennifer Shay, In Memoriam

Isobel Waters



Jennifer Shay, 1930–2018

The community of Canadian botanists and ecologists has lost one of its most esteemed and valued members. Jennifer Shay, Professor Emerita at the University of Manitoba and long-time member and supporter of the Canadian Botanical Association, has died in Kingston-upon-Hull in her native Yorkshire at the age of 88 from complications of Parkinson's disease.

A lover of nature from early childhood, Jennifer received her undergraduate training at the University of London, graduating with a biology degree in 1952. Steeped in the time-honoured British tradition of field-based studies in the manner of Arthur Tansley, Jennifer began her scientific career as the first female staff member at the Flatford Mill Field Centre in Suffolk. In 1957, her life-long spirit of adventure drew her across the pond, when she accepted a position as a research assistant at the University of Manitoba in Winnipeg. Soon thereafter she embarked upon her graduate education, ultimately earning a PhD for her groundbreaking research in freshwater wetland ecology. Immediately after graduation, she began a distinguished career as teacher and researcher that spanned some 35 years in both the Departments of Botany and Landscape Architecture at the University of Manitoba.

Jennifer inspired both undergraduate and graduate students alike with her boundless enthusiasm and broad-based knowledge. As one of the few female academics working in the mid 20th century, she served as exemplar and mentor for generations of students. She held her students to a high academic standard, while at the same time exercising a deep compassion for and interest in them as individuals. Her challenging yet cheerful attitude rescued many a floundering student. Working with Jennifer was demanding, but it was also fun. As one of many examples of her enthusiastic spirit, at the many entertainments that she hosted for her large retinue of graduate students, a sumptuous meal would often be preceded by a botanical scavenger hunt.

Although Jennifer recognized the importance of specialized knowledge, she was a champion for a generalist approach, particularly in the field of ecology where knowledge of a range of related subjects is essential to fostering an integrated understanding. Her own academic background exemplified this approach, given that her undergraduate training was focused more on zoology than botany. The fruits of her generalist approach are manifest in the unusually wide range of subjects in which she and her students published. In addition to many papers in her specialization of freshwater ecology, Jennifer published in fields as diverse as fire ecology, invasive species, biological controls, prairie conservation, restoration ecology, and paleobotany.

Her CBA colleagues will be well aware of her tireless work for ecosystem and species conservation in Canada, work for which she was recognized by being named an Officer of the Order of Canada in 2000 and a recipient of the Queen Elizabeth II Diamond Jubilee Medal in 2012. In 1973, she was instrumental in the founding of Manitoba's ecological reserves program, and served on the Ecological Reserves Advisory Committee from its inception until 1993. Less well-known is the range of her paleobotanical studies, which encompassed (in collaboration with her husband, anthropologist C. Thomas Shay) ground-breaking contributions to ethnobotany and paleobotany in Bronze Age Greece. Her impressive and influential contributions to botanical and ecological research has been recently celebrated by the decision of the University of Ottawa, in collaboration with the International Network of Women Engineers and Scientists – Education and Research Institute (INWES-ERI), to include Jennifer in their Canadian Archive of Women in STEM (Science, Technology, Engineering and Mathematics) initiative. Apart from her own publications, her long-term role as curator of the University of Manitoba Herbarium (WIN) made a significant contribution to the advancement of botanical taxonomy in Canada.

Throughout her stellar career, be it as a teacher or researcher, Jennifer's passionate commitment to the importance of field work only deepened. Upon her arrival at the University of Manitoba in 1957, she was dismayed to discover that the university lacked a biological field station.

Convinced that field experience was integral to the training of any biologist, Jennifer spear-headed the search for an appropriate facility. Almost single-handedly, she was responsible for the establishment of the Delta Marsh Field Station at the southern end of Lake Manitoba, where an extensive network of freshwater wetlands and upland prairie and parkland sites furnished a plethora of teaching and research opportunities for students and scientists from across Canada and around the world. Jennifer served as the Field Station's director for 20 years until 1986. Unfortunately, extensive flooding on Lake Manitoba contributed to the field station's closure in 2011, much to the detriment of field research in western Canada.

Jennifer's involvement in environmental issues and outdoor education extended far beyond the academic arena. She was a founding member of the Manitoba Museum, served on the board of the Fort Whyte Nature Centre, was instrumental in the establishment of the Living Prairie Museum, and was an active member the Manitoba Naturalists Society throughout her time in Manitoba. Nor did she shy away from controversial issues. In the 1970s, she and other Manitoba scientists protested the Churchill River diversion and flooding of South Indian Lake by Manitoba Hydro. Taking part in legal proceedings, she eloquently made the case for the environmental damage that such actions would inevitably cause.

As well as motivating her public life as a scientist, Jennifer's love of and appreciation for nature was pivotal in her personal life. She and her husband Tom purchased a home situated in river-bottom forest along the Red River in St. Adophe Manitoba. During the devastating floods of 1996 and 1997, she and Tom undertook a massive effort (aided by a contingent of friends, students, and colleagues) to sandbag their home against the rising waters. After the floodwaters retreated, the Shays turned over the property to the Province of Manitoba. The seven-hectare site, which is home to a rich diversity of plant and animal life, has since been designated as the Jennifer and Tom Shay Ecological Reserve, as part of the province's Protected Area Initiative – a program that Jennifer was instrumental in establishing.

Iain Taylor, long-time president of the Canadian Botanical Association, speaks for many of us in the Canadian botanical community with his memories of Jennifer: "My first impression was simple - an outstanding field botanist who brought her teaching skills to field trips, society lectures and the administration of the CBA. She was a person to be remembered in two great ways. She was a scientist through and through and she was a person of impeccable integrity…The naming of an ecological reserve for her was… a great tribute for her tireless work to get the first national park [Riding Mountain] established on the Prairies."

The Canadian Botanical Association extends its deepest sympathies to her husband Tom and her many family members and friends in Great Britain and Canada.



Lyn Baldwin Wins Prestigious Desire2Learn Teaching Award

Nancy J. Flood[1]

Many CBA members may recognize Lyn Baldwin from her participation in various association events, including an invited lecture for the Teaching Section at the 2011 Plant Canada meeting in Halifax, NS. ("Teaching Botany with a dash of SOTL") and co-curation of an art exhibit entitled "Art and Science: Drawing and Botany," at the 2013 annual CBA/ABC conference in Kamloops, BC. Others may recognize her name from the CBA bulletin article "Does the science of botany need art? Does art need the science of Botany?" co-written by Lyn and visual artist colleague Ila Crawford in 2012. This is just a small sampling of Lyn's many contributions to the fields of botany, art, creative non-fiction writing, and effective post-secondary teaching — and how all are intertwined. This body of work, and her evident passion for connecting students with nature, was rewarded in 2018 with a D2L (Desire2Learn) Innovation Award in Teaching and Learning.

D2L awards are a big deal! Officially announced at the annual conference of the Society for Teaching and Learning in Higher Education (STLHE), only five recipients are selected annually. According to Denise Stockley, president of STLHE, "each year we have an amazing group of individuals who are nominated," making the task of the adjudication committee difficult. She noted that 2018 was no different, and commented that this year's winners include, "five talented individuals who provide a glimpse into their classrooms, showcasing their innovative practices, and giving all of us something to aspire to in our own teaching."

Lyn's teaching innovations can be grouped into four main categories, the first of which is the contributions that art can make to learning botany. Of this, Lyn says, "I didn't set out to transgress my discipline's boundaries. I was just trying to solve a teaching and learning problem. In botany, before the internal anatomy of a plant can be understood, it has to be observed. Observation, however, is more difficult than it sounds. Soon after I began teaching botany, I realized that although students might *look* at a stem section of a fern, they lacked the tools to *see*, to observe closely enough to detect patterns. Artists have long understood the way drawing can transform simple *looking* into *seeing*." With this realization, she incorporated an "Illustrated Learning Journal" into her botany course. To help overcome the reticence of some students, she asked a visual arts professor into her class to provide drawing tutorials, and then set about improving her own illustration skills so that she could provide the tutorials herself. She now uses formal illustration assignments in a variety of the botany and ecology courses she teaches, having ascertained that they *do* benefit students; in one survey, for example, 95% of students indicated that the use of learning journals had enhanced their learning. In a paper summarizing these findings, she and her co-author wrote, "Drawing, and the creation of illustrated learning journals, provided an opportunity for the students to model the active observation and inquiry that is a critical part of "doing" science" (Baldwin and Crawford 2010).



Lyn Baldwin ©Marc Jones

The second category of innovation in Lyn's teaching relates to her emphasis on the value of place-based education. Teaching that pays attention to the lived experience of students, including the places where they live, is not a new idea, but it has most commonly been used in elementary and secondary schools, where classes are small. Traditionally, in fact, post-secondary institutions have shunned the idea that the actual places where learning occurs are important, emphasizing instead 'eternal truths' and placeless theories. Bucking this trend, Lyn has devised innovative assignments that help students better understand abstract, theoretical concepts by relating them to their own lives and the locations in which they reside — and she had done so even in medium to large classes. She also initiated a multi-disciplinary community of practice (COP) at Thompson Rivers University, to look at how place could be better integrated into teaching and other work on campus. One of the many outcomes of the work of this COP was a monograph, recently published by STLHE, which "provide(s) Canadian post-secondary educators with a suite of tools that could serve as the scaffolding on which to build their own place-based teaching and learning practices" (Baldwin et al. 2017, p. 17.).

Using creative writing to learn biology is the third area in which Lyn has been innovative. Her goal here is to make students understand an aspect of science well enough to be able to describe it to a non-scientist, as well as to im-

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prove their basic read and writing skills. She starts with low-stakes practice assignments, in which students write and share their responses to readings — pieces written by authors skilled in just what she is trying to teach. Students then workshop their writing in peer groups, learning another skill as well — that of effective critique. For this too, Lyn sought out the help of a colleague on the other "side" of campus (a writer and teacher-of-writing), and developed her own competency by joining a creative nonfiction writing group, and attending conferences and a writing workshop in that genre at the Banff Centre. Honing her skills, she now publishes creative nonfiction pieces about the things that inspire her: teaching and doing research, home and place, plants and people — typically communicating science to non-scientists in the process. The results of student surveys have again validated this teaching tool. As one wrote, "I am so proud of the stories I wrote. I never knew I had it in me to write [this] way…I really felt like I was giving a piece of me with each word…and it felt amazing." Multiple students from the various courses in which she uses this technique have read their essays at local or international conferences and/or published them in various journals (e.g., Ellis 2017).

The fourth category of innovation Lyn describes as using "field journals as a path to care." Lyn lives and breathes journaling; her journals attend meetings and seminars, go on every hike, and are often at hand while she is working or relaxing. Making sketches and writing notes makes her observe and listen closely — attend to what is going on, ask questions of the world around her, compare current experiences to past ones and form hypotheses. In essence, they help her see, connect to and care more about where she is, and who or what she is with. And she teaches her students — in various courses — to use journals the same way, giving them tools and helping them cultivate practices that allow them to experience the natural world deeply. "Each time we open our journal," Lyn says, "we become active creators of our own stories about place, and in doing so, we reclaim our own knowledge about the world." She views "field journaling — both [her] own, and that of her students — as an immersive practice in place and community that facilitates experiences rich in inquiry and imaging" and makes us care more about the more-than-human world. Her students affirm that this is true, with after-course comments like "The more attention you give, the more complex something seems to become…As someone with no aptitude for art... [it] was hard work. If I had a good drawing, I got attached to the object behind," or, "I feel a greater connection to the natural world. It's also made me more empathetic…towards other people too, I'm not sure why….Perhaps because I search more for the underlying reasons of things now."

These four categories are, of course, intertwined—both for Lyn and her studenst. As the biographical sketch that was part of the D2L nomination states, "As an educator, Lyn's greatest delight occurs when students can use the tools of both art and science to connect with the transformative power of place." Richly deserved, the D2L award is an affirmation of Lyn's skill and dedication to teaching. No student of Lyn's will ever suffer from the proverbial affliction of 'plant blindness'!

Want to Learn More?

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Top Canadian Ornamental Plants. 20. Gladiolus

Ernest Small[1,2]

Gladiolus is one of the most beautiful and popular of decorative plants. It is honoured by numerous horticultural societies, flower shows and amateurs dedicated to its spectacular blooms, and many paintings by the world's greatest artists. As a cut flower employed in bouquets and floral arrangements, it is among the leading commercial ornamentals in international trade. Gladiolus is also admired as a majestic garden and landscape plant, although insufficiently hardy to overwinter outdoors in most of Canada. Several decades ago gladiolus became so common that it seemed old-fashioned, and demand diminished. However, the dazzling floral displays of recent cultivars have resurrected the popularity of this long-admired, elegant classic.

Scientific names: The genus name *Gladiolus* is the Latin diminutive of *gladius*, meaning sword, referring to the shape of the leaves. Most modern cultivars are hybrids, sometimes identified as *G.* ×*hybridus* Hort., *G.* ×*grandiflorus* Hort., *G.* ×*hortulanus* L.H. Bailey, *G. gandavensis* L. van Houtte, and *G. lemoinei* Baker. [The multiplication sign × (often a space is inserted between it and the following species epithet to emphasize that it is not part of the epithet) is a convention indicating that the taxon is of hybrid origin; in non-technical literature the × is frequently omitted. "Hort." is short for the Latin *hortulanorum*, of gardeners (although widely alleged to be from *hortorum*, of gardens), and indicates that the name has been used significantly in the horticultural literature (usually prior to the 20th century) but never formally published (i.e. it does not have standing in Latin botanical nomenclature). Hort. is frequently (and advisedly) spelled with a lower case h to emphasize that it is not a genuine authority (author) of a valid scientific name. "Hort" with a capital H and not followed by a period refers to the botanist Fenton John Anthony Hort, 1828–1892, who spent most of his career as a theologian.]

English names: Gladiolus (the plural is usually "gladioli," or less formally "glads;" "gladioluses" is correct as a plural but is quite rare; "gladiola" is also rare and is encountered both as singular and plural), garden gladiolus, sword lily. In human anatomy, gladiolus refers to the middle of the three parts of the sternum.

French name: glaïeul.



Figure 1: Photo (public domain) of mixed gladiolus cultivars available in the mid-20th century. Source: Germain Seed and Plant Company (California) 1940s catalogue, maintained by U.S. Department of Agriculture, National Agricultural Library (www.flickr.com/photos/internetarchivebookimages/20522069791).

Symbolism

Ornamental flowers have been assigned meanings in the "language of flowers" (floriography), especially popular in Victorian England, although attributing particular significance to given plants has been practiced for millennia. Today, internet florists repeat many of the old associations, and often invent additional meanings, since they are interested in selling bouquets, and gifts of flowers are particularly associated with holidays, marriages, funerals and anniversaries. The symbolisms alleged for gladiolus (all quite positive) include strength of character, infatuation, faithfulness, sincerity, integrity and honour. Gladiolus has been represented as the birth month flower for August and the 40th wedding anniversary flower. The alternative name "sword lily" has likely been influential in creating symbolism: lilies have long been associated with nobility of character, positive aspects of Christianity and tradition, and the sword reflects military and national honour.

Wild *Gladiolus* species

Typically, *Gladiolus* species are adapted to a subtropical climate. Most of the approximately 300 species are native to sub-Saharan Africa and the main distribution area is South Africa. About ten species are indigenous to Eurasia. Some endemics are threatened or endangered, other species are

[1]Science and Technology Branch, Agriculture and Agri-Food Canada, Saunders Bldg., Central Experimental Farm, Ottawa ON, K1A 0C6
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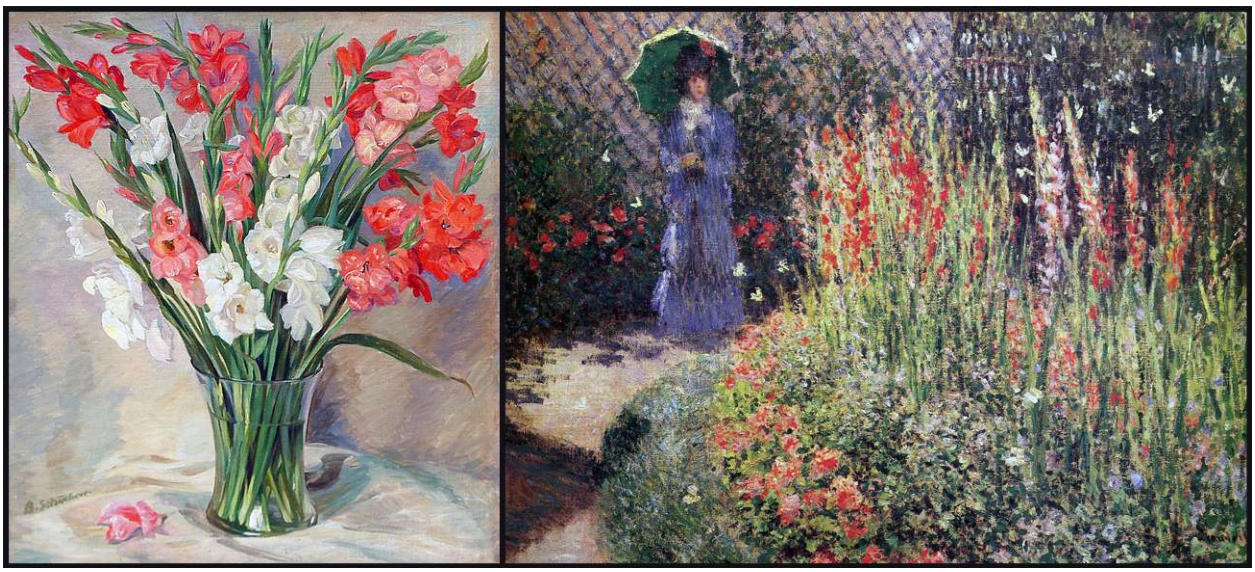


Figure 2: Great art featuring gladiolus. **Left:** "Gladioluses in a vase" by Bernd Schuchert (1886–1936). ©Irina, based on a private collection (CC BY 2.0). **Right:** "Gladioli" by Claude Monet (1840–1926), housed in Detroit Institute of Arts (public domain image).

widespread noxious weeds. *Gladiolus angustus* has become invasive in many places, especially Australia, and *G. undulatus* is considered a threat in New Zealand. Four species have been introduced in the U.S., none is naturalized in Canada. Although wild species of *Gladiolus* are much more humble in appearance than modern cultivars, they are often grown in conservatories, parks and rock gardens.

Gladiolus species are herbs, some growing to 2 m (6.6 feet) in height. The plants produce up to nine or so narrow, deciduous, sturdy leaves with overlapping bases. The foliage is displayed in a vertical fan, with the opposite leaves in two ranks. The longest leaves may exceed 1 m (3 feet) in some cultivars. The flowers usually occur in a double row on one side of a terminal spike, blooming occurring successively from the base to the top. The six petal-like tepals form a tube at the base of the corolla while at the open end they may be plain, cut, frilled or ruffled. The fruit is a many-seeded capsule.

Corms

Many plants have annual herbaceous above-ground parts that die at the end of a season of growth, but survive a period that is hostile because of extreme temperature (cold or heat) or drought by producing dormant underground organs that vegetatively reproduce the plant the next growing season. A "perennial" is a plant that lives for several years. *Gladiolus* is a perennial in the sense that a least some of the vegetative plant is alive at any given time (although no part remains viable for as long as 1 year). In practice, as pointed out later, since *Gladiolus* cannot overwinter in cold climates it is often treated as an annual. In contrast to seeds, which are usually very small and require considerable growth to produce large plants, perennating underground structures are normally relatively large, with considerable energy reserves that allow very rapid growth following the quiescent season. Subterranean vegetative propagules are usually modified roots, stems, or a combination of stem and leaf tissues, associated with bud meristems that will later produce new roots and stems. Many herbaceous plants whose tops are killed annually survive a dry or cold season simply by conventional underground stems and/or roots, but many also produce specialized structures that are strongly swollen to store food reserves. These are classified as bulbs, corms, rhizomes and tubers.

True bulbs (exemplified by onion, tulip and daffodil) are spheroidal masses made up mostly of modified fleshy storage leaves ("scales") which appear as rings in a cross section. Corms (e.g. crocus, banana) are similar in shape but made up mostly of a solid mass of compacted stem tissue, lacking internal layers like true bulbs. Rhizomes (e.g. ginger, iris), like corms, are made of fleshy stem tissue, but unlike corms which orientate vertically, rhizomes elongate laterally quite substantially. "Stem tubers" (such as potato and true yam – *Dioscorea* species) are essentially short (i.e. not substantially elongated), compact, swollen rhizomes. "Root tubers" or "tuberous roots" (such as sweet potato, cassava, daylily and dahlia) are simply swollen roots, and are internally composed of root tissues. All of these storage structures produce both shoot and root meristems from the outer part of the storage organ (e.g. eyes of a potato). In the horticultural industry, the term "bulb" usually includes all fleshy underground storage structures; accordingly gladiolus corms are widely called bulbs.

In addition to sexual reproduction by seeds, gladiolus reproduces vegetatively by corms, and most cultivation is by corms. The corm of gladiolus is a subterranean modified stem, including nodes, extremely short internodes and buds (meristems). The mature corm is enveloped in several layers (collectively termed "tunic") of brownish, fibrous husks, each composed of the petiole base of an old deteriorated leaf. The tunic is protective, and in some genera related to *Gladiolus*, is more substantial. The corm produced in the



Figure 3: *Gladiolus flanaganii* growing in the Alpine Garden, University of British Columbia. ©Daniel Mosquin (CC BY NC SA 4.0). The following information accompanied the photo: "The common name… suicide lily, refers to the death-defying stunts photographers and observers need to perform to see this plant in the wild. Growing on cliff faces in the Drakensburg Mountains of South Africa, finding a plant is an adventure not for the timid. Fortunately, this treasure is becoming easier to find in cultivation… The flowers of *G. flanaganii* last little more than a day, then quickly decay."

previous season serves as a "mother corm" to produce a "daughter corm" immediately on top of it. As the energy reserves are consumed from the mother corm, it shrivels and shrinks, and conversely the daughter corm expands. This system of having a daughter corm (sometimes more than one) develop on top of its mother corm every season would eventually result in the elevation of the newest corm out of the ground. However, young gladiolus corms produce some contractile roots, which pull them down into the soil. Depending on cultivar, corms may be as large as 15 cm (6 inches) in diameter. Also produced are much smaller offsets termed cormels (also cormlets) at the tips of short, branched stolons (shoots) arising between the new and old corms. Cormels are miniature corms, varying in size from a pinhead to a hazel nut. Wild species produce one or occasionally two corms and a few cormels, but modern cultivars can produce 2–4 corms and sometimes over 400 cormels. The fleshy tissue of a cormel is surrounded by a single, loosely fitting hard shell. At maturity, corms and cormels are easily detached. At the bottom of the corm, a fibrous root system is generated, while above a leafy shoot is produced. The shoot also produces a flowering spike if the corm is large enough to provide sufficient energy.

The corms of gladioli serve to survive (in a dormant state) the dry season found in most of their southern African habitats, and to reproduce the plants when spring rains arrive. Corms are designed by nature for reproduction in the same location as the mother plant. In their native areas, *Gladiolus* corms are consumed by many animals, including baboons, porcupines, naked mole-rats and other rodents, and some birds such as guinea fowl. The smaller and more numerous cormels tend to break off and become scattered during attacks by herbivores, and this serves to spread genetically identical daughter plants locally in the vicinity of the mother corm. Seeds are intended for dispersal, especially long distances, of genetically variable offspring.

Corms and cormels exhibit a period of dormancy, which may be overcome in weeks at either high or low temperature. The gladiolus industry has conducted extensive research on environmental and chemical stresses that are useful commercially to break dormancy.

Domesticated *Gladiolus* species

Gladioli were cultivated in ancient Greece and Rome, but the plants could not have been nearly as impressive as today's garden selections. Extensive hybridization, especially by the Dutch, began after several species were brought from South Africa to Europe in the early 18th century. Modern cultivars are the product of hybridization, mostly from southern and eastern African species. Species considered to be progenitors include *G. cardinalis*, *G. carneus*, *G. cruentus*, *G. dalenii* (*G. natalensis*), *G. oppositiflorus*, *G. papilio*, *G. saundersii*, and *G. tristis*. An estimated 70,000 cultivars of *Gladiolus* have been bred to date (peterzwaal.nl/a-short-cultural-history-of-gladioli-in-the-netherlands/).

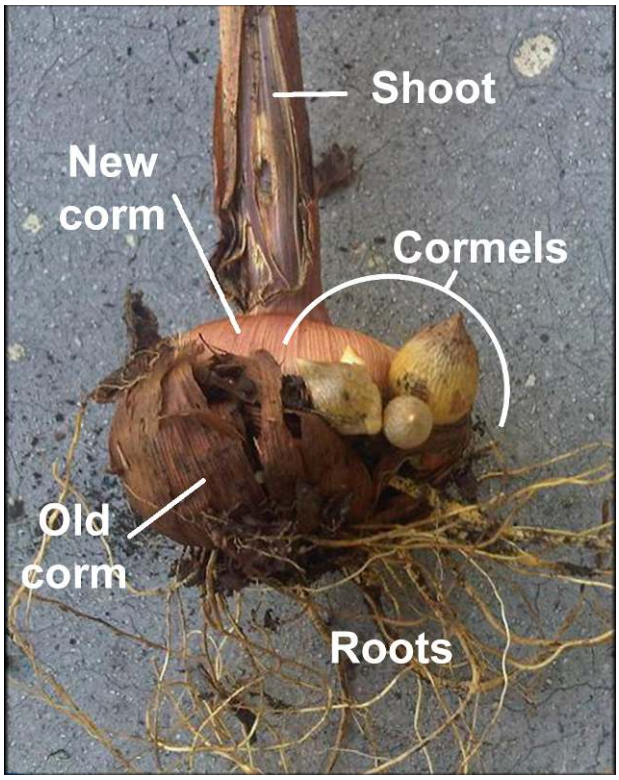


Figure 4: Base of a gladiolus plant showing a new and an old corm and cormlets. ©Emőke Dénes (CC BY SA 4.0).



Figure 5: Gladiolus corms. **Left:** corms covered by brown tunics (made up of husks, i.e. petiole bases). ©Legirons (CC BY SA 3.0). **Right:** corms with tunics removed. The circumferential rings around the corms are the stem nodes where the petioles arise (see text). Source: Pixabay (public domain).

Breeders have created new varieties with attractive flower colours and an increased number of flowers that are well displayed on long spikes. The blooms of modern *Gladiolus* hybrids are much larger than those of unmodified wild species. The flowers are typically 5–10 cm (2–4 inches) across, but may range up to 20 cm (8 inches) in diameter, and are often trumpet-shaped in the large-flowered cultivars. The spikes sometimes develop several dozen flower buds, as many as half of them open simultaneously. Common flower colours include white and shades of yellow, pink, red, and purple. Greenish, blue, lavender, orange, apricot, burgundy, gold, and multicolored flowers are also well known. Some cultivars have doubled flowers, i.e. the number of perianth segments has been increased. Modern cultivars usually lack significant odour, but there are recent efforts to breed attractive scents (for example 'Limoncello', which is lemony). Height of garden varieties varies from 50 cm to 2 m, and "miniature" cultivars are available for indoor cultivation as houseplants. The ability of corms to generate many new corms and cormels has also been selected, since this is highly advantageous commercially. There are ongoing efforts to breed cultivars which produce cut flowering spikes that have longer shelf life.

Economic value

For many years, gladiolus has been considered to be a traditional flowering ornamental, and the most desirable of cut flowers, loved particularly by florists for preparing bouquets. After the mid-1970s sales of gladiolus waned somewhat because it had become cheap, common and old-fashioned, but new cultivars, diverse in colour, shape, and size, revived its popularity. In recent years, gladiolus has often been ranked among the five most important cut flowers in international trade. Major producers include the United States (Florida and California), the Netherlands, Italy, France, Poland, Bulgaria, Brazil, India, Australia and Israel. In the 1970s, gladiolus produced for cut flowers was the tenth most important floral crop in Canada, with about 1 million spikes produced annually in Ontario, and a quarter-million in Quebec and the remainder of the country. Since then, there has been a world-wide transfer of cut-flower production to warmer countries south of the temperate industrialized world where most markets are located. Of course, transportation costs add to importation costs, but this is more than compensated by savings for labour and heat. For cut flowers from bulbs, it sometimes makes economic sense to import bulbs from foreign countries and harvest the flowers from greenhouses in which the bulbs are grown. However, there are far more competitive cut-flower greenhouse floral crops in Canada (www.omafra.gov.on.ca/english/stats/hort/greenhouse2.htm), and cut-flower gladiolus sold in Canada is mainly imported.

Although gladioli are primarily employed as cut flowers, they also have some usage in landscaping. Gladioli can be used as ornamentals in many circumstances – in herbaceous borders, rock gardens, and containers for patios and decks.

Viral, microbial and fungal pathogens cause significant damage to gladiolus. Indeed, viruses are a major problem for most bulb crops because once infected all subsequent



Figure 6: Late 19th century paintings of gladiolus cultivars (public domain images). **Left:** source: The Garden (journal), 1886, vol. 30. **Right:** source: Revue horticole (journal), 1899, Serié 4, vol. 71.

propagating material may harbour the virus. Viruses affecting gladiolus are a particular economic concern of commercial growers.

Edibility and toxicity

Some species of *Gladiolus* are employed for food and medicine by indigenous peoples in Africa. Gladiolus corms are consumed in Ghana, Nigeria, Cameroon and Botswana, while in Nigeria they, together with cereals, are used in the preparation of a non-alcoholic drink. *Gladiolus dalenii* is one of the primary parents of many modern cultivars. It is widely distributed, from eastern South Africa and Madagascar throughout tropical Africa and into western Arabia. The plant is used by indigenous groups both as food and as medicine. The flowers are eaten raw or cooked, and the corms are consumed cooked. Extracts from the corms have been used in traditional medicine to treat a variety of conditions, including fungal infections, convulsions, seizures and insomnia.

Gladiolus italicus (*G. segetum*), a native of much of Eurasia and North Africa, is occasionally grown as an ornamental, and has become a common weed on other continents, particularly in cultivated fields. It is employed in North Africa as a traditional medicine. The species has been responsible for the death of grazing livestock in Algeria, where the plant is widespread. Nevertheless, Burrows and Tyrl (2013), the most authoritative survey of toxic plants affecting livestock, states "Intoxication problems are only occasionally caused by species of *Gladiolus*."

There is very limited information on either the edibility or toxicity of gladiolus cultivars. Some reports on the Internet (none from authoritative sources) claim that the flowers (at least the petals) are edible, but that the corms and perhaps other parts of the plant are toxic to cats, dogs and possibly some wild rodents. Garden gladiolus has been so widely cultivated that if it constituted a significant threat of poisoning this should be well known by now. Nevertheless, it is premature to assess its toxicity, so deliberate consumption is unwise.

Cultivation

In cold climates such as in most of Canada, gladioli are usually treated as a dispensable annual flowering ornamental, and new starting stock is purchased each year. Alternatively, as detailed below, the corms produced can be dug up in the autumn, stored, and replanted the following spring.

Purchasing

Home gardeners typically buy large corms in order to rapidly produce large flowering plants. Corm diameter of 2.5 cm or 1 inch is minimal for most cultivars to produce flowers. Larger corms ("Jumbo" class is at least 5 cm or 2 inches) will produce better plants. Corms may be in sealed packages making evaluation difficult; nevertheless, it is wise to check that the corms have a smooth tunic, showing no signs of damage or discoloration, and when the tunics are removed the corms should be firm and without dark areas or spots. While chain stores offer a selection of cultivars, a far greater and more interesting range of gladioli are offered in the online catalogues of specialty dealers. Local nurseries are likely to be familiar with cultivars that perform well in the region, and should be able to provide advice on how to minimize problems.

Planting

Gladiolus corms are best established in the spring, in well-tilled soil, when danger of frost is minimal. They are frequently planted in a trench, pointed end up, in single or double staggered rows 5–7.5 cm (2–3 inches) apart. Large bulbs can be planted 10–15 cm (4–6 inches) deep, initially covered with only 5 cm (2 inches) of soil, but the trench progressively filled over a period of weeks. Smaller bulbs are best planted more shallowly. Rows may be spaced from 50–90 cm (20–36 inches) apart. Taller cultivars (up to 2 m or 6.6 feet) are best located at the back of a bed, shorter ones (less than 1 m) in the foreground. Staking is recommended for tall cultivars as these could be blown over by wind. Home growers are often advised to apply a combination fungicide and insecticide to corms when they are being planted.

Scheduling

As an outdoor plant, gladiolus blooms in midsummer, but given plants are in good display only for 2 or 3 weeks. A flowering bed can be arranged to have continuing displays by staggering planting times of early, mid, and late season cultivars at 2- or 3-week intervals. In short-season climates, starting corms indoors is a technique that encourages earlier flowering. Generally 70 to 90 days are required from planting to maturation of corms, depending on cultivar and weather, and if the objective is to produce new corms the local date of frost needs to be considered. As noted below, to save the corms they must be dug up after they have matured in late summer or fall, dried, and stored during the winter months.



Figure 7: Commercial production of gladiolus south of Santa Maria, California, in 2010. ©Anita Ritenour (CC BY 2.0).



Figure 8: Left: Gladiolus exhibit celebrating strength and victory at the world's largest civilian and military parade, "International Four Day Marches," a 4-day event held annually in the Netherlands. ©Leonard461341 (CC BY SA 4.0). **Right:** Canadian soldier, decorated with gladioli, participating in the march. ©Canada Department of National Defence.



Figure 9: Front cover (public domain) of the John Lewis Childs 1900 gladiolus catalogue, showing mixed cultivars available at the end of the 19th century.

Soil & Moisture Conditions

Gladiolus thrives in well-drained, rich fertile sandy-loam soils, but is tolerant of a range of soil conditions However, heavy clay promotes water-logging, which is harmful. Soil pH of 6–7 is ideal. Ample irrigation should be provided to maintain the soil in an evenly moist condition. A fertilizer with extra phosphorus (such as 5-10-5) to encourage flowering may be added as a side-dressing once the plants are established.

Location

Avoid planting gladiolus near trees, shrubs, or other large plants, as it does not compete well. Gladiolus grows best in full sun. A location that is sheltered from wind is advisable, especially to prevent windthrow of tall varieties.

Temperature

For most cultivars, optimal growth of gladiolus occurs when daylight temperatures are 10–25°C (50–77°F) and night temperatures are 16–18°C (61–64°F). The plants are frost intolerant, and the corms will not withstand freezing. The climate of southwestern coastal British Columbia is mild enough for the corms of some cultivars to survive overwinter in the ground if protected by a mulch.

Harvesting Flowers

To harvest the flowers for display in a vase, cut the spike when the first (lowest) flower is open (remaining flowers will subsequently open), using a sharp knife to make a slanting cut so that a few leaves are included. Immerse immediately in water. If flowering spikes are not cut off for indoor display, spent flowers need to be removed to maintain appearance.

Harvesting Corms

Gladiolus is propagated commercially by natural multiplication of new corms and cormels, and occasionally by in vitro (micropropagation) techniques. A mother corm may produce about 25 cormels, but these require three to four seasons to produce full size daughter corms. The home gardener can dig up the new corms 4–6 weeks after the flowers have faded or when the above-ground plant has died, leaving 1.3 cm (0.5 inch) of stem attached to the new corm. Corms should be dried well for several weeks, and the old, shriveled corm cut away. Cormels may be saved, but replanting these will require 2–4 years to produce a corm large enough to produce a flowering spike. Corms should be stored during the winter at 2–7°C (35–45°F) in a well-ventilated, dry area. Dusting the corms before storage with a garden fungicide may prevent both insect and disease issues in storage. In principle, harvesting corms can maintain a gladiolus bed indefinitely, but after 6 years or so, the vigour of corms that have been harvested year after year may decrease.

Curiosities of Science and Technology

- In the King James Version of the Bible, Matthew 6:28 reads: "And why take ye thought for raiment? Consider the lilies of the field, how they grow; they toil not, neither do they spin." The identity of the "lilies" mentioned has been debated, since the biblical names applied to the many flowering plants in Galilee are uncertain. It has been suggested that they are in fact gladioli.

- "Gladiolus" was correctly spelled by 11-year-old Frank Neuhauser to win the first U.S. National Spelling Bee in 1925. Subsequently, words to be spelled became more challenging. The 2018 second-place finisher failed to spell "Bewusstseinslage" (a state of consciousness or a feeling devoid of sensory components), while the winner correctly spelled "koinonia" (the Christian fellowship or body of believers).

- Corvettes are small warships designed for convoy escort duty. The "Flower-class corvette," also called the Gladiolus-class after the lead ship, was a British set of 267 ships used during World War II by the Allied navies (mostly Great Britain and Canada) as anti-submarine guards during the Battle of the Atlantic. Most of the ships were named after flowers. The Flower class represented half of all Allied convoy escort vessels in the North Atlantic during the war. Thirty-six flower-class ships were lost, while 51 enemy submarines were sunk. The Gladiolus was torpedoed and sunk in 1941 by a U-boat, while escorting a convoy south of Iceland. All 65 on board were lost.

- In the Netherlands in the 21st century, gladiolus became symbolic of athletic prowess, military strength, and victory, an association attributed to the origin of the word

gladiolus from the Latin word for swords such as employed by ancient Roman gladiators. The largest civilian and military marching event in the world, "International Four Day Marches," has been held annually since 1909, in July in Nijmegen. The participants are showered with gladioli near the finish on a street called the Via Gladiola.

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Figure 10: Cartoon (public domain) of a girl holding an oversized bunch of gladiolus stems, based on the cover of the 1922 William Marks seed catalogue. Source: openclipart.com.

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Acknowledgements

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