

3. Morphology of the plant body – Tried and tested for 400 million years

The first plants on land appeared some 400 million years ago in the geological periods of the late Silurian and early Devonian. The morphological structure of these spore plants is similar: The tiny leaf-less plants consist of roots, stems and branches. These plants represent the initial point for the evolution of a vast taxonomic and morphological diversity over the next

250 million years. At the beginning of the Early Cretaceous, approximately 140 million years ago, seed plants developed a variety of growth forms, and occupied most terrestrial habitats on earth. The image below demonstrates that many different growth forms exist in ecologically similar ecotones.

Various growth forms in an ecotone



3.1 Riparian zone of the Danube in Slovakia.

3.1 Growth forms and life forms

Life forms and growth forms are principally synonymous terms. The image on the following page shows that the currently existing plant forms are based on a principle that was invented 400 million years ago. It also demonstrates that plant age does not correspond with the morphological classification; perennial and annual plants can have the same size.

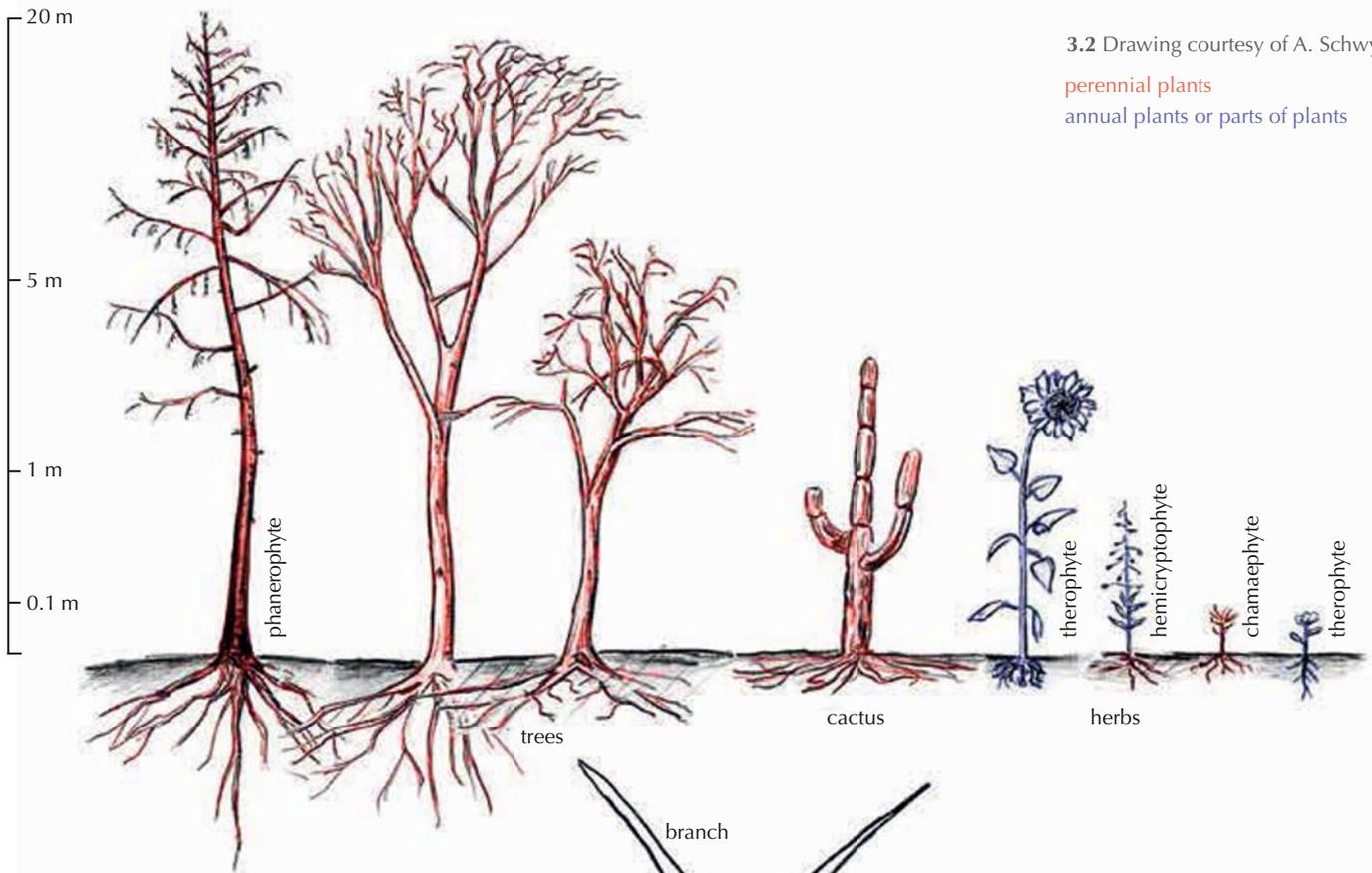
A few annual (blue) and perennial (red) growth forms in Fig. 3.2 on the following page relate to branching and plant height:

- Straight, self-supporting, and poorly branched plants (monopodial at least at the base) with heights of 5 cm to >100 m.
- Intensely branched plants (sympodial) with heights between 3 cm and 5 m.

- Intensely branched, cushion-like plants with heights between 1 cm and 50 cm.
- Liana-like, not self-supporting annual and perennial plants with lengths between 1 m and 50 m.
- Soft plants in wet environments (hydrophytes and helophytes) with various morphological adaptations.

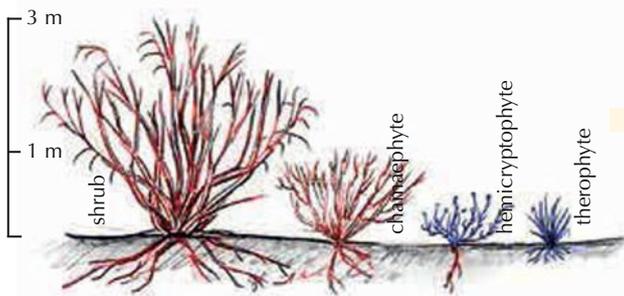
For further growth and life form classifications refer primarily to the Raunkiaer growth forms, which have been defined by Ellenberg & Mueller-Dombois 1967.

Upright growth forms with one stem at the base

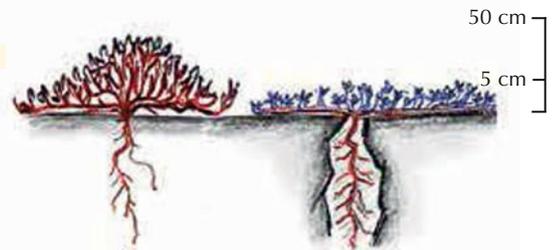


3.2 Drawing courtesy of A. Schwyzer
perennial plants
annual plants or parts of plants

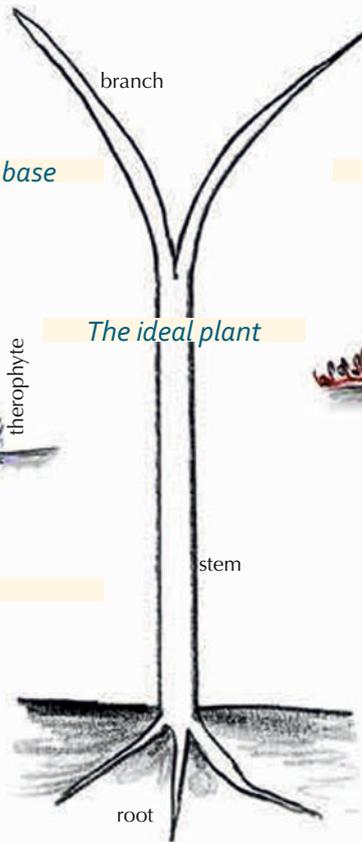
Upright growth forms with several stems at base



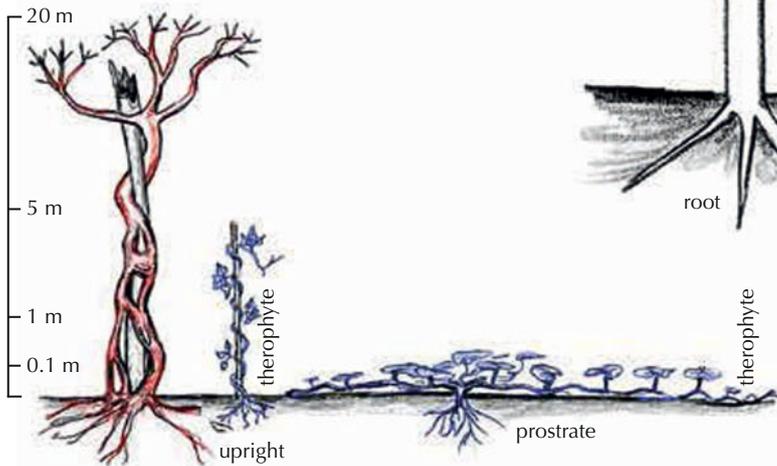
Cushion plants



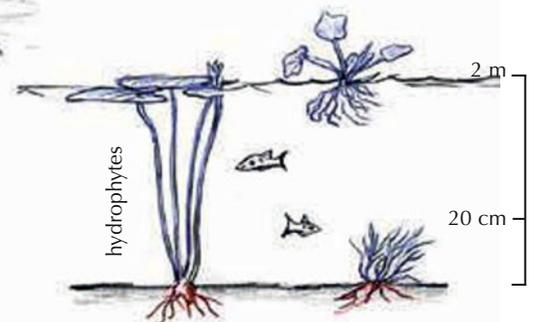
The ideal plant



Lianas



Water plants



3.2 Parts of the stem and definition of bark terms

The principal structure of stems is defined in this section, generally following Junikka 1994 and Crivellaro & Schweingruber 2015.

Bark is a general term, which includes all tissues outside of the wood (*Borke* in German).

Inner bark (colloquial) or phloem (scientific term) includes the living part of the bark.

Outer bark (colloquial) or rhytidome (scientific term) includes all dead parts outside the phellogen.

Bast is a colloquial term for phloem. Annual increments in the phloem consist of an early and a late bark.

Cambium is the growth zone (meristem) between the xylem and phloem.

Cambial zone contains the initial meristem, the xylem and phloem mother cells.

Cork is the colloquial term for phellem.

Cortex is a product of the primary meristem. It is located between the epidermis and the phloem. Rays are absent in the cortex.

Heartwood is the dead, non-conducting part of the xylem.

Periderm consists of phellogen, phellderm and phellem.

Pith is the central parenchymatic part of shoots.

Phellem is the product of the phellogen, often called cork. It consists of suberized dead cells.

Phellderm is the product of the phellogen. It is normally a very small zone which consists of living parenchyma cells.

Phellogen is a growth zone (tertiary cambium). Its origin are parenchyma cells within the cortex or the phloem.

Phloem is the (peripheral) product of the cambium. Rays are characteristic for the phloem.

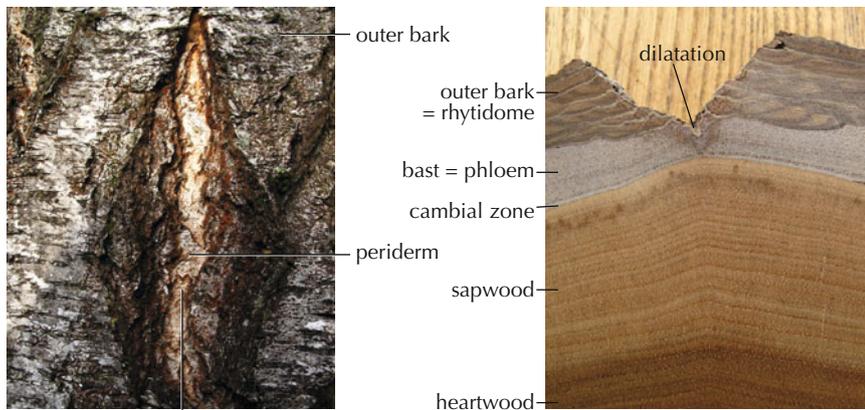
Rhytidome is the outer bark. It consists of all dead parts outside of the periderm.

Sapwood is the living and water-conducting part of the xylem.

Wood is a colloquial and technical term for all components inside of the cambium of which most are lignified.

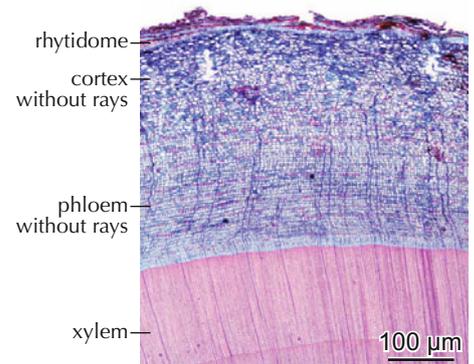
Xylem is the (centripetal) product of the cambium.

Macroscopic aspect of old bark



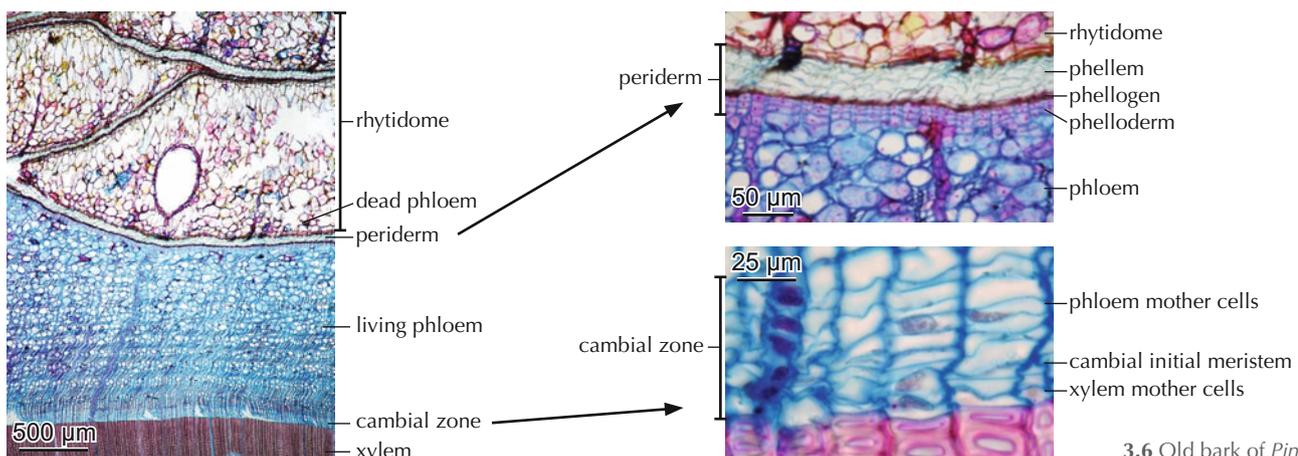
3.3 Old bark with dilatation in *Betula alba*.

Microscopic aspect of young bark



3.5 Young bark of *Juniperus communis*.

Microscopic aspect of old bark



3.6 Old bark of *Pinus sylvestris*.

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