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2010



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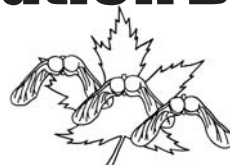
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The Canadian Botanical Association Bulletin



Bulletin de l'Association Botanique du Canada

December/Décembre 2009. Volume 42 No.3/N°3



**Canadian Botanical Association—
L'Association Botanique du Canada**

And

**The Society for the Preservation of
Natural History Collections (SPNHC)
May 31 – June 5, 2010**

University of Ottawa, Ottawa, Ontario, Canada

Keynote Speaker

**Dr. Paul Hebert (University of Guelph)
iBOL – The International Barcode of Life
Project**

**Plenary Symposium
Global Biodiversity Mega Initiatives**

<http://www.spnhc-cba2010.org/>



Canadian Botanical Association Bulletin

The CBA Bulletin is issued three times a year (in theory in March, September and December) and is available to all CBA members in electronic format or for an additional fee, in hard copy.

Information for submitting texts

All members are welcome to submit texts in the form of papers, reviews, comments, essays, requests, or anything related to botany or botanists. Any medium is acceptable for submission but electronic documents are likely to speed up the publication. For detailed directives on text submission please contact the Editor (see below). For general information about the CBA, go to the web site: <http://www.cba-abc.ca>

Association botanique du Canada Bulletin

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 nature concernant la botanique et les botanistes (articles, revues de publication, commentaires, requêtes, essais, etc.). Tous les supports de texte sont acceptés. L'utilisation de documents électroniques peut accélérer la publication. 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: <http://www.cba-abc.ca>

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Next issue / Prochain numéro

Texts for the next issue, **43(1)**, must be received **before February 22nd 2010**

La date de tombée des textes du prochain numéro, le no **43(1)**, est le **22 février 2010**

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Association News



The CBA needs YOU !

Consider serving on our Board! Nominations are invited for the following positions each of them for a 2 year term:

- Treasurer
- Two directors representing Eastern Canada
- Two directors representing Western Canada

These terms will begin at the end of our next AGM in June 2010.

Please send your nominations (or expression of interest) to: Christian Lacroix, Dean of Science, University of PEI

550 Univ. Ave, Charlottetown, PE C1A 4P3 e-mail: lacroix@upe.ca

L'ABC a besoin de VOUS !

Devenez un membre de notre conseil d'administration
Un appel de candidatures est lancé pour les postes suivants, chacun d'une durée de deux ans:

- Trésorier
- Deux directeurs représentant l'est du Canada
- Deux directeurs représentant l'ouest du Canada

La période de service pour chaque poste débutera à la fin de la réunion annuelle générale en juin 2010.

Veuillez faire parvenir vos nominations (ou nous communiquer votre intérêt à soumettre votre candidature) à: Christian Lacroix, Dean of Science, University of PEI, 550 Univ. Ave, Charlottetown, PE C1A 4P3
e-mail: lacroix@upe.ca

People often ask what the role of a director is. The following comes from the Manual of Policies and Procedures of the CBA/ABC

ELECTED DIRECTORS.

1. CBA/ABC has six elected Directors. Directors are elected for a two year period and may serve for two terms (a total of 4 years), consecutive or not. Three Directors are elected in any one-year.
2. Directors who resign before the completion of their term are replaced by appointment of the Board until the next Annual General Meeting. If the unexpired term is less than one year, the election that year is as normal. If the unexpired term is more than one year, the election will include a Director for a one year term. All other aspects of the By-laws must be adhered to, e.g. correct representation in eastern and western Canada.
3. The President may assign the Directors portfolios.
4. It is now established that the **Awards Committee** shall consist of all elected Directors plus others as determined by the By-laws and the President.
5. As part of their mandate, the Directors are considered to be **Regional Reporters for the Bulletin** and should send information on botany and botanists (not only CBA/ABC members) to the Editor.
6. The intent of the elected Director positions is that members with interest in CBA/ABC can learn the administrative executive activities of the Association. The position of elected Director thus becomes training **ground for senior officers** (Secretary, Treasurer, and President). Elected Directors are also a **pool of interested and active members** who can represent CBA/ABC in other areas, e.g., Youth Science Fair, etc.
7. Part of the job of elected Director includes finding members who can and will work 'to make things happen' for CBA/ABC. In accepting nomination for position as elected Director, a person is implying that he/she expects to be active in CBA/ABC for the term of his/her Directorship. This includes **attending the annual meeting** and being able and willing to do the jobs assigned by the President and Executive.
8. Each elected Director must submit a **written report of the year's activities** for inclusion in the Annual Report circulated to members attending the annual meeting. The President (or Secretary) may produce a combined report for all Directors (using information provided) if this will save space and eliminate redundancy.

CBA/ABC Student Awards '09-'10

~Awards for Papers published by Students~

Alf Erling Porsild Memorial Prize

Award honoring the memory of the eminent Arctic botanist Alf Erling Porsild. Applications/nominations for students who published a paper in plant systematics and/or phytogeography (as senior author) during the previous year should be sent to the current Chair of the Systematics and Phytogeography Section of the CBA/ABC (Dr. Tim Dickinson, Royal Ontario Museum; e-mail: tim.dickinson@utoronto.ca) before April 1st 2010.

J. Stan Rowe Award

Award established to celebrate the life and work of Stan Rowe, eminent Canadian Plant Ecologist. Applications/nominations for students who published a paper in plant ecology in 2007 should be sent to the current Chair of the Ecology Section of the CBA/ABC (Dr. Liette Vasseur, Brock University; e-mail: lvasseur@brocku.ca) before April 1st, 2010.

Taylor A. Steeves Award

Award established to honour Taylor Steeves' numerous contributions to the CBA/ABC and botany. Applications/nominations for students who published a paper in 2008 in plant development, structure or morphology should be sent to the current chair of the Plant Development Section of the CBA/ABC (Dr. Jane Young, University of Northern British Columbia; e-mail: youngj@unbc.ca.) before April 1st, 2010.

Luella K. Weresub Memorial Award

Award established in memory of Dr. Luella Kayla Weresub, a well-known Canadian mycologist who worked at the Biosystematics Research Institute of Agriculture Canada. The award is open to all undergraduate or graduate students working on fungi. Applications/nominations for students who published a paper in fungal biology in 2007 should be sent to the current chair of the Mycology Section (Dr. Hugues Massicotte, University of Northern British Columbia; e-mail: hugues@unbc.ca) before April 1st, 2010.

Please refer to CBA/ABC website (cba-abc.ca) for eligibility details

CBA-ABC '10 Conference Awards

John Macoun Graduate Student Travel Bursary & Keith Winterhalder Undergraduate Travel Award

Awards established to provide partial financial assistance for travel to the Annual Meeting to a student (or students) presenting a paper in the Lionel Cinq-Mars competition or a poster in the Taylor competition.

Eligibility:

1. Open to all student members of CBA/ABC.
2. Students must present a paper (Lionel Cinq-Mars competition) or a poster (Taylor competition) at the Annual CBA/ABC Meeting.
3. No student may receive more than one travel bursary while registered for the same degree.
4. Students must apply no later than the submission deadline for abstracts to the Annual Meeting.
5. The application must contain the following documents:
 - a. A copy of the abstract of the paper to be given at the Annual Meeting in the Cinq-Mars Competition;
 - b. A supporting letter from the student's Supervisor of research that also includes a statement that the student is engaged in a MSc. or Ph.D. program;
 - c. The student's curriculum vitae (one page);
 - d. A letter of recommendation from a member of the student's research committee (not the Supervisor)

Applications should be sent the President of CBA/ABC (Dr Rodger Evans, Acadia University; e-mail rodger.evans@acadiau.ca) before April 1st 2010

Lionel Cinq-Mars Award

Award for the best oral presentation by a student of his or her own research, as a contributed paper at the Annual Meeting.

Eligibility:

Any bona fide (under-)graduate Canadian student enrolled at a Canadian institution of higher learning, as well as Canadian students at foreign institutions, are eligible. Every effort will be made to ensure that each student in the competition has a fair evaluation and an equal chance of winning the award.

Oral presentation will be evaluated by a panel of judges (at least one from each CBA/ABC section) chaired by the President-Elect. The merit of each paper will be judged on the basis of content (60%) and presentation (40%). All students who wish to compete for this award must indicate this by checking the appropriate box on the abstract form. Abstracts must be submitted for the Annual Meeting at which the student will compete for the Award.

Iain and Sylvia Taylor Award

Award for the best student research poster presented at the CBA Annual Meeting.

Eligibility:

Any bona fide (under-)graduate Canadian student enrolled at a Canadian institution of higher learning, as well as Canadian students at foreign institutions, are eligible. Every effort will be made to ensure that each student in the competition has a fair evaluation and an equal chance of winning the award.

Posters will be evaluated by a panel of judges chaired by the Vice-President of CBA/ABC. All students who wish to compete for this award must indicate this by checking the appropriate box on the abstract form. Abstracts must be submitted for the Annual Meeting at which the student will compete for the Award.

Please refer to <http://www.spnhc-cba2010.org/> for submission details and deadlines

ABC/CBA Prix Étudiants '09-'10

~Prix pour les articles publiés par les étudiants~

Le Prix Commémoratif Alf Erling Porsild

Prix honorant la mémoire de l'éminent botaniste de l'arctique Alf Erling Porsild. La mise en candidature d'étudiants ayant publié un article en phytogéographie ou systématique végétale (comme auteur principal) durant l'année précédente devrait être envoyée au président de la section systématique et phytogéographie des plantes de l'ABC/CBA (Dr. Tim Dickinson, Royal Ontario Museum; e-mail: tim.dickinson@utoronto.ca) avant le 1 avril 2010.

Le prix J. Stan Rowe

Prix établi pour célébrer la vie et le travail de Stan Rowe, éminent écologiste canadien des plantes. La mise en candidature d'étudiants ayant publié un article en écologie végétale durant l'année précédente devrait être envoyée au président de la section écologie de l'ABC/CBA (Dr. Liette Vasseur, Brock University; e-mail: lvasseur@brocku.ca) avant le 1 avril 2010.

Le prix Taylor A. Steeves

Prix établi pour honorer les nombreuses contributions de Taylor Steeves à la botanique et à l'ABC/CBA. La mise en candidature d'étudiants ayant publié un article en 2008 en développement, structure ou morphologie végétales devrait être envoyée au président de la section développement végétal de l'ABC/CBA (Dr. Jane Young, University of Northern British Columbia; e-mail: youngj@unbc.ca) avant le 1 avril 2010.

Le prix commémoratif Luella K. Weresub

Prix établi en mémoire du Dr. Luella Kayla Weresub, une mycologue canadienne reconnue qui travailla à l'Institut de recherche en biosystématique d'Agriculture Canada. Cette compétition est ouverte à tous les étudiants de premier cycle ou diplômés qui travaillent sur les champignons. La mise en candidature d'étudiants ayant publié un article en mycologie devrait être envoyée au président de la section mycologie (Dr. Hugues Massicotte, University of Northern British Columbia; e-mail: hugues@unbc.ca) avant le 1 avril 2010.

S'il vous plaît visiter le site web de l'ABC/CBA (cba-abc.ca) pour les détails d'éligibilité

ABC-CBA '10

Prix de conférence

John Macoun Bourse de Voyage pour étudiant gradués & Keith Winterhalder Bourse de Voyage pour bachelier

La bourse a été établie pour aider à défrayer une partie des coûts de déplacement à la réunion annuelle pour un(e) étudiant(e) (ou des étudiants) qui présentent une communication orale dans la compétition Cinq-Mars ou une affiche dans la compétition Taylor.

Eligibilité:

1. Ouvert à tous les membres étudiants de l'ABC/CBA.
2. Les étudiants doivent présenter une communication orale (compétition Cinq-Mars) ou une affiche (compétition Taylor) à la réunion annuelle de l'ABC/CBA.
3. Aucun étudiant ne peut recevoir plus d'une bourse de voyage pendant qu'ils (elles) sont inscrit(es) au même programme d'étude.
4. Les étudiants doivent soumettre leur candidature avant la date limite de soumission des résumés à la réunion annuelle.
5. L'application doit contenir les documents suivants:
 - a. Une copie du résumé de la communication prévue à la réunion annuelle pour la compétition Cinq-Mars;
 - b. Une lettre de support du directeur de thèse de l'étudiant(e) qui inclue aussi une déclaration que l'étudiant est inscrit à un programme de maîtrise ou de doctorat;
 - c. Le curriculum vitae de l'étudiant (une page);
 - d. UNE lettre de support d'un membre du comité de direction de l'étudiant (autre que le directeur)
5. Les demandes devraient être envoyées au président de l'ABC/CBA (Dr Rodger Evans, Acadia University; e-mail: rodger.evans@acadiau.ca) avant le 1 avril 2010

Le prix Lionel Cinq-Mars

Décerné à un(e) étudiant(e) pour la meilleure présentation orale de son propre projet de recherche, présenté à la réunion annuelle.

Eligibilité:

Tout membre étudiant(e) de premier cycle ou diplômé inscrit(e) dans une institution canadienne d'études supérieures, ou membre étudiant(e) canadien(ne) d'une institutions étrangères, est éligible. Tous les moyens nécessaires seront employés afin d'assurer que chaque étudiant(e) participant à la compétition reçoive une évaluation juste et une chance égale de gagner la compétition.

La présentation orale sera évaluée par un comité de juges (au moins un représentant de chaque section de l'ABC/CBA) sous la direction du président élu. Le mérite de chaque communication sera jugé sur le contenu (60%) et la présentation (40%). Tous les étudiants qui souhaitent participer à cette compétition doivent indiquer leur intention en cochant la case appropriée sur le formulaire de soumission du résumé. Les résumés doivent être soumis pour la réunion annuelle à laquelle l'étudiant participera à la compétition.

Le prix Iain et Sylvia Taylor

Décerné à un(e) étudiant(e) pour la meilleure affiche présentée à la réunion annuelle.

Eligibilité:

Tout membre étudiant(e) canadien(ne) de premier cycle ou diplômé inscrit(e) dans une institution canadienne d'études supérieures, ou membre étudiant(e) canadien(ne) d'institutions étrangères, est éligible. Tous les moyens nécessaires seront employés afin d'assurer que chaque étudiant(e) participant à la compétition reçoive une évaluation juste et une chance égale de gagner la compétition.

Les affiches seront évaluées par un comité de juges sous la direction du vice-président de l'ABC/CBA. Tous les étudiants qui souhaitent participer à cette compétition doivent indiquer leur intention en cochant la case appropriée sur le formulaire de soumission du résumé. Les résumés doivent être soumis pour la réunion annuelle à laquelle l'étudiant participera à la compétition.

**S'il vous plaît visiter <http://www.spnhc-cba2010.org/>
pour les détails de soumission et les dates limites**

Section News

Teaching section news

Dr Kate Frego of the University of New Brunswick, St John campus, and winner of a 3M Teaching fellowship in 2008 will be presenting a special lecture at the conference and all are invited to attend. The title of her talk will appear in the next Bulletin in March, and also on the conference website.

Do you have any innovative teaching ideas to share with others? Have you developed interesting novel labs or field trips which your students have found useful and enjoyable? If so please contribute to a session on teaching ideas by giving an oral presentation at the conference. Submit your abstract to the conference organizers following the instructions on the conference website.

The CBA/ABC Teaching Section is proud to host a Panel Discussion on "Best Botanical Teaching Practices: Reaching Students in the Classroom, Lab, and Field". The panelists from institutions across Canada will discuss aspects of teaching and learning as these processes occur in different settings and will engage the audience in discussion of ideas and technologies that work in three different teaching environments. The panel, moderated by Frédérique Guinel (Wilfrid Laurier University) and Vipen Sawhney (University of Saskatchewan), will include Mihai Costea from Wilfrid Laurier University, Art Davis from the University of Saskatchewan, Kate Frego from the University of New Brunswick, Larry Peterson from the University of Guelph, and Jane Young from the University of Northern British Columbia; these individuals have all been recognized for teaching excellence.

Chlorofilms update! A WORLD-WIDE, OPEN COMPETITION FOR PLANT BIOLOGY VIDEOS ON YOUTUBE™

Deadline: 10 January 2010; enter by 16 Dec 2009 for a chance to win an iPod Touch

Those of you who have seen the videos from the first competition, will appreciate the value of these in teaching.

Check out the website for more details www.chlorofilms.org

Plant Development Section News

A reminder for students of structure and development and their professors to submit applications or nominations for the Taylor A. Steeves Award before **April 1, 2010**. This award was established to honour Taylor Steeves for his numerous contributions to the CBA and to botany. For more information or to submit applications or nominations, please contact Dr. Jane Young, Ecosystem Science and Management Program, University of Northern British Columbia, 3333 University Way, Prince George, BC, V2N 4Z9 or at youngj@unbc.ca.



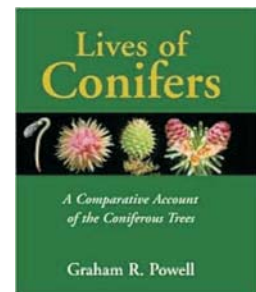
Book Review

Review of Book: "Lives of conifers" by Graham R Powell, Fitzhenry and Whiteside, 195 Allstate Parkway, Markham, Ontario, L3R 4T8, 2009. ISBN-13: 978-1-55041-869-9. 276pp. Review by John N Owens.

The author covers many of the aspects of the lives of selected conifers emphasizing their growth and development from seed structure and germination to the first and second years of seedling development, older seedlings, sapling stage, reproductive stage, branch and older crown development, then through mature growth, old age and death. The book was conceived and developed during the authors many years of teaching undergraduate and graduate courses in silviculture, dendrology, forest botany, and tree reproduction and development.

At the outset the author acknowledges some limitations of the book as a text and that it was not intended to be a reference book or complete review of the relevant literature. Regarding the limitations, the author explains that the conifer species covered in detail are limited to the 12 conifers indigenous to northeastern North America, with some occurring in boreal forests across Canada, and in eastern Canada and the North Eastern states of US. These species include, in the Pinaceae: *Abies balsamia*, *Tsuga canadensis*, *Larix laricina*, *Pinus strobus*, *P. banksiana*, *P. rigida*, *P. resinosa*, and *Picea mariana*, *P. glauca* and *P. rubens* and in the Cupressaceae: *Thuja occidentalis* and *Juniperus virginiana*. The author states at the outset that the literature cited is generally limited to articles dealing primarily with these species in this geographical region. These limitations, although well intended, are unfortunate because with the addition of another 50 to 100 references, the potential users of the text would increase many fold because many of the generalizations described are for the most part applicable to many of the additional 5 genera and 215 species within the Pinaceae and the additional 26 genera and 133 species within the Cupressaceae. This may unnecessarily limit the use of the book as a text or reference by students, teachers and researchers whose interests are in other species of these genera in many other parts of the world because all of the genera covered, except for *Tsuga* and *Thuja*, have extensive distributions in the north temperate regions across North America, Europe and Asia. This is especially true for *Pinus*, *Picea* and *Abies*. For the genus *Tsuga* limitation to *T. canadensis* may not be too restrictive since the genus has only nine species and eight of these, including *T. canadensis* are within the Subgenus Micropeuce and the other subgenus, Hesperopeuce, is limited to one species, mountain hemlock (*T. mertensiana*) of western North America. Similarly, *Thuja* has but six species native to China, Japan, Taiwan and North America and both North American species belong to the same sub-genus *Thuja* and are very similar.

(Continued)



For the larger genera within the Pinaceae, such as the genus *Pinus*, broad generalizations may not be as reasonable. In *Pinus* there are about 108 species falling into three subgenera: 1. Deucampopinus with but one Asian species; 2. The subgenus *Strobus*, the soft or five-needle pines, which appear very similar in morphology and reproduction and have a scattered but wide north temperate distribution in North America, Europe and Asia, and for which *P. strobus* is used in the text to represent this group, which may be acceptable; and, 3. The subgenus *Pinus*, the hard pines, for which the author uses mostly *P. banksiana*, plus *P. rigida*, and *P. resinosa* to represent this group. Again, the reader may be able to cautiously generalize from these to other members of the large subgenus *Pinus*.

For the genus *Picea* of the Pinaceae, there 34 to 37 species, found throughout most of the northern hemisphere and they are usually separated into two fairly distinct sections each with two subsections. The author uses examples of *P. glauca* and *P. mariana* and unfortunately both belong to Section *Picea*, Subsection *Picea* which is but one of the four subsections.

Although the number of species in this subsection is by far the most numerous, they may not represent all subsections which are commonly separated on the basis of leaf and seed cone morphology - a topic covered in some detail in the text.

For the genus *Larix* of the Pinaceae, there are only about 11 species, not separated into sections or subgenera and widely distributed across the boreal forest zone of Eurasia and North America. We may assume from the lack of subgenera that they may be fairly similar in morphology and development, but we are not yet certain how similar they are in reproductive development. Although *Larix* is not separated into subgenera, taxonomic keys for identification separate the genus into two groups based on seed-cone characters and bud and shoot pubescence.

Therefore, the reader should be very careful to consider the size and complexity of each genus before generalizing from the species used in the text to other species in some of the same genera. This may be particularly true for species within *Picea* and *Larix*, whereas broader generalizations among species may be made within each of the two main and distinct subgenera of pines, *Strobus* and *Pinus* and species of *Tsuga* where there is but one species not in the subgenus *Micropeuce* and *Thuja* which is not separated into subgenera.

Therefore, readers should be cautious not to generalize among species within *Picea* and *Larix* to the same extent that they might be able to generalize among species of soft pines, species of hard pines, species of *Tsuga*, species of *Thuja*.

Another perhaps unnecessary limitation of the book results from the lack of specific citations in the text. If these had been added they would not have detracted from the readability of the text and would have allowed the book to serve as a useful reference for the teacher or researcher as well as a text for the students. The number of appropriate classes and students in this region of North America is rather limited. This addition would have been valuable. But as it now stands, readers may not go to the trouble to try and sort out which of the approximately 200 references relate to specific comments and observations in the text.

The book is beautifully illustrated with colour photographs and diagrams of most stages of development of the selected species, simple and clear tables and the text is written in a very readable manner. The photographs of whole and dissected buds and cones at various stages of development throughout the year are particularly good and informative as a way of familiarizing the student with the many stages of development of different structures that, because of the limited time the students have, they may only be able observe one stage in class, usually the dormant stage. The degree of detail is extreme in some cases, such as the comparison of leaves of forced grown seedling which is not compared to wild or field grown seedlings and pubescence on buds and shoots, but some of this information could be useful to the researcher but of questionable value in a text intended for students. Other areas are much more useful such as the changes that occur in crown development from the sapling to the reproductive stage to the mature trees in terms of vegetative and cone-bud position in the selected genera and species. Again, these generalizations might be able to be applied to other species in the genera included in the text if a few additional references had been added.

The author has chosen, perhaps wisely, not to include a lot of microscopic anatomical and developmental detail of leaf, bud, shoot, root and reproductive development which would likely have made the text far too long, especially if these areas were covered in the detail that is already given on other aspects of structure and development.

In general, I believe the text may have a broader application to other species of the genera, which were not included, than has been laid out by the author in the short introductory chapter with regard to species included and their limited geographical distribution in northeastern North America. This creates a problem for the reader unfamiliar with conifers. Is the example used in the text similar enough to the species on which I am studying? This may not be a major drawback for most readers but the problem could have been avoided with the addition of not many more references and the citation of these in the text.

John N Owens



Important Conference Deadlines

Registration begins December 1st, 2009

Early bird registration until March 31st, 2010

Abstract submission deadline April 31st, 2010

SPNHC Travel Grant application deadline March 31st, 2010

University residences reservation before April 14th, 2010

Obituary

Jack Dainty 1919-2009

By Nancy G. Dengler and Robert L. Jefferies*
*Department of Ecology & Evolutionary Biology
University of Toronto*



Jack Dainty was a pioneering plant biophysicist who introduced a thermodynamic approach to the study of the movement of water and ions across plant cell membranes. Although he began scientific life as a nuclear physicist, an early interest in natural history and an early transformative teaching experience led him into the field of biophysics. Jack established strong research groups in plant biophysics first at the University of Edinburgh, and subsequently at the University of East Anglia and then University of Toronto. Through a series of influential review articles and research papers, Jack established the importance of understanding the basic physical processes that underlie the ion and water relations of plant cells. Jack was born in an economically depressed coal-mining town near Sheffield, England. His father had died when he was three, and he grew up in what he described as a deprived and poverty-stricken environment, an experience that made him a life-long committed socialist. Although none of his immediate family had continued schooling past the age of 14, Jack received a scholarship to attend Mexborough secondary school where he specialized in mathematics, physics and chemistry in the last two years. He was taught English by the mother of A.S. Byatt and Margaret Drabble, but at that stage his consuming interest in literature was dormant. Jack was a very keen football player and at one stage was head-hunted by one of the professional Yorkshire football teams but mathematics prevailed! He also maintained a personal interest in natural history, going on long walks in the South Yorkshire countryside and reading British naturalists such as Gilbert White. In 1937, Jack won a scholarship to Cambridge University (an almost impossible achievement from such a background) to study mathematics, but he switched to physics, and graduated with first class honors in 1940. At the beginning and end of each term, he would cycle between Mexborough and Cambridge, a distance of 120 miles with his books secured on the back of the bike.

Completion of his studies at Cambridge coincided with the early days of the Second World War, and Jack was recruited by the military authorities to remain at Cambridge as part of a team working on nuclear fission. This research ultimately led to the construction of an atomic bomb, but it was realized at the time that only the United States had sufficient industrial power to actually make such a bomb. One of Jack's specific responsibilities was to calculate whether Germany had enough heavy water to make an atomic bomb (which it did not). Jack became head of the cyclotron team and spent the war years working on basic aspects of nuclear fission; for this work he received the Stokes Medal from Cambridge University in 1945. He was an ARP (air raid protection) warden and when on duty played bridge with Fred Hoyle and others to pass the time. Also, because of a shortage of faculty during the war years, Jack did a great deal of teaching, lecturing on atomic and nuclear physics and giving tutorials. He later said that teaching strengthened his understanding of physics and was of great importance when he switched to biological problems. During his time at Cambridge, Jack continued his interest in natural history, chiefly bird-watching, and read more deeply in evolutionary biology, including works by Darwin, Huxley, Mayr and Dobzhansky.

After the war, Jack spent two years at the Canadian Atomic Energy Laboratories in Chalk River, Ontario, where he helped to establish the program in nuclear physics and worked on methods to measure doses of radioactivity received by biological tissues. In 1949, he was invited to join the physics faculty in the Department of Natural Philosophy at the University of Edinburgh where he built up a research group around a small accelerator. In the early 1950's Jack was asked by the head of the department, who knew of his interest in biology, to take on the task of teaching elementary physics to a large class of medical, dental and veterinary students. Although he initially balked, he was offered the opportunity to establish a new Department of Biophysics as an inducement, and thus, in his own words, he moved into biology "almost by accident". Early collaboration with an animal physiologist on the exchange of sodium across the membranes of cat nerve cells pointed Jack in the direction in which he was to make his most important contributions: the transport of water and ions across the membranes of plant cells. A brilliant physics graduate student, Enid MacRobbie (now Professor Emeritus, University of Cambridge) joined forces with Jack to work on membrane transport in plants, using the characean alga *Nitellopsis* and radioactive isotopes to measure influxes and effluxes of Na, K, and Cl. These pioneering studies demonstrated the presence of ion pumps in the cell membrane and tonoplast and established that the fast-diffusion, so-called free space, fraction of ions was located exclusively in the cell wall, not in the protoplast as previously thought. Further collaboration with Alex Hope at the University of Sydney on water permeability and ion exchange in the giant cells of the freshwater alga *Chara corallina* established that the rate of water exchange was controlled by the rate of diffusion across the unstirred layers of water external to the cell membrane.

These early publications made clear the importance of a biophysical approach to plant membrane transport and transformed the field. As a consequence, Jack was invited to write several reviews in the early 1960s, including ones for the Annual Review of Plant Physiology and Advances in Botanical Research. In these he argued that the older concepts of "suction pressure" and "diffusion pressure deficit" be replaced by more rigorous irreversible thermodynamic approach to understanding the driving forces of plant water relations. In 1963, Jack moved to the new University of East Anglia in Norwich where he attracted a strong group of academic visitors, graduate students and post-doctoral fellows working on ion and water relations, including the ion exchange capacity of cell walls and the measurement of membrane potentials. Here, he carried on with his strong interest in teaching physics to undergraduate biology students, as well as to graduate students in

biophysics. His lectures to M.Sc students started at 8 am because everyone was so busy that this was the only time available. Jack somehow made it but often looking the worse for wear. The students were prepared and provided coffee and he would cadge a cigarette and puff away as lucidity prevailed.

In 1969, Jack moved again to the University of California at Los Angeles, first to the Laboratory of Nuclear Medicine and Radiation Biology and then to Department of Botany at UCLA. At that time, Hal Mooney had recently moved from UCLA to Stanford and Jack volunteered to look after his grad students and to teach an undergraduate course in plant ecology. Jack saw this as an opportunity to integrate his knowledge of biophysics with a life-long interest in natural history. Despite the enjoyment of putting a biophysical slant on everything ecological, he decided in the end that ecology was biologically too complex for a physical scientist. Development of this course, however, influenced the direction of research taken by Park Nobel at UCLA, who subsequently made important biophysical contributions to plant ecology and the course also provided the foundation for the successful advanced textbook written by Nobel.

After just two years at UCLA, Jack moved to the Department of Botany at the University of Toronto to take up the position of Chair and the opportunity to return to biophysical plant physiology. A former grad student from East Anglia, Mel Tyree, joined faculty at same time and together they formed a fruitful collaboration, studying water relations of *Tsuga canadensis* using the Scholander pressure bomb and symplastic transport between the giant internodal cells of *Chara corallina* using radioactive tracers as a test of theoretical considerations. In the mid-1970s, Bill Lucas (now University of California, Davis) joined the lab to continue electrophysiological work on the properties of HCO_3^- transport across the cell membrane of *Chara* and demonstrated the dramatic effects of cations on HCO_3^- influx and membrane integrity. Other students and associates also worked on the electrophysiology of membrane transport and on the ion exchange properties of plant cell walls. During this period, he was also an Associate Editor of *Plant Physiology*, a position that he took very seriously but enjoyed. Jack stepped down as Chair in 1976 and retired from the University of Toronto in 1984. In retirement, he continued collaboration with his successor, Eduardo Blumwald (now at UC Davis) on the regulation of ion channels in the cell membranes of halophytes. Jack continued to be sought after as a consultant and collaborator in various aspects of membrane biology and biophysics throughout his life. His most recent publication dealt with the biomechanics of aquatic vegetation (Schutten et al., 2005, *J. Ecol.* 93: 556-571); thus, his publication record spanned more than 60 years (another joint MS is under review at present). As Chair of the Department of Botany at the University of Toronto, Jack was distinguished by his strong sense of fair play, open-mindedness, and lack of pretension. Despite his distinguished academic career, his behavior was democratic and his attitude toward the diversity of fields of study found in the department inclusive. He was uniquely able to personally connect with individual faculty members, support staff, and graduate students and was generous with advice and encouragement. Throughout his life, Jack was a loyal and steadfast friend of many, maintaining friendships and collaborations with many in North America, the U.K and Europe, and Australia.

Teaching played an important part throughout Jack's career and he later stated that one of his most significant accomplishments was to inculcate a feeling in students for the biophysical aspects of biology. For example, while at the University of Toronto, he taught an introductory biology course for non-Biology students on the "Design of Organisms" that discussed questions of size and shape and how these were determined by the physics of diffusion, the bulk flow of fluids, and biomechanical constraints. The textbook for this course was "Gulliver's Travels", a choice that surprised many of the students, but one that forced them to think analytically about biological size. While an untenured faculty member, I (Nancy) audited an upper division course on "Plant Biophysics" taught by Jack (and Mel Tyree) and was entranced by how straightforward and logical he made the physical processes underlying membrane transport and the bulk flow of fluids in the xylem and phloem seem. Even an elementary understanding allowed an evaluation of conflicting theories and a check on the interpretation of experimental evidence.

The significance and impact of Jack's research accomplishments were recognized by appointment as "University Professor", the highest academic honor at the University of Toronto. He has been a recipient of the Gold Medal of the Canadian Society of Plant Physiologists and was elected a Corresponding Member of the Botanical Society of America and of the American Society of Plant Physiologists. Jack was also a Fellow of the Royal Society of Canada, the American Society for the Advancement of Science, and the Royal Society of Edinburgh. He was elected as a Foreign Associate of the Academy of Sciences of the Institute of France and also he was appointed an Academician of the National Academy of Lincei, Rome. Sadly, election to the Royal Society of London eluded him, a reflection of the somewhat myopic views of the day. In 1994, he was invited to write a biographical chapter for the *Annual Review of Plant Physiology and Plant Molecular Biology* (Vol 41: 1-40).

In retirement, he lived in France and Norwich in East Anglia, U.K. Much of the time was spent avidly reading European and North American literature or watching football. He had an excellent command of languages, and a phone call a month before he died revealed that he had just finished reading a novel in French. He celebrated his 90th birthday a few weeks before he died with family, friends and colleagues, but had been in failing health for over a year. Jack is survived by Mary Elbeck and their sons Anton, Chris and Patrick and by Trish Shea and their sons Jack and Matthew.

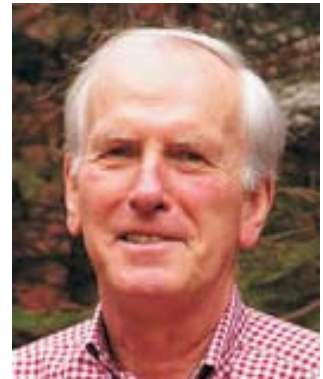
At the University of Toronto he is remembered by the Jack Dainty Graduate Scholarship in Ecology and Evolutionary Biology, which was set up two months before he died. It gave him considerable pleasure that a Scholarship was to bear his name. So far about half of the funds needed have been donated. (Donations may be sent to the University of Toronto at Office of Advancement, Faculty of Arts & Science, 100 St. George Street, RM 2033, Toronto, ON, M5S 3G3, Canada. Cheques should be made payable to 'University of Toronto' and identified as 'Jack Dainty Fund')

* Sadly, Robert Jefferies passed away soon after writing this obituary. Please see the next page for his obituary.



Obituary

Robert Lenthall Jefferies (1936-2009)



The obituary for Jack Dainty elsewhere in this issue (page 82) of the Bulletin was, by a harsh twist of fate, probably one of the last items that Bob Jefferies would write. As noted in the September Bulletin, in July of this year, still an active and dynamic person, he was struck down suddenly and unexpectedly by a serious fatal illness. In early November roughly five hundred of us assembled in the Great Hall of Hart House, University of Toronto, to commemorate and celebrate the life of one of the university's most accomplished and respected members of the academic staff. Canada and the international scientific community have lost a remarkable colleague, who, unusually, combined brilliance in **both** research and teaching. Past and present members of the Department of Botany (to use its former name) feel a deep sense of loss, not just of an outstanding colleague, but of a dear and loyal friend. At that moving and splendid celebratory event, three salient aspects of Bob's life were highlighted: his original and acclaimed investigations of subarctic ecosystems; his remarkable and wide-ranging talent as a teacher, of both undergraduates at all levels and of graduate students; and his wonderful human qualities of modesty, kindness, and friendship, and devotion to a loving family. Of the last, moving tributes to their father were given by his daughters, Rachel and Alison.

At the celebration Bob's sister Marion described the roots of his love for, and deep knowledge of all things natural, plants and animals. Born and brought up in Somerset, England, he completed undergraduate and doctoral degrees at the University of Bristol, won a postdoctoral fellowship for study at the University of California, Davis, where he met and married Susan Locke, then was awarded a NATO fellowship for study at the University of East Anglia (Norwich, UK), where his association and friendship with Jack Dainty began. After Jack assumed the chairmanship at Toronto (to the delight of us all, as Nancy Dengler has noted elsewhere in this Bulletin), he persuaded Bob to take up a visiting professorship in 1973 which led to a permanent position that he held until his untimely death this year.

Although he had formally retired, Bob continued to teach and develop part of the first-year course, Organisms in their Environment, that every year attracted over 1500 students, and he had planned to extend his unbroken sequence of 19 years in the fall term of 2009. During that long period, he rearranged his research leaves so that, each year, he could teach the first section of the course - a rare habit among academics!

The research that he began on the salt marshes of Cape Churchill in 1978 continued without pause, including the early summer of 2009, and these investigations of the interactions of Snow Geese populations and the tundra vegetation are recognised internationally as among the most complete and thoroughly studied anywhere. Bob's insights into the role of climatic change in modifying ecosystem responses lead to his appointment as a Canadian member of the Intergovernmental Panel on Climate Change, and its impact on global thinking and awareness resulted in the award of the Nobel Peace Prize to the panel and its chair, Al Gore. Bob, characteristically, did not divulge widely news of that signal honour, and even his colleagues, far less the Canadian community at large, were unaware of it!

In common with many colleagues, I recall how, in his capacity as Graduate Secretary of the department, Bob helped me and particularly my graduate students, with his constant grace and friendship, to negotiate the tricky hurdles, financial and academic, that seemed to pop up.

Bob Jefferies' legacy - of scientific originality and accomplishment, of skill and dedication as a teacher, and of profound humanity, humour and personal loyalty - will endure. The Robert Jefferies Memorial Fund at the University of Toronto will make a formal contribution to preserving that legacy.

Jim Ritchie, Emeritus Professor of Botany, University of Toronto.

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Postdoctoral Fellowship in Pollination Biology

A postdoctoral position is available to conduct research projects related to angiosperm reproductive biology, particularly floral nectaries, nectar production and pollen formation, from developmental and cytological perspectives, with the possibility of some field work. Candidates with a Ph.D. in plant cell biology/development/anatomy including experience with transmission and scanning electron microscopy are encouraged to apply. This position, jointly supervised by Drs. A.R. Davis and V.K. Sawhney, is available immediately. The salary is \$30,000-35,000 per year (dependent on experience) and is available for one year with the possibility of renewal for a second year. Applications will be considered until the position has been filled. Please send details of your career goals, curriculum vitae, reprints of published papers, and the names, addresses and emails of three referees to: Dr. Arthur R. Davis, Department of Biology, University of Saskatchewan, 112 Science Place, Saskatoon, Saskatchewan, S7N 5E2, Email: art.davis@usask.ca

Professor John L. Harper: the Canadian Connections

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"Professor John Lander Harper revolutionized plant ecology and had perhaps a greater impact on its development as a modern science than anyone else since Darwin. John brought population biology and experimental approaches into the forefront of plant ecology, linking demography and selection, and therefore ecology and evolution. He will be remembered with great affection and gratitude by plant ecologists throughout the world." [Taken from Turkington, R.A. "A tribute to Professor John Harper FRS, CBE (1925-2009)" in the *Bulletin of the British Ecological Society* 40 (3): 22-24].

When Professor Harper died earlier this year, there was a rapid and immense outpouring of tributes from a host of scientists around the world. Already, there have been detailed remembrances in British newspapers, the *Journal of Ecology*, the *Bulletin of the British Ecological Society* and in "Memories of John L. Harper", a volume of more than 100 pages containing tributes from more than 40 of his colleagues, former students and friends (edited by Glenn R. Matlack, SPB Publishing).

John Harper spent the bulk of his career at the University College of North Wales in Bangor. His connections with Canada were many and varied. The first (Paul Cavers) and the last (Céline Boutin) Ph.D. students that he took on during his time in Bangor were Canadian. At least 2 of his other Ph.D. students also were Canadian (Lucie Maillette, Jon Lovett-Doust). Several of his British graduate students came to Canada to work after finishing their degrees (e.g. Lesley Clegg, now Lovett-Doust; Roy Turkington). Several Canadian scientists (e.g. Pierre Morisset) worked or visited with him in Wales. Another one of these, who shall remain nameless, arrived in Bangor just after the eminent Mexican ecologist, José Sarukhán, had submitted his Ph.D. thesis. The visitor was given the unbound manuscript of that thesis to peruse at his Bed and Breakfast overnight. Unfortunately, he parked his car in an open space near the top of a hill. He placed the thesis on the roof of the car before he locked the doors. Immediately the wind picked up the many pages and distributed them over the adjoining fields! Fortunately, the day had been dry (unusual in North Wales) but the scientist and his wife spent all of the evening hours of daylight collecting the pages and much subsequent time reassembling them in the right order. Not surprisingly, he read very little of the thesis.

In 1966, John Harper and I devised a scheme whereby one Canadian undergraduate worked in Bangor for a summer while an undergraduate from Bangor came to London, Ontario (The University of Western Ontario) to work in the same summer. The first British student to arrive was Alan Coackley, followed in subsequent years by Sheila Cook (now Jones), Anne Cobb (now Looker) Ellen Edwards (now Billett), Tony Stead, Katie Sellek, June Randell, Keith Wood, Roger Kennett, Steven Cooper, Lisa Kelly, Helen Kibblewhite, Judith Horlock (now Quigley), Joanne Wainwright, Iona Andrews, Andy Holmes and Ian Smart. Canadian students who went to Bangor included Shirlyn Barkey, Fred Rutherford, Peter Beninger, David Wake, Lonnie Aarssen, Carolyn Emo, Lynda Olson, Sarah Rang, Catherine Vis, Catherine Major (now Davidson), Dan Pust and Louise Rang. I must acknowledge the important role that Dafydd Wynn Parry, and later Richard Shattock, filled by handling the correspondence from the Canadian exchange students, finding accommodation for them and ensuring that they spent at least some of their time in the Harper lab. At least one student from each country married someone that they met during their summer exchange.

There were quite a few amusing and/or challenging incidents from this exchange.

a) The British students usually arrived in Canada in the middle of our field season. Naturally, they wanted to maintain their reputation for hard work so they inevitably spent their first full day in London, Ontario in the field under a hot sun. Quite a few of them felt faint by the afternoon and several had to be cared for until they became acclimatized.

b) One of the girls was soon joined by her male partner who moved into the "digs" that she occupied. All was fine until the girl received a phone call to say that her parents were arriving for a visit the next day. Apparently, they were not fond of the partner so our lab people helped to move him rapidly into temporary accommodation.

c) Our first Welsh student was invited to a party north of London one evening. Shortly after she got there, the mother of the girl who was hosting the party started to make some very rude remarks about the Welsh language, essentially describing it as a degenerate form of English. Our student was so angry that she marched out the front door and started to walk home. She had forgotten that she was about 10 miles away from her residence and so it took several hours because she wasn't sure of the route. The next day we had to send her home from work to recover.

d) Another girl was an avid supporter of nuclear disarmament and had been arrested at a "Ban the Bomb" march in the U.K. just before she was supposed to leave for Canada. We were not sure that she would be allowed into Canada but this did not prove to be a problem. Her worst problem in Canada was that she did not like Canadian food, thus causing a logistical problem for our Postdoctoral Fellow and his wife with whom she boarded (They came from the U.K.).

e) Several students purchased a bus pass from Greyhound. This enabled them to travel all over North America for a period of 30 days. Not surprisingly, they all tried to see as much as possible, which involved sleeping on the buses each night as they traveled for another stint of hundreds of miles. Eventually, they returned to Wales in a state of exhaustion and, in at least one case, the student was not able to recover sufficiently to earn the first-class degree that was expected of her. Fortunately, she was accepted for postgraduate studies at a prestigious university and subsequently has carved out an outstanding academic career.



John L. Harper in May 2006. Photo: Roy Turkington

This student exchange continued into the early 1990s. Many of the participants have gone on to postgraduate studies and several from each group have become highly successful teachers at the university or high-school level. Several have achieved excellence in their research and have taught postgraduate students of their own. Many have remained in contact with the people they met in the other country.

In addition, several people who had completed their undergraduate degrees in Bangor subsequently completed postgraduate degrees in Canada (e.g. Richard Staniforth). In his tribute to John Harper, Roy Turkington noted that 18 of John's former students hold (or held) faculty positions in universities throughout the world. At least 6 of that number have spent all or most of their careers in Canada. One of these, Lesley Lovett-Doust was appointed recently as the President of Nipissing University in Ontario.

In the summer of 1967, John Harper gave a memorable invited lecture to the Annual Meeting of the Canadian Botanical Association in Ottawa. He then visited Montreal (for Expo 67 and meetings with leading ecologists) and London, Ontario. During the latter visit he interviewed and hired a new faculty member for the newly-formed School of Plant Biology in Bangor. He also served as the External Examiner for several Ph.D. theses in Canadian universities.

An obituary for John L. Harper, written in Mexico by Miguel Franco, José Sarukhán and Rodolfo Dirzo, is entitled "A Darwinian Plant Ecologist". I conclude over the next four paragraphs with extracts from their article.

"John Harper is credited with the establishment of the field of plant population ecology, which is rooted in Darwin's emphasis on the role that individual differences play on evolution by natural selection. In 1960, he was appointed chair of Agricultural Botany at the University college of North Wales, Bangor. In 1967, he founded and became head of the School of Plant Biology, a fusion of the Departments of Botany and Agricultural Botany. This became the Mecca of plant population biology, attracting students and visitors from all over the world. He was President of the British Ecological Society (BES) between 1966 and 1968. His presidential address entitled "A Darwinian Approach to Plant Ecology" became an instant classic in ecological literature. For his significant contribution to the development of the science of ecology, he was the recipient of the Marsh Award from the BES in 2000. The BES' "John L. Harper Young Investigator Award" is given for the best paper published over the course of each year by a young researcher in the Journal of Ecology.

His monumental work *Population Biology of Plants* was published in 1977. A year later he was elected Fellow of the Royal Society (U.K.). He was appointed to the Order of the British Empire (CBE) in 1989 and awarded the Darwin Medal by the Royal Society in 1990. This medal recognizes "work of acknowledged distinction in the broad area of biology in which Charles Darwin worked". John Harper received this medal for his research on the population biology and evolution of plants, which has greatly improved understanding of the adaptation of plants to their environment".

Over the course of his successful career, John Harper published more than 130 scientific papers and several books, including the highly successful textbooks *Ecology: from Individuals to Ecosystems* and *Essentials of Ecology* in collaboration with Michael Begon (Liverpool) and Colin Townsend (Otago, N.Z.). The first of these, now in its fourth edition, has been the standard higher-level ecology textbook for more than twenty years. For this book, in 2007 the authors received a Lifetime Achievement Award from the BES, prompting Michael Begon to say that this award "had made one old man feel very proud and two proud men feel very old".

John Harper's long-time colleague and friend, the evolutionary biologist John Maynard Smith, once said that biology is difficult because of the number of facts one has to retain in one's head to be able to make connections and generalizations. John Harper was among the few biologists with this capacity. His childhood acquaintance with farming, his perennially youthful zeal for natural history, his professional training in agriculture, and his ability to soak up and retain everything he read allowed him to see beyond the surface of ecological questions and make insightful, often unexpected, connections. He had a sharp intellect and extraordinary memory, he was renowned for his flair as a lecturer and performer, he had a powerful charisma, and he was protective of his numerous students and collaborators."

Glenn Matlack (in *Memories of John L. Harper* 2009) noted that John Harper's published works have earned close to 10,000 citations in the professional literature, placing him easily in the same class as Sewall Wright, Richard Lewontin, G.E.

Hutchinson, Fakhri Bazzaz, Ernst Mayr, A.S. Watt, John Maynard Smith, E.O. Wilson and Charles Elton. I can concur with this estimate since, in the early 1990s, I found more than 1000 citations of his publications in the Canadian literature alone.



AoB PLANTS a new open access journal for plant biologists

Authors are turning in increasing numbers to open access journals to publish their work. The attractions of doing so are several. They include having greater control over copyright, the appeal and flexibility of the latest publishing technologies and, above all, having papers made available without charge worldwide and thus freely available to anyone who wishes to read them as soon as they are published. The newly launched journal *AoB PLANTS* offers these and other attractive features. It covers all aspects of plant biology, is owned and managed by plant scientists on a not-for-profit basis and is published by Oxford University Press. *AoB PLANTS* publishes 'Research Articles', 'Points of View', 'Reviews', 'Mini-reviews' and 'Technical Articles'. Submitted papers are evaluated against published minimum criteria for acceptability using a double-blind refereeing system. Papers will appear online within 3-5 days of acceptance and benefit from a full typesetting and proofing service. For an introductory period, there will be NO CHARGE to publish in *AoB PLANTS*. This creates the ideal opportunity for authors to try the new journal and enjoy the benefits of open access publishing at no cost. For further information contact Mike Jackson, Chief Editor *AoB PLANTS*, E-mail: mike.jackson@bristol.ac.uk or visit the web site <http://aobpla.oxfordjournals.org/>.

L'arbre à pain et l'arbre d'or

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The author on the external staircase of his cévennol *pied à terre*



The long-running debate about what is natural and what is anthropogenic with respect to individual plant or animal species and ecosystems, has intensified recently (Willis & Birks, 2006). The increase in biological invasions, pressures of technology, and the urgent need to clarify the role and history of anthropogenic impact on climate change, have spawned a growing research activity and attendant literature. For example Ruddiman's hypothesis that the human impact on climate change extends back millennia, long before the influence of the 20th century industrial revolution, has sent a ripple through the international scientific community.

A remote corner in the Cévennes National Park in south-central France illustrates several relevant aspects of the question. Although this beautiful landscape was known to early travelers and commentators, it was Robert Louis Stevenson's published description of his leisurely journey through part of the Cévennes in the late 19th century that stimulated interest in the region by tourists, primarily from outside France. Today, its particular physical geography, flora and vegetation, and its unique history of religious conflict, attract a distinctive, small spectrum of both visitors and seasonal residents.

The tiny hamlet of Millerines (Fig. 1) is one of the many remote settlements that were resistant Huguenot outposts in the 17th-18th century, during the *Wars of Religion*. A historical anecdote about Millerines illustrates the drama of the period. In 1705 a platoon of papist military descended on the hamlet in pursuit of a protestant rebel Camisard leader. While most of the residents hid in the surrounding woods, the soldiers looted and pillaged the hamlet, then passed on down the valley.

At that time, many Huguenots emigrated to countries where Calvinists could settle happily, so today some of their descendants arrive, from Switzerland, the Netherlands, Germany and elsewhere as summer tourists, keen to explore their historical roots. Hamlets like Millerines were established in the 16th century and they emerged from historical obscurity as a result of three influences – religion, as noted, and the two trees that make up the title of this article – the chestnut and the mulberry.

While there is evidence in the Eastern Pyrenees and the Cévennes of pollen of the chestnut, *Castanea sativa*, in peat bog samples dated at 6000 years ago, it was introduced extensively in western Europe by the Romans. Its dominance of many low-elevation slopes with thin siliceous soils of the cévennol landscapes dates from the 10th and 11th centuries when it was introduced from Italy by Benedictine monks. They organized the construction of terraces on the hill slopes to retain the thin soils and to support the chestnut trees. By the 18th century, it had become the central item in the economy of the cévennol culture, and the modern trees on the predominantly north-facing slopes around Millerines illustrate its long history of successive pollarding, with multiple trunks supported on massive stools. South-facing slopes, by contrast, support apparently natural woodlands dominated by the evergreen oak, *Quercus ilex*, associated with a shrub and herb flora of predominantly Mediterranean affinity. Chestnut is one of the longest-lived European trees, and in the extremely rare absence of successive pollarding, it can reach heights of over 40 meters and basal diameters of 1-2 meters at ages in excess of 3000 years. In the simple economy of the Cévennes it provided hard, resistant wood for a multiplicity of purposes – roof beams, firewood, fencing, baskets and beehives, and most importantly, the chestnuts were dried, then ground into flour, a staple of the diet of that time – l'arbre à pain. (Fig. 2)

The other tree that has symbolised the Cévennes is the mulberry. It was introduced to France in the 13th century, then the species *Morus nigra*, the black mulberry, the basis of the growing silk industry.

As Christopher Lloyd comments, the beginnings of silkworm cultivation can be traced far back in time, to the development of Chinese agriculture more than 3000 years ago, and the rapid expansion of sericulture resulted in a vast increase in the economic status



Fig.1: The hamlet of Millerines, in the Cévennes mountains of south-central France.



Fig. 2: *Castanea sativa*, in flower, early June 2009.



Fig 3. *Morus alba* and a background of slopes dominated by *Quercus ilex*

(Continued)

of China. Silk trade, along the famous Silk Road, grew rapidly to satisfy the demands of southern European countries, particularly from the period of the Roman Empire. The silk bolt was an important item of currency until in the early 12th century when the Chinese invented paper-money, initially, as it happens, made from the bark of the mulberry.

At about this time, mulberry was brought from Italy to Provence, and in 1309 Pope Clement V ordered extensive planting in the region of Avignon. Documentary evidence suggests that the black mulberry was in use to support silk-worm culture in the Cévennes in the 13th century, but much later, in the period from the 16th to the 18th centuries the white mulberry, *Morus alba*, (Fig. 3), was imported from China because of the finer, lighter silk thread it produced. What Graham Robb describes as the “agricultural goldrush of the mid-nineteenth century” dominated the life and economy of the Cévennes, with a flourishing industry that had been actively promoted by Colbert, finance minister of Louis XIII. As the industry boomed, many of the houses in the cévennol hamlets had an additional upper storey added, where the leafy mulberry branches were dried to support the *Bombyx mori* populations. For example, the Millerines house illustrated here (Fig. 4) would have supported an extended family occupying the middle storey, a few animals in the lower, basement level, and the drying mulberry branches above in the top storey. Chestnuts were also dried in the upper level on incompletely sealed floors to permit warmth from the lower level to penetrate.

Cotton-mill factories were built in the region where the cocoons were assembled and silk produced. However, the spread of a silkworm parasite in the mid 19th century signaled the first decline of the industry, and though Louis Pasteur found a cure for the disease, other negative factors were operating. The arrival in Europe of superior silks from China and Japan, facilitated by the opening of the Suez Canal in 1869, and then the advent of artificial fibres, brought about the demise of the cévennol silk industry. The Cévennes economy collapsed, and as agriculture became industrialized many people moved away to larger urban centres. Many cévennol houses and farms were abandoned, or later were purchased as seasonal residences. Today, most of the Millerines houses are occupied seasonally by owners whose permanent residences are elsewhere in France, or further afield.

So here in this small, distinctive landscape ‘natural’ and historical anthropogenic elements are juxtaposed in a stable equilibrium. The Millerines valley is rare in that by its remoteness it has not been modified in the 20th century, as have many other cévennol areas, by such forestry activities as clearing and replanting with *Picea*, *Larix*, *Cedrus* and other introduced taxa. This particular valley is made up of a mosaic of ecosystems – on the predominantly south-facing slopes, those of Mediterranean affinity that we might describe as ‘natural’ as the impact of humans has been minimal (walkers, naturalists, and seasonal hunting of wild boar), and on the other hand those dominated by the consequences of historical anthropogenic influences, centred on *l’arbre à pain* and *l’arbre d’or*.

So, apart from that general point, what’s this got to do with the CBA, I hear you say? Just a little..... if you were to visit us you would find our *salle de séjour* replete with Canadiana – tables and chairs of Canadian maple, and that Lawren Harris print over the mantelpiece (Fig. 5), to remind us of many happy working days in the Canadian Arctic.

My thanks to Laura Nightingale for expert technical assistance.

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Fig. 4: A three-storey Millerines house, typical of the region.



Fig. 5: Our *salle de séjour* with one of its several items of Canadiana.



NATIVE PLANT EMBLEMS OF CANADA

11. British Columbia

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FLORAL EMBLEM: PACIFIC DOGWOOD

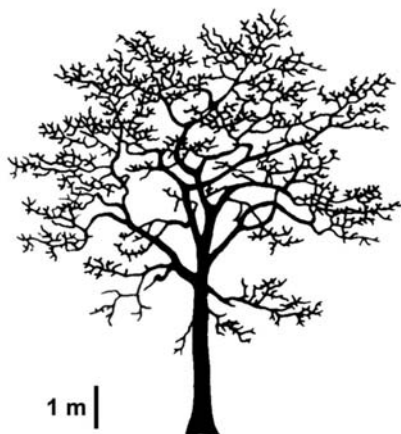


Fig. 1. Silhouette of Pacific dogwood (*Cornus nuttallii*). Source: Farrar, J.L. 1995. Trees in Canada. Canadian Forest Service and Fitzhenry and Whiteside, Markham, ON, Canada. Reproduced with permission.

SYMBOLISM

Pacific dogwood is an excellent floral symbol for British Columbia. The province is the only part of Canada where the species grows naturally, and it can not easily be cultivated elsewhere in the country. The plant is fairly common in the southwestern part of the province, and well represents the widespread forest ecosystem of the West Coast of Canada. Pacific dogwood in flower is spectacularly beautiful and the brilliant red fall foliage is also very impressive. The species has been a useful economic plant for Indigenous Peoples of the province, and thus serves as

a reminder of the native culture. Moreover, a dogwood blossom is on a flag representing Franco-Columbians (French speaking British Columbians) that was chosen in a contest in 1981 and first hoisted in 1982.

LATIN NAMES

Cornus nuttallii Audubon ex Torr. & Gray

The genus name *Cornus* is the Latin name for the (Eurasian) cornelian cherry, *Cornus mas* L., originating from the Greek *keras* and the Latin *cornus*, meaning "horn" (applied because of the hardness of the wood).



Fig. 2. Thomas Nuttall (in 1824), commemorated in the name *Cornus nuttallii*. This engraving was published in London in 1825.

The specific epithet *nuttallii* in the name *Cornus nuttallii* honours Thomas Nuttall (1786-1859), a British-American botanist and ornithologist, the first to recognize Pacific dogwood as a new species, in 1834 at Fort Vancouver. His friend, the famous ornithologist John James Audubon, named the species after Nuttall. Nuttall was one of the most knowledgeable of early North American plant collectors. He made numerous, significant collections, and published extensively on these. Nuttall is noted for his encyclopedias: *The Genera of North American Plants*, *North America Sylva*, and *Manual of Ornithology of the United States and Canada*. In addition to providing Audubon with specimens to illustrate, Nuttall contributed generously to the works of other naturalists. He is commemorated not only by *C. nuttallii*, but also in the names of several other birds and plants. For more on him, see Graustein, J.E. 1967. Thomas Nuttall naturalist exploration in America 1808-1841. Harvard University Press, Cambridge, MA. 481 pp.

ENGLISH NAMES

Pacific dogwood. Also: California dogwood, flowering dogwood (the phrase currently used in British Columbia legislation designating the floral emblem of the province, although this name is much more widely used for *C. florida* L.), mountain dogwood, mountain flowering dogwood, Nuttall's dogwood, Oregon dogwood, Pacific mountain

dogwood, Western dogwood, Western flowering dogwood.

It has been suggested that the name “dogwood” arose in England where a boiled tea made from the bark was used to remove external parasites from dogs; or, from the words “daggerwood” or “dagwood”, reflecting use of the hard wood as a dagger or skewer on which to cook meat. A third explanation that has been proposed is that the unpalatable fruits gave rise to the names “dogberry” and “dogwood”; this is consistent with an old tradition of using the word “dog” in reference to things of very limited value (e.g., as in the expression “not fit for a dog”).

FRENCH NAMES

Cornouiller du Pacifique. Also: cornouiller de Nuttall.

HISTORY

a. Canada

The Pacific dogwood was adopted in 1956 as British Columbia's floral emblem, winning out over the columbine (presumably *Aquilegia formosa*). The dogwood was considered to be an unofficial emblem as early as 1931, when the Dogwood Protection Act was passed to prohibit cutting or picking its flowers on public land. During World War II, dogwood lapel pins were sold and the money used to buy wool and other goods for British Columbian soldiers.

b. Foreign

In 1918, Virginia adopted the flowering dogwood (*C. florida*) as its official state flower, and in 1956 proclaimed it to also be the official state tree. In 1941 North Carolina adopted “dogwood” (generally interpreted as *C. florida*) as the official state flower. In 1951 New Jersey adopted *C. florida* as its official “state memorial tree”. In 1955 Missouri adopted the same species as its official arboreal emblem. Although *C. florida* is mainly found in the U.S., it is also native to the southernmost part of Ontario.



Fig. 3. Pacific dogwood (*Cornus nuttallii*). Source: Canadian Heritage. 2002 (revised edition). Symbols of Canada. Canadian Heritage, Ottawa, ON. Reproduced with permission.

APPEARANCE

Pacific dogwood is a small to medium-sized, multi-branched, deciduous tree, 6-25 m (20-82 feet) tall, sometimes appearing to be a shrub. In Canada it is typically 6-8 m (20-36 feet) in height, with a trunk 15-30 cm (6-12 inches) in diameter. The maximum trunk diameter (breast height) reported is 61 cm (24 inches). The canopy of the larger trees sometimes spreads 6 m (20 feet). The bark is thin, smooth, and dark purple, in mature trees occasionally breaking into small rectangular plates. The tiny, dull-purple or green flowers are in dense clusters, surrounded by 4 to 6 (usually 5, sometimes 7 or 8), showy, creamy-white or (uncommonly) pinkish, petal-like bracts that are about 5 cm (2 inches) long. The clusters of flowers surrounded by the white bracts have the appearance of large flowers with white petals, and are widely interpreted as such. The clusters together with their bracts are often 10-13 cm (4-5 inches) across. The pinkish-red berries (technically drupes) are 1-1.5 cm (0.40-0.6 inch) in diameter, occurring in clusters of 30-40. The root system is typically deeply penetrating, often with a main taproot.

CLASSIFICATION

Family: dogwood family (Cornaceae).

The genus *Cornus* consists of several dozen species. The number of species is not clear because different authorities include different numbers of species. The plants are mostly deciduous shrubs and small trees of north temperate grasslands, woods, and swamps, but a few species are evergreen, some are perennial herbs, and one is native to the Southern Hemisphere. Ten species are native to Canada.

The bunchberries or dwarf cornels (*C. canadensis* and *C. suecica*), are familiar woodland herbs reaching 30 cm (1 foot) high, across Canada. Their flowers are very similar to those of the much larger Pacific dogwood and flowering dogwood, which are often trees. Despite the huge difference in size, the forest herbs appear closely related to the trees, and recent molecular evolutionary studies have confirmed this close relationship. There are few other examples in the Canadian flora of trees and herbs so closely related as to be placed in the same genus.

GEOGRAPHY

The Pacific dogwood is a native of the West Coast of North America, found in the coastal forest regions west of the Cascade Mountains, from southwestern British Columbia (including central and southern Vancouver Island) to southern California, with an isolated inland population in northern Idaho (considered to be in danger of extinction), and occasional populations in the mountains of San Diego and Los Angeles counties of California. The species usually occurs below 1500 m (5000 feet) in altitude over most of its range, generally below 300 m (1000 feet) in Canada. (See next page)

ECOLOGY

Pacific dogwood occurs in the understory in low-elevation coniferous, hardwood, and mixed coastal forests. It develops best in Douglas fir (*Pseudotsuga menziesii*) forests and in the redwood forests of California. In



Fig. 4. Painting of the official flower of British Columbia, Pacific dogwood (*Cornus nuttallii*), from the Walter Coucill Canadian Centennial official flowers of Canada series (see Coucill 1966 cited in #1 of this series). Reproduced with the permission of the copyright holders, the Coucill family.

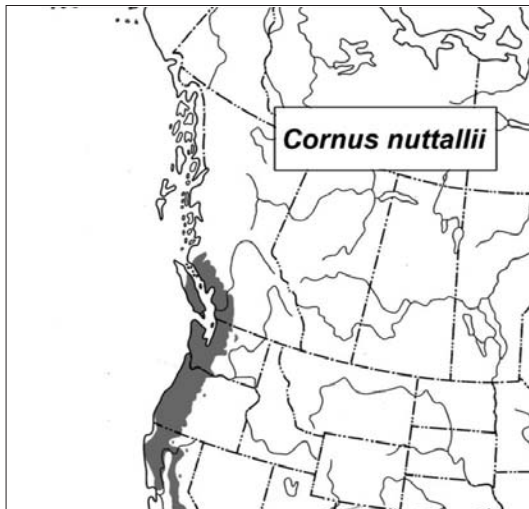


Fig. 5. Canadian and adjacent United States distribution of Pacific dogwood (*Cornus nuttallii*).

southwestern B.C., Pacific dogwood associates with Douglas fir, grand fir (*Abies grandis*) and western hemlock (*Tsuga heterophylla*).

Habitat

The Pacific dogwood generally lives in the shade of forests, often along stream banks. It prefers moist but well-drained soils, and is both drought-tolerant and tolerant of flooding. The soils occupied are typically deep (often more than 2m (6.6 feet)), somewhat acidic (pH typically 5.5-6), range in texture from clay to sandy loam, and are often high in humus. Consistent with its mild, West Coast distribution, the species has limited frost tolerance.

Inter-species Relationships

Some deer species (especially mule deer) are known to graze regenerating sprouts of Pacific dogwood, but most mammals avoid eating the leaves (which have a bitter sap) and the branches. Bears, shrews, voles, and other small



Fig. 6. Band-tailed pigeons (*Columba fasciata*) perched on a branch of Pacific dogwood (*Cornus nuttallii*). Source: Audubon, J.J. 1827-1838. The birds of America. Robert Havell Jr., London, U.K. Plate 367. Audubon based his painting of the birds on preserved specimens collected by explorer-biologists John Townsend and Thomas Nuttall during an expedition to the Pacific Northwest in 1834. In 1837 Audubon described the plant as a new species of *Cornus*, *C. nuttallii*, naming it in honour of Nuttall. The plant was painted by Audubon's assistant Maria Martin.

mammals, and many species of birds such as pigeons (especially the band-tailed pigeon shown here), quail, grosbeaks, hermit thrushes, and waxwings consume the fruits. Beavers will eat all above-ground parts of the plant. Pacific dogwood has been recommended as an appropriate garden plant to attract butterflies and hummingbirds.

Dogwood anthracnose (also called dogwood leaf blotch) is a disease caused by the fungus *Discula destructiva*, which

has become a major threat to *C. nuttallii* and *C. florida* since the 1980s. It has been claimed that the fungus was imported to North America in shipments of Japanese dogwoods (*C. kousa*). Many wild and cultivated trees in North America have been affected. The disease begins with spots on the leaves, leading to the killing of branches which subsequently retain their dead leaves overwinter. This is followed by progressive dieback of the limbs, and the infected trees perish within 2 or 3 years. In parts of northeastern North America, the disease has become less virulent. Although the reasons for this are not understood, it is hoped that a similar trend will occur in northwestern North America.

Pollination & Dispersal

Flowering plants employ different structures to create displays that attract pollinating insects. Most insect-pollinated plants have large, attractive petals. However, Pacific dogwood uses large white bracts, which are actually not part of the flower, although they look like petals. The very conspicuous bracts surround a group of small flowers with small petals. What looks like a flower is actually an inflorescence, and the effect of many such inflorescences produces a very noticeable floral display. Pacific Dogwood is considered a pollinator friendly tree but little has been recorded about its pollinators. The closely related flowering dogwood of eastern North America is self-incompatible at least to a degree and its pollinators include bumble bees and honey bees. In British Columbia, flowering occurs from April to June, and fruits are ripe by September or October. Curiously, the species often flowers twice in a growing season, coming into bloom a second time in late summer or early fall. It regenerates both through seeds and by vegetative sprouting. The latter mode is common when the plants are damaged by fire or clearcutting. The fleshy fruits are likely dispersed by birds and small mammals.



Fig. 7. Pacific dogwood (*Cornus nuttallii*). Source: Curtis's Botanical Magazine, 1910. Vol. 6. Lovell Reeve & Co., London, U.K. Plate 8311. 1, Flowering branch; 2, fruit cluster; 3, flower (the petals are above the sepals).

USES

The principal economic usage of Pacific dogwood is as an ornamental, widely employed in landscaping, notable for its showy flower clusters, bright red berries, and colorful fall foliage. However, the threat of dogwood leaf blotch has reduced new plantings. The wood is hard, heavy, whitish, and fine-grained, and wears smoothly. It has been used to make cabinets, piano keys, knitting needles, thread spindles, slingshots, golf club heads, mallet handles, and other tools requiring very hard wood that resists wear and repeated hammering. The berries are edible but bitter. Native peoples used the bark to make a brown dye, and medicinally as a general tonic and to treat a variety of ailments, including constipation, indigestion, and other stomach complaints. The wood was employed to make bows, arrows, harpoons, tools, and toys. The leaves were occasionally used for smoking, either directly or mixed with tobacco. Baby baskets were fashioned out of the twigs.



Fig. 8. Flowers of Pacific dogwood (*Cornus nuttallii*). Photo courtesy of Calvin Jones, Government of British Columbia.

CULTIVATION

Pacific dogwood is used to some extent in revegetation, but is much more commonly planted as an ornamental. In Canada, the species is not hardy outside of its native area in the southwestern part of coastal British Columbia. In eastern Canada and parts of New England, it often fails to stop growing in time to harden for winter. Wild-growing trees are difficult to transplant, but nursery-grown stock can be easily established, preferably in well-drained soil. The foliage of plants grown in shade will be exposed to sunscald if the plants are moved directly to a sunny location. Once trees are established, natural summer rainfall is usually sufficient, and it is not necessary to provide water. Pruning the plant back to its base results in a proliferation of basal branches, and the development of a large shrub 2.4-3.7 m (8-12 feet) high. Fruits normally ripen in August and early September. The soft, outer pulp can be washed off in a pail of water, discarding any seeds that float (these are unlikely to germinate). The seeds need to be cold stratified to germinate. Seeds collected in the fall can be sown directly into soil outdoors, and during the winter the natural dormancy will be eliminated. The seeds can also be artificially stratified by storage in moist sand or peat moss in

a refrigerator (0-4.5 °C, 32-40 °F) for 18 weeks. Professional horticulturists sometimes establish plants from softwood cuttings 5-7.5 (2-3 inches) long, from young, vigorous growth, rooting these in sand in a propagation case.

Cultivars of *Cornus nuttallii* include Barrick (with large bracts and flower clusters), Boyd's Hardy (a Tennessee selection), Colrigo Giant (also known as Corrigo Giant and Corego giant; named after the Columbia River Gorge where it was discovered, this has huge flower heads up to 15 cm (6 inches) across), Colrigo Wonder (a variation of Colrigo Giant with smaller flower heads), Eddiei (discovered in 1918 by H.H. Eddie, a Vancouver nurseryman, the leaves have yellow blotches), Goldspot (the leaves also have yellow blotches, and this may well be Eddiei with a different name), Monarch (a form with large flowers bracts and purplish young shoots), North Star (has very large floral bracts, purple young shoots), Pilgrim (a California selection with relatively small flowers), Portlemouth (selected in England, this has large floral bracts), Vrugtman (a selection with variegated white/green foliage), and Zurico (an early flowering form). There are over 100 cultivars of *C. florida*, far more than of *C. nuttallii*, although the latter is one of the most widely cultivated species of the genus. The following cultivars are hybrids of *C. nuttallii* and *C. florida*: Ascona (a small tree with pendulous branches), Eddie's White Wonder (a sterile hybrid selected by H.H. Eddie, mentioned above), Ormonde (with large flower bracts and almost fluorescent autumn foliage), Pink Blush (with pink flowers).

Cornus nuttallii has been hybridized with some of its close relatives in an attempt to produce superior cultivars. *Cornus florida* × *nuttallii* hybrids appear more like *C. nuttallii* than *C. florida*. *Cornus kousa* × *nuttallii* hybrids have been known to produce floral bracts 12.5-15 cm (5-6 inches) wide, occasionally up to 17.5 cm (7 inches). Venus is a recently released cultivar of this hybrid.

Three exotic woody species of *Cornus* are occasionally planted in Canada. Kous dogwood resembles the eastern flowering dogwood but comes into flower 2 to 3 week later. The cornelian cherry (*C. mas*), is an early flowering species which produces many yellow flowers and has edible fruit. Red-branched dogwood (*C. sanguinea* L.) is notable for its dark red branches in winter. Similar to the last-mentioned is red osier, *C. stolonifera* Michx., a native of eastern North America that is widely cultivated.

CONSERVATION STATUS

Cutting down or harvesting any part of the Pacific dogwood was prohibited in 1996 by the province of British Columbia, but the protective statute (The Dogwood, Trillium and Rhododendron Protection Act) was repealed in 2002. The recent threat posed by dogwood leaf blotch may necessitate reinstatement of protection for the species. In Idaho, Pacific dogwood is listed as a "Priority 1 species", with the indication that it is in danger of becoming extinct from the state in the foreseeable future. Because Pacific dogwood is fairly widely distributed in the western U.S., the future survival of the species is not threatened, but genetically distinct variations on the periphery of the range may require conservation measures.



Fig. 9. The Coat of Arms of British Columbia. The crowned lion at the top is wearing a collar of Pacific dogwood flowers. At the base, flowers of Pacific dogwood also entwine the Latin motto "Splendor sine Occasu", meaning "splendour without diminishment".

Key to species of *Cornus* with showy bracts cultivated in Canada

- 1a. Plant a low herb..... *C. canadensis* (bunchberry)
- 1b. Plant a tall shrub or tree..... 2
- 2a. Fruits joined into a globular, fleshy head (somewhat like a strawberry); leaves often narrow or long pointed; Eurasian..... 3
- 2b. Fruits densely clustered but individually distinct; leaves usually oval and shortly pointed; North American..... 4
- 3a. Leaves ovate, thin, deciduous..... *C. kousa* (kousa dogwood)
- 3b. Leaves lanceolate, thin, partially evergreen..... *C. capitata* (Himalayan evergreen dogwood)
- 3c. Leaves narrowly elliptic, thick and evergreen..... *C. angustata* (Chinese evergreen dogwood)
- 4a. Bracts 4, emarginate (with a shallow notch) at the tip..... *C. florida* (flowering dogwood)
- 4b. Bracts 4-6, pointed to flat at the tip..... *C. nuttallii* (Pacific dogwood)

MYTHS, LEGENDS, TALES, FOLKLORE, AND INTERESTING FACTS

- According to legend, the dogwood was once a huge forest tree. Because it was firm and strong, it was chosen as the timber for the Crucifixion of Christ. Distressed at this cruel usage, the tree decided to never again grow large enough to be used as an execution cross. To further express its regret, its blossoms took the form of a cross (evident in 4-bracted species).
- The cornelian cherry, *Cornus mas*, a native of Eurasia, is reputed to have provided the wood used by Odysseus and his men to build the Trojan horse, a huge figure of a horse in which Greek soldiers hid. When the Greeks sailed away, the Trojans hauled the horse into the city of Troy, and subsequently the soldiers opened the gates to allow the entry of Greek forces which had sailed back under cover of night. It has been thought that the conflict was entirely fictitious, but some modern scholars have suggested that there may be a grain of truth to the legendary events, tracing back to the 11th or 12 century B.C. However, the small cornelian cherry is unlikely to have provided enough wood for a large Trojan horse.
- The Thompson Indians used the flower heads of Pacific dogwood to wash the skin to treat "seven year itch", and a boiled tea made with bark strips to improve the lungs of hunters.
- Dogwood species are often called arrowwood (or arrowwood), a usage that also reflects the very hard wood of many of the species. The ancient Romans used the wood to make spears and arrows.
- Dogwood timber is so hard that it was once used as a wedge to split other wood.
- North American pioneers used boiled teas of both Pacific dogwood and eastern flowering dogwood as a substitute for quinine to treat malaria.
- A "dogwood winter" is a phrase used in the southern United States (especially in Appalachia) to indicate a spell of cold weather in the spring (April and May) that coincides with the blooming period of local dogwoods. Such a period of cold is often the last harsh weather before summer. American journalist and poet W.J. Lampton (1859?-1917) wrote the following:
 Now Jack Frost comes with his nipping airs
 To take from the Spring his final toll;
 He looks like Winter but he always wears
 A dogwood blossom in his buttonhole

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Fig. 10. How can you identify a dogwood? By its bark (rough-rough)! Prepared by B. Brookes.

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TREE: Western Red Cedar



Fig. 11. Silhouette of Western red cedar (*Thuja plicata*). Source: Farrar, J.L. 1995. Trees in Canada. Canadian Forest Service and Fitzhenry and Whiteside, Markham, ON, Canada. Reproduced with permission.

SYMBOLISM

The Western red cedar is an appropriate symbol of British Columbia given its current importance as a commercial source of lumber, and its key historical roles in the lives of West Coast Aboriginal Peoples. The towering trees are breath-taking, and their groves are as spiritually symbolic as cathedrals, providing mesmerizing havens for biodiversity, and representing the precious rainforest ecosystem of Canada's West Coast.

LATIN NAMES

Thuja plicata Donn ex D. Don

The genus name *Thuja* traces to the Greek *thyia*, referring to a kind of resinous tree or a juniper, and the Latin *thyia*, an allusion to a citrus-tree. The specific epithet *plicata* is based on the Latin *plicare*, to fold, to plait (like a fan), a reference to the overlapping scale-like leaves.

ENGLISH NAMES

Western red cedar. Also: British Columbia cedar, British Columbia red cedar, canoe cedar, cedar, giant arbor-vitae (= giant arborvitae, a name used in the American horticultural trade), giant cedar, giant redcedar, Pacific red cedar, shinglewood, western arbor-vitae ("arbor-vitae" is Latin for "tree of life").

"Red" in the name refers to the wood colour, which is pale to dark red. The name "cedar" is inappropriate (although it was originally applied because of the cedar-like appearance), since true cedars belong to the genus *Cedrus*. There have been attempts to avoid confusion by referring to *T. plicata* as "redcedar" instead of "red cedar". "Red cedar" (or eastern red cedar) is also the name of *Juniperus virginiana* L., and there have been similar attempts to call it "redcedar".

FRENCH NAMES

Cèdre de l'Ouest. Also: cèdre rouge de l'Ouest, cèdre, thuya géant, thuya de l'Ouest.

HISTORY

a. Canada

The British Columbia Tree Council was formed in 1987 to recommend a tree symbol for the province. The selection process also involved public nominations (British Columbians were given a list of 25 species, including Western red cedar), and an essay contest for students. The Western red cedar was adopted as the arboreal emblem of British Columbia on Feb. 18, 1988.

b. Foreign

Thuja species are not recognized as official symbols of any political region outside of British Columbia. "Yellow cedar" or yellow elder (*Tecoma stans*), the official flower of the U.S. Virgin Islands, is quite unrelated to *Thuja*.

APPEARANCE

Western red cedars are evergreen coniferous trees, generally 21-30 m (70-100 feet) at maturity, usually with a

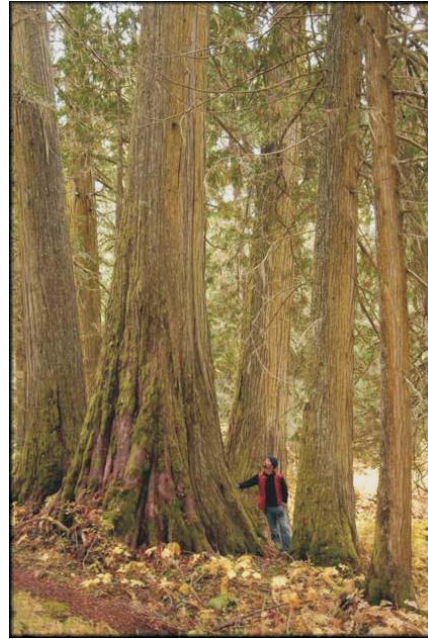


Fig. 12. University of Northern British Columbia student Dave Radies in an ancient Western red cedar rainforest 130 km east of Prince George. Photograph by Robert van Adrichem, Sept. 28, 2007. Photo reproduced with permission.

trunk 0.6-1.2 m (2-4 feet) in diameter; very large trees have reached 75 m (246 feet) tall and 7 m (23 feet) in trunk diameter. The western red cedar is one of the most colossal trees in the world. However, the inland trees (see distribution, below) are smaller than the coastal trees, and at high altitudes the plant may be reduced to a shrub. In harsh sites, stunted or distorted trees sometimes occur. The base of the tree is buttressed (swollen and fluted). Old trees often have many dead major limbs in the crown, and many leader limbs. The reddish brown or grayish brown, stringy, ragged bark is relatively thin (up to 25 mm or 1 inch thick), and is finely vertically ridged and furrowed. The bark is easily peeled off in long strips. The evergreen foliage is composed of scale-like leaves, 1.5-3 mm (0.05-0.1 inch) long, in opposite pairs with successive pairs at 90° to each other. The leaves are displayed in flat sprays. Male and female cones occur on the same trees. The male cones are small (about 2 mm or 0.08 inch long) and inconspicuous. The seed cones are ellipsoid, 10-20 mm (0.4-0.8 inch) long, and clustered near the ends of twigs. Some trees live more than 1000 years, and a few have been dated at almost 1500 years of age.

CLASSIFICATION

Family: Cupressaceae (cypress family).

The genus *Thuja* has five species, two native to North America, three to eastern Asia. Several studies of genetic variation have concluded that *T. plicata* is a fairly uniform species, with limited evidence that subspecies or varieties deserve to be recognized. Northern white cedar (*Thuja occidentalis* L.) is the only other species of *Thuja* in North America. It has leaves that are dull yellowish-green above

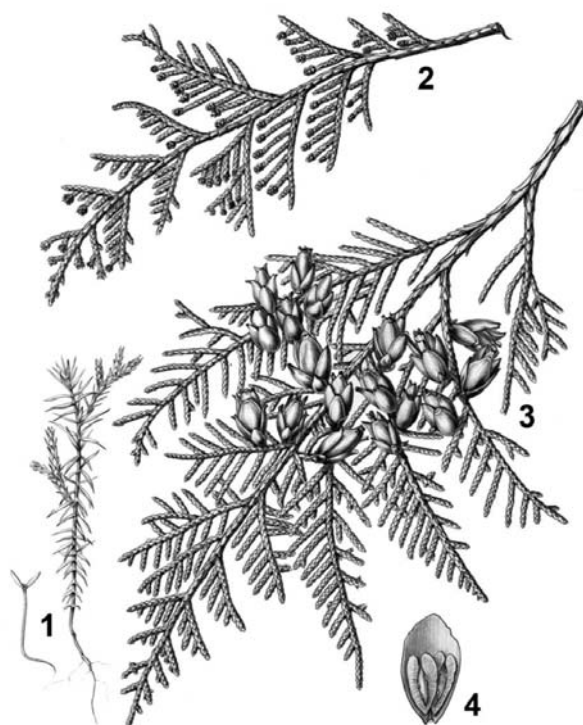


Fig. 13. Western red cedar (*Thuja plicata*). 1, seedlings; 2, flowering branch (flowers scarcely apparent); 3, fruiting branch; 4, scale of a fruit, showing seeds. Source: Sargent, C.S. 1896. The silva of North America. Vol. 10. Houghton, Mifflin and Company, New York, NY. Plate 533.

and below and the seed-cone scales are minutely mucronate (ending in a sharp point). In Western red cedar the leaves are white-striped below (when fresh) and glossy green above and the seed-cone scales have a triangular projection near the tip.

GEOGRAPHY

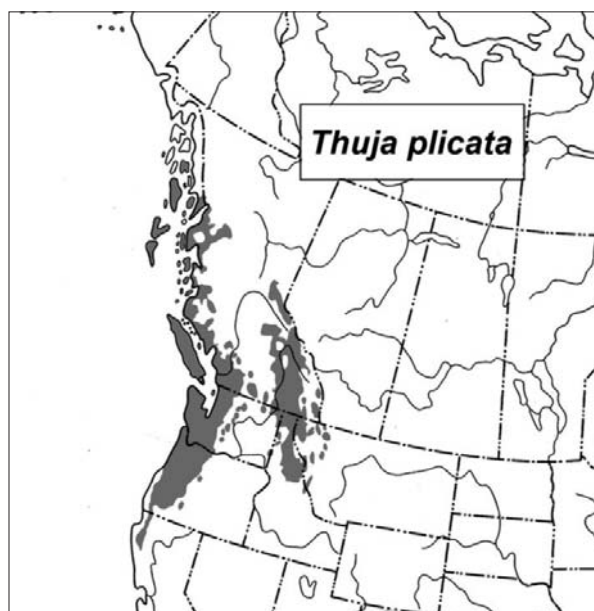


Fig. 14. Canadian and adjacent United States distribution of Western red cedar (*Thuja plicata*).

Thuja plicata has two major distribution areas: (1) a Coast Range/Cascade Range, including the coastal mountains in southeast Alaska, British Columbia, Washington, Oregon, and northwestern California, and (2) in the Rocky Mountains, including southeastern British Columbia and southwestern Alberta, northeastern Washington, northern Idaho and northwestern Montana. The trees occur at altitudes from sea level to 1500 m (5000 feet), rarely to 2300 m (7500 feet).

Acreage of Canada occupied by the Country's Arboreal Emblems

Province/ Territory	Common Name	Scientific Name	Area in Canada	
			square miles	square kilometres
Newfoundland & Labrador	Black spruce	<i>Picea mariana</i>	2 208 078	5 718 922
Prince Edward Island	Red oak	<i>Quercus rubra</i>	149 905	388 254
Nova Scotia	Red spruce	<i>Picea rubens</i>	92 405	239 329
New Brunswick	Balsam fir	<i>Abies balsamea</i>	1 173 643	3 039 735
Quebec	Yellow birch	<i>Betula alleghaniensis</i>	231 656	599 989
Ontario	Eastern white pine	<i>Pinus strobus</i>	319 114	826 505
Manitoba	White spruce	<i>Picea glauca</i>	2 258 026	5 848 287
Saskatchewan	White birch	<i>Betula papyrifera</i>	2 222 603	5 756 542
Alberta	Lodgepole pine	<i>Pinus contorta</i>	416 690	1 079 227
British Columbia	Western red cedar	<i>Thuja plicata</i>	140 464	363 802
Yukon	Subalpine fir	<i>Abies lasiocarpa</i>	362 815	939 691
Northwest Territories	Tamarack	<i>Larix laricina</i>	1 918 585	4 969 135

Compared to Canada's other official arboreal emblems, Western red cedar occupies a relatively limited portion of Canada. The above table has been corrected from a version in evergreenmagazine.com/app/portal/mm/Canada.pdf

ECOLOGY

Western red cedar grows in mixed coniferous forests, rarely in pure stands. In its geographic area, it has been estimated that it covers about 20% of the vegetation. In Canada it usually associates with Douglas fir and western hemlock (two species that Pacific dogwood, also associates with, as noted earlier). As well as growing in forests, the species also occurs on rocky slopes, in forested swamps, and along streams. The trees are susceptible to frost, especially in late spring and early autumn.

A major requirement for regeneration from seed is disturbed mineral soil. Seed will also germinate on rotting wood in old groves but replacement in these situations may more often result from vegetative reproduction. Although Western red cedar is usually considered a climax or near climax species, the fact that seed development may be best on disturbed mineral soil raises the interesting question of whether it should also be considered a pioneer. Slash burning favours this tree by increasing mineral soil surfaces in cutover areas.

Habitat

Western red cedar is adapted to cool montane habitats in the foothills of the Rockies, and to maritime coastal climates with cool, cloudy summers and wet, mild winters. The trees generally occur in moist areas (including swamps, wet ravines, and poorly drained depressions), and occupy a variety of types of soil, preferring acidic, well-drained substrates (but tolerating alkaline soils). Western red cedar is quite shade-tolerant, and is able to reproduce under dense shade. Although the species is usually associated with coastal rainforests, the inland sites in the Rocky Mountain foothills may be better called “snow forests” because of the very heavy snow accumulation.

Inter-species Relationships

Deer, elk, and rodents browse on Western red cedar seedlings and saplings, sometimes causing extensive damage. Near the coast, deer consume the foliage year-round, and in the northern Rocky Mountains the leaves are a major food for big game. Black bears have been observed to remove the bark and feed on the exposed sapwood. The trees provide cover for numerous birds and mammals. The species is host to many insects, some specific to it, but severe damage is not common. A gall midge fly (*Mayetiola thujae*) sometimes seriously damages the seeds. Although 200 fungi have been reported on Western red cedar, it is less susceptible to pathological attack than other conifers. Over the long life of the trees fungi detoxify heartwood chemicals that provide decay resistance. As a result the accumulated decay in living trees is greater than for any other major conifer in British Columbia and hollow trees are common.

Western red cedar forests on the offshore islands of Haida Gwaii (Queen Charlotte Islands) evolved for a thousand years in the absence of large mammal browsing. Black-tailed deer (*Odocoileus hemionus sitkensis*) were introduced in 1901. Recent field experiments have suggested that the chemical defenses of plants from Haida Gwaii are less effective than those of mainland plants.

“Nurse logs” are trees that have fallen on the forest floor and

decompose, providing nutrients for young plants to grow rapidly. Fallen trees leave openings in the canopy allowing sunlight to penetrate, accelerating growth. Western red cedar decays extremely slowly, so it releases nutrients slowly. Nevertheless the species has considerable value in nurturing the growth of other plants, as is evident by the fact that many plants, including young Pacific yew seedlings and saplings, grow well for decades on top of the fallen trees, finally growing around or through the trunks to contact the soil. Often one sees a row of trees with stilt-like roots, an indication that there was once a fallen tree upon which the trees became established. The moist environment in which Western red cedar grows results in fallen trees becoming covered by mosses, which greatly facilitates the development of a substrate on which seedlings can become established.

Western red cedar is the predominant feature of some old-growth forests with rare and significant species and high biodiversity. At a site near Prince George (east-central B.C.), it has been estimated that there are about a thousand species of lichens and fungi. The Northern spotted owl (*Strix occidentalis caurina*) is just one of hundreds of species that occur in remnants of the once extensive old growth red cedar forest of southwestern B.C.



Fig. 15. Foliage of Western red cedar (*Thuja plicata*). Photo courtesy of Chris Schnepf, University of Idaho and Bugwood.org.

Pollination & Dispersal

Western red cedar sheds windborne pollen in early spring (February to April), individual trees releasing pollen for 1 to 2 weeks. The species is self-fertile, but a moderate degree of cross-fertilization normally occurs. Western red cedar produces abundant, tiny, winged seeds, which are distributed by the wind, generally no farther than 122 m (400 feet) from the parent tree. The cones are mature in October, and seeds are distributed in October and November (occasionally some seeds are retained in the cones and are shed gradually during the winter). In coastal forests seed production may be as high as 2.5 million seeds/ha (1 million seeds/acre). The plants also propagate vegetatively, by layering (attached branches contacting the soil and developing into new shoots), and by branches that break off the trees, producing roots where they contact the ground. The trees are often windthrown in wet environments, and branches from the fallen trees can produce new shoots.



Fig. 16. Totem poles at Kisegukla, a 1912 painting by Emily Carr (see discussion of her in the legend to Fig. 17); Vancouver Art Gallery. Totem poles last a long time because Western red cedar resists decay, but many that Emily Carr saw as on-site relicts of a remarkable past culture have now fallen and others have been cut down and sold for museums and public parks. The few surviving ancient poles are compelling art forms that arouse the imagination to thoughts of what it was like in their special places only a few hundred years ago. Fortunately totem poles are not a bygone art form. Some painted by Emily Carr have been re-carved. In 1972 a totem pole was raised at the town of Kispiox at the junction of the Skeena and Kispiox Rivers in northern British Columbia. Two poles outside the Vancouver airport were carved in 1990. Of course this art is dependent on the preservation of declining primeval cedar forests.

USES

North American Indians, especially those living along the coasts of British Columbia and Washington, used Western red cedar extensively. Some coastal tribes called themselves "People of the Red Cedar" because of their dependence on the tree. Large trunks were carved into totem poles, hollowed out to produce huge, ocean-going whaling canoes (some capable of holding more than 60 people), and split into wide planks used in large, timber frame longhouses that sometimes extended more than 30 m (100 feet). The wood was used to make many objects, including paddles, religious masks, and utensils. The bark of young trees was fashioned into thatch, clothing (including rain-capes, skirts, and complete dresses), mats, blankets, ropes, and baskets. Finely shredded inner bark was once used by Northwest Coast Indians for use as an absorbent in diapers and as cradle padding. The inner bark was also

employed as a slow match to carry fire from camp to camp. Flexible slim twigs were woven into baskets and whaling ropes. Thicker branches were used to make arrows. Roots were used for fishhooks. Boiled teas of various parts of the trees were used to treat a wide variety of illnesses.

Western red cedar is a major lumber tree of the West Coast of North America. In addition to the harvest of wild trees, it is cultivated to a small extent as a lumber tree in North America, western Europe, and New Zealand. British Columbia is the largest supplier, followed by the states of Washington and Alaska. In order of importance, the trunks are turned into lumber, shingles and shakes, and logs, these accounting for 90% of the harvest. In British Columbia, considerable cedar is used for fence posts, poles, pilings, and pulp. Manufactured products include veneer and plywood, rough lumber, decking, boards, siding, panelling, and fence and furniture products. The wood is often used for guitar sounding boards. In some years British Columbia has produced more than half of the world's demand for shakes and wooden shingles. Cedar leaf oil extracted from the leaves and twigs is used in perfumes, veterinary soaps, shoe polishes, deodorants, and other products. The pungent, aromatic wood is employed to line closets and chests in the widespread belief that the odour repels moth and carpet beetle larvae that can damage wool and other natural fibres. (There appears to be no reliable evidence that Western red cedar is actually effective in this regard, although there is some evidence that eastern white cedar may have a small protective effect. Bee hives have been made from Western red cedar, suggesting that the toxicity to insects may be limited.)

Possibly the earliest commercial manufacturing of Western red cedar products was in 1825 in Fort Vancouver (in Washington, near Portland, Oregon), where the Hudson's Bay Company employed people to hand-split cedar into shakes. A "shake" is a wooden shingle made by splitting logs, usually not by sawing (although "tapersawn shakes", which are thicker at their butt ends, are made partly or wholly by sawing). Shakes can be used for various purposes (e.g. for siding), and are especially used to cover roofs. Originally shakes were not tapered, while shingles were often tapered. In early times all shakes were made by hand, but almost all are now produced with machinery. Wooden shingles (which are usually used to cover roofs) are always made by sawing wood on all six sides (in which case they are usually not shakes). Shakes are somewhat thicker than shingles, and since they are rougher in appearance they give a more rustic look when installed. Today, there are many kinds of products that are intermediate between shakes and shingles, and the distinction between them has become imprecise. The ease with which Western red cedar wood can be split makes it particularly useful for preparing shakes and shingles, and 95% of these products sold in North America are made from Western red cedar. Unfortunately, the ease with which breakage and splitting occurs is a disadvantage for structural uses, such as in beams and posts. The wood is also soft and extremely sensitive to marring. However, it has few knots, does not exude resin like many other conifers, has a beautiful, reddish appearance, takes stains well, possesses a pleasant aroma, is light in weight, and has very good insulating properties. Stainless-steel nails and fasteners are recommended for use with Western red cedar, although hot-dipped galvanized and aluminum nails can be used. Regular

galvanized nails and other kinds of metal fasteners react adversely with the oils in the wood, resulting in stains or streaks on the wood, and deterioration of the metal.

Western red cedar is favoured for outdoor uses where conditions promote decay. The wood is very resistant to insects as well as to fungi (a fallen tree may remain intact for a century), and is well suited for external uses such as siding, shingles, shakes, decking, shutters, outdoor furniture, arbours, gazebos, pergolas, trellises, sheds, greenhouses, planters, fences, gates, and utility poles. The wood is also in demand for indoor uses where high humidity is common, such as with saunas and hot tubs. Although Western red cedar shingles can cost several times as much as standard asphalt shingles, they can last 100 years on a roof. Western red cedar is one of the preferred woods for boats and canoes, and is the principal veneer for covering racing shells (i.e. boats propelled by oarsmen in racing contests). The decay resistance is due to the presence of toxic chemicals called tropolones that are concentrated in the heartwood. Certain tropalone derivatives called thujaplicins are potent anti-fungal and anti-bacterial compounds.

The sweet smell and attractive, lacy foliage make branches of Western red cedar ideal for use in flower bouquets and decorative floral arrangements.

TOXICITY

Workers in the lumber, furniture, and cabinetry industries, and some wood carvers, have experienced asthma, rhinitis, or irritation of skin and eyes from exposure to the sawdust of *Thuja plicata*. "Western red cedar asthma" is a significant occupational hazard, and those diagnosed with the condition have often been forced to find other careers. Plicatic acid from wood has been shown to be the chief cause of the asthma. Cedar sawdust and shavings have occasionally been used in plant mulches, soil conditioners and animal litter, but acceptance is limited because of the known toxicity of the dust associated with these materials. However, Western red cedar bark is widely employed as a long-lasting mulch. The wood is commonly used in outdoor furniture and play structures, suggesting that contact dermatitis is not a major problem for most people.

CULTIVATION

Western red cedar is easily established from seeds, most samples not requiring cold stratification to germinate well. However, most cultivated plants grown for ornamental purposes are clones, established in containers from rooted stem cuttings, facilitating transplanting. The species is widely grown as a park tree, and often also as a hedge. The trees are used to some extent to revegetate disturbed sites and in erosion control. There are many ornamental cultivars, including: *Atrovirens* (a slow-growing pyramidal plant with shiny green foliage), *Canadian Gold* (a tree to 21 m or 70 feet tall, with golden foliage), *Cuprea* (a dwarf, globe form with deep green leaves tipped with yellow), *Green Giant* (a hybrid of *T. plicata* and *T. standishii*, with deep green foliage and a pyramidal habit), *Grovpli* (a hardy tree about 6 m or 20 feet high), *Hogan* (a tree about 6 m or 20 feet tall, with a densely columnar silhouette), *Sunshine* (with golden foliage), *Stoneham gold* (an upright shrub with golden new growth that turns green), *Virescens* (a narrow form, growing to about 9 m or 30 feet, with dark green foliage), and *Zebrina* (a pyramidal form with variegated yellow foliage, growing to about 9 m or 30 feet).

CONSERVATION STATUS

British Columbia is one of the most biologically and ecologically diverse regions of Canada, with grasslands, oak parklands, desert-like steppes, dry pine forest, boreal black spruce muskegs, tundra, and alpine meadows. Two-thirds of the province is covered by forest land. The Western red cedar occurs in the temperate rainforest along the Pacific Coast, and in an interior rainforest. Temperate rainforests are rare globally, and the Pacific Coast rainforest is the largest. British Columbia is the world's most important exporter of forest products, and the forests are critical to the province's economy, with perhaps one in every five jobs depending on forestry. The Western red cedar is one of the most important forestry trees in the province, and its impressive stature and delicate habitat has led to conflicts among the forest industry, government, Indigenous Peoples, and Conservationists. Western red cedar is a common tree, not requiring protection of its genetic resources, but the old growth ecosystem and biodiversity it represents are fragile and likely to continue to be the subject of debate between proponents of short-term resource exploitation and advocates of environmental protection.

Is the Western red cedar a "flagship species"?

A flagship species is one that has been chosen to represent an environmental cause, such as an endangered ecosystem. Such species are not only vulnerable, but are photogenic, charismatic, and distinctive, thereby inspiring public action for their preservation. They are valuable in leveraging support for conservation of entire ecosystems. Examples of flagship species are the Asiatic lion of India, the giant panda of China, the mountain gorilla of Central Africa, and the northern spotted owl in Western North America. Western red cedar has been a focus of attention in attempts to protect old growth forests in Western Canada. The spectacular, old trees are vulnerable and diminishing. The species is distinctive and well-known as a provincial emblem. The huge size, soft foliage, and pleasant fragrance are appealing. There is also a mystical appeal associated with the tree, associated with images of rugged coasts with totem poles rising from the mist. There is now widespread public sympathy for the preservation of the vulnerable, ancient groves of towering, old trees. Although the species is not endangered, Western red cedar serves all the purposes of a flagship species

“Sustainable Development” an Oxymoron?

“Sustainable development” has become the key phrase that indicates the ideal compromise between mankind's use of planetary resources and the future welfare of the planet. Google this phrase together with “oxymoron” and you will get over 20,000 responses, suggesting there is something fundamentally wrong. American ecological economist Herman Daly (1938) is credited with first calling sustainable development an oxymoron. Oxymorons are rhetorical figures in which incongruous or contradictory terms are combined (e.g. deafening silence, giant shrimp, natural makeup, a little pregnant, alone together, Hell's Angels). Certainly there is a contradictory element in the phrase “sustainable development”: sustainable means to maintain, develop means to change. Nevertheless, in this practical world, does “sustainable development” at least point the way to a better world? The phrase was initiated in a 1987 report of the World Commission on Environment and Development (Brundtland Commission, *Our Common Future*), which defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. We can't really judge what future generations need, but we can assume that it is desirable to limit the continuing deterioration of the planet's resources, biota, and atmosphere. Numerous analyses have been advanced recently by economists and ecologists arguing that good business practices are inherently respectful of the environment, and accordingly there is no fundamental disagreement between economic development and sustainability of the natural world (so sustainable development is not an oxymoron). Certainly it is true that pollution and depletion of natural resources injure businesses directly dependent on those resources: fishermen, farmers, foresters, and many others are harmed by water pollution, soil contamination, depletion of biodiversity, and atmospheric degradation. But in the short run it is almost always much easier in this extremely competitive world to maximize profit by using present technologies and practices, irrespective of the associated harm to the planet. The simple fact is that in most cases doing good for the future of the environment requires sacrifice, and most people are unable for a variety of reasons to sacrifice much. Elected governments invariably reflect the general will of the people, homogenizing the different viewpoints of all interested parties. Of course, some interests, especially large corporations, tend to be more equal than others. We conclude that “sustainable development” is a nice phrase, but that each of us needs to make whatever contributions we can to limit the overuse of resources, and to urge our elected officials to do the same. We recommend a visit to a grove of Western red cedars by our political representatives, in the way that Indigenous People have congregated for millennia, to contemplate how best to carry on their lives; perhaps the emotional experience would be of greater benefit to Canada in the long run than a similar visit to the boardrooms of the corporate elite.



Fig. 17. Emily Carr (1871-1945), at left, was born in Victoria, British Columbia. She traveled widely training as an artist but it was not until 1928 that she gained recognition when Lawren Harris of the Group of Seven said to her, “you are one of us”. It appears that her favourite trips were along the coast of British Columbia and her subjects were often sites of abandoned native villages with totem poles, and also scenes of the western forest. Her painting of a Western red cedar (at right) has curves and waves characteristic of her style. She was an artist of stunning originality and strength, but was also an accomplished writer receiving the Governor-General's Award for her first book published in 1941. She was one of the first Canadian artists to capture the wild landscape of Canada in an impressionistic style

MYTHS, LEGENDS, TALES, FOLKLORE, AND INTERESTING FACTS

- In pre-Columbian times, Native peoples of the West Coast lacked sharp metal tools that could be used as axes or saws to cut down the huge Pacific red cedars needed for canoes and totem poles. Felling of large trees was initiated with stone or mussel-shell adzes, and wedges and mauls made of antlers, bones, stones, or other local materials, creating a circumferential triangular cut. The cut was filled with tinder and small kindling, and lit. Wet moss and clay was packed above and below the cut to prevent the trunk from catching fire. Workers keeping the fire going were rotated day and night for several days until the trunk was burned through.
- The leaves of Western red cedar have been shown to last about 11 years in the lower third of the canopy in forest trees, and about 7 years in the upper third, apparently because of the greater stresses there.
- With heights of up to 75 m (246 feet) and trunk diameters up to 7 m (23 feet), Western red cedars are among the largest plants on earth. However, they are by no means the largest trees. The world's **tallest standing tree species** is the coast redwood (*Sequoia sempervirens*) of California. One of these, the “Hyperion”, discovered in 2006, has been measured at 115.5 m (379.1 feet) in height, with a diameter at breast height of 3.14 m (10.3 feet). However, some trees of the species are thought to have grown taller than this, and a *Eucalyptus* tree of Australia is claimed to have been over 150 m (492 feet) tall. The world's **heaviest tree**

is the giant sequoia (*Sequoiadendron giganteum*) of California (another “redwood”). One of these, the “General Sherman”, which (at 83.8 m or 275 feet) is one of the tallest trees in the world, has been estimated to weigh 5595 metric tons (6167 tons). It has been calculated that the wood in the tree could be used to make 30 trillion matches! At breast height the tree has a diameter of 8.8 m or 28.9 feet (at ground level the circumference is 31.1 m or 102.6 feet), accepted by some to be greater than any other known tree in the world. However, the tree with the **largest girth** appears to be a Montezuma cypress (*Taxodium mucronatum*) called “El Arbol del Thule” in Oaxaca, Mexico, which has a circumference of 36 m (118 feet) at breast height (54 m or 178 feet at ground level). Some researchers have suggested that this tree might actually be a clonal colony of genetically identical individuals.

- Plants obtain water from the soil, and the water is moved upward through vascular tissues to the top of the plant. Water can be transported to considerable heights in very narrow, stiff-walled tubes, such as found in the xylem tissue of plants. Transpiration (water loss through the leaves) generates a gradient of pressure that pulls the water up from the roots, but in tall trees the pressure required can be enormous, especially during dry spells. The problem can be compared to getting water up very tall skyscrapers (normal city water pressure cannot adequately supply more than six floors, so pumps, and tanks on top of the buildings are necessary). In view of this, how can the redwood species described above and the Western red cedar grow so tall? The fact that these species grow in humid environments is an essential consideration. The leaves seem to be adapted to condensing water droplets out of the air, facilitating hydration of the upper parts of the plant. (Reference: Limm, E.B., Simonin, K.A., Bothman, A.G., and Dawson, T.E. 2009. Foliar water uptake: a common water acquisition strategy for plants of the redwood forest. *Oecologia* 161: 449-459.) As fog moves in from the sea, the leaves of the trees also serve to condense moisture out of the air, raining water droplets down to the roots, additionally reducing water stress on the trees. (Reference: Dawson, T.E. 1998. Fog in the California redwood forest: ecosystem inputs and use by plants. *Oecologia* 117: 476-485.)

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Fig. 18. Western red cedar (*Thuja plicata*). Source: Nicholson, G. (Editor). 1889. *The illustrated dictionary of gardening*. Vol. 4. L. Upcott Gill, London, U.K



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