

1. Introduction

Terrestrial life forms made their move on land about 400 million years ago. Plants crossed the barrier between life in water to life in the atmosphere. With the invention of stable stems, plants overcame hydrological and mechanical problems. The construction of plant stems is the focus of this book. It demonstrates that nature created a framework in which plant stems evolved—annual herbs as well as century-old, 100 m-tall trees, from tropical to arctic environments.

The book offers a very wide view of stem anatomy. Chapter 2 explains simple anatomical preparation techniques. The six following chapters present basic, cell-based anatomical traits. Two chapters deal with taxonomically related anatomical stem characteristics in living and fossil plants. Anatomical structures which are related to short- and long-term external influences all over the globe are intensively discussed. The general part of the book ends with a section about wood decay and wood conservation.

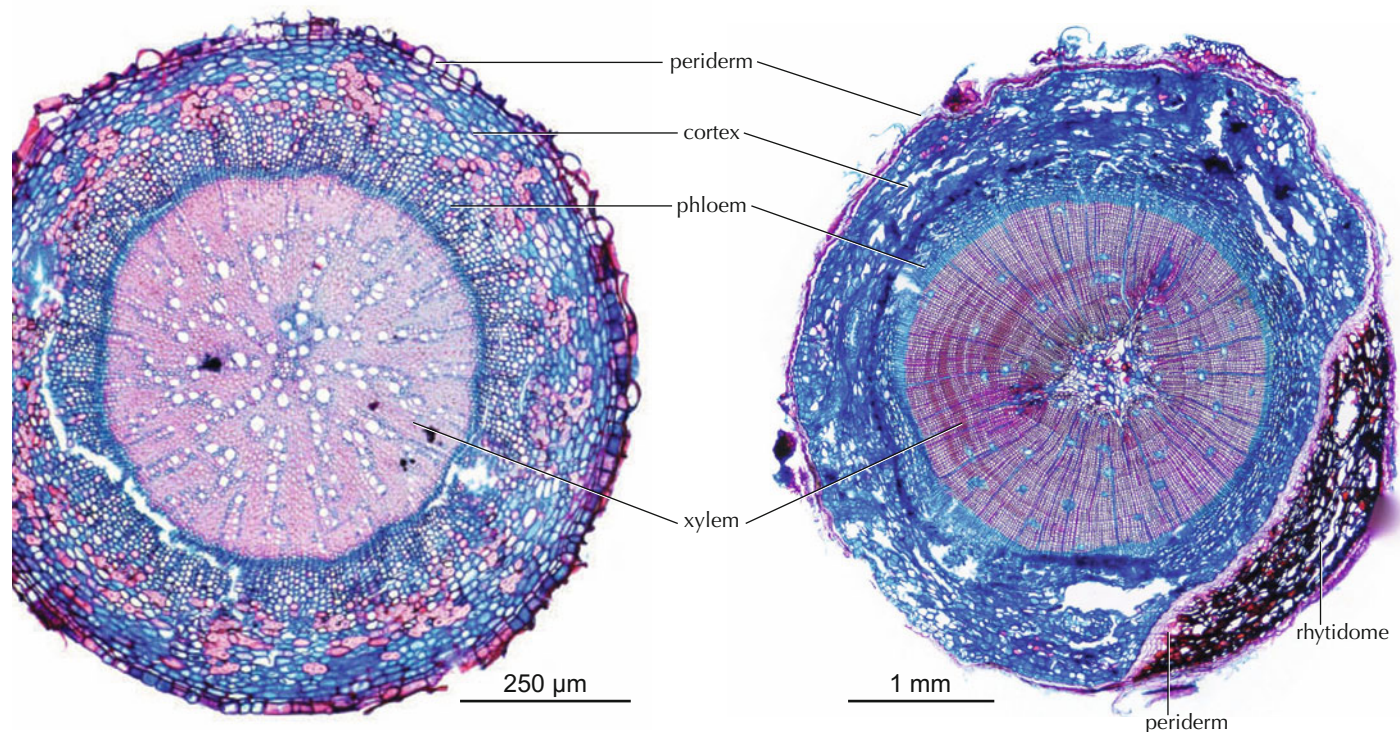
One major objective of this book is to show that nature principally does not distinguish between plant stems of different growth forms, e.g. between small herbs and very tall trees. The following two microscopic cross-sections demonstrate that the basic stem construction of vascular plants, such as ferns, monocotyledons and dicotyledons, consists of the pith and the cortex, the xylem and phloem, and often a periderm.

Why a new book about plant anatomy? Isn't it repeating knowledge already previously demonstrated by great botanists? That is partially correct. However, this book has different goals.

Firstly, this book connects a variety of fields of research. Stem anatomy today is no longer a science per se. Dendrochronologists, ecologists, taxonomists, plant pathologists, foresters, archaeologists, paleobotanists, historians, criminologists, and technically oriented wood scientists use stem anatomical structures to solve specific problems. However, not all of them have

Principal stem construction of most dicotyledonous vascular plants

Sections stained with Astrablue/Safranin. Red-stained cell walls indicate an intensive lignification, blue-stained cell walls a purely cellulosic composition.



1.1 Main root of the annual, 5 cm-tall, dicotyledonous alpine herb *Polygonum plebeium*.

1.2 Fifteen-year-old twig of the 10 m-tall subalpine coniferous tree *Pinus mugo*.

an anatomical training. Each concept in this book is introduced by presenting well-known objects in macroscopic images before explaining their microscopic structures, e.g. an orange, followed by microscopic details of oil ducts, or an *Arabidopsis* plant followed by its anatomical stem structure. Basic anatomical knowledge is presented so it can be understood by readers with different academic training.

Secondly, this book addresses a worldwide multilingual auditorium—even when the knowledge of the English language might be limited. International dendroanatomical training classes have shown that pictures overcome many language problems. This book is therefore extensively illustrated, and introductory texts are kept short. Photographs are presented where possible instead of abstract drawings, and the images are captioned and labeled in an easily understandable manner.

The book builds a bridge between basic and detailed anatomical and physiological studies. Most concepts are of common knowledge, and can already be found in many botanical

textbooks, e.g. Beck 2010, Bresinsky *et al.* (Strasburger) 2008, Carlquist 2001, Crivellaro & Schweingruber 2015, Cutler *et al.* 2008, Eschrich 1995, Evert 2006, Fahn 1990, Fink 1999, Herendeen *et al.* 1999, Mauseth 1988, Nabors 2004, Schweingruber 2007 and Taylor *et al.* 2009. However, the here presented color photographs of stained microscopic slides enhance previous knowledge about lignification, and in consequence the relations between anatomy, physiology and plant stability. All microscopic slides have been made recently with modern sledge microtomes, and have been analyzed with light microscopes.

Since most of the scientific content is of common knowledge, citations of sources occur only sparsely in the text. The reader can find a summary of sources and recommended reading at the end of the book.

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