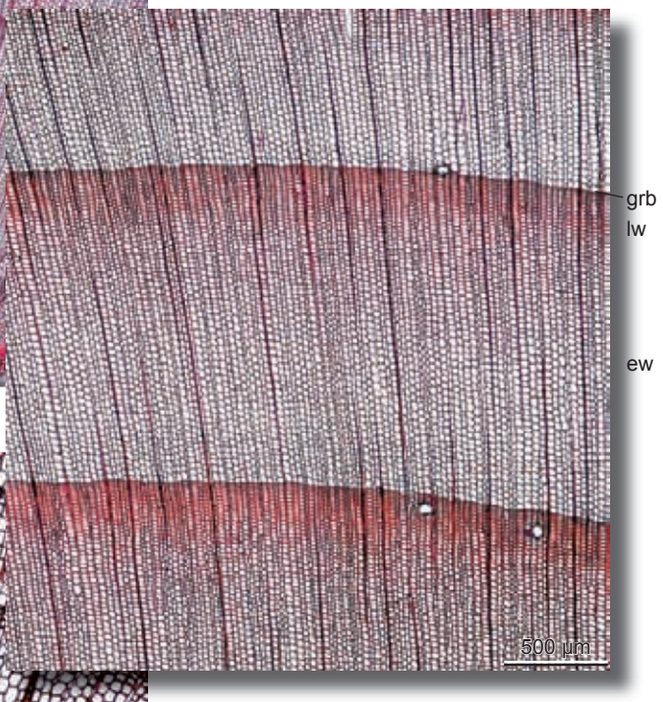
Modification of the Xylem Within a Plant
Conifer: Root, Twig and Stem

General features of the xylem structure are species-specific, many attributes are modified by the growth environment.

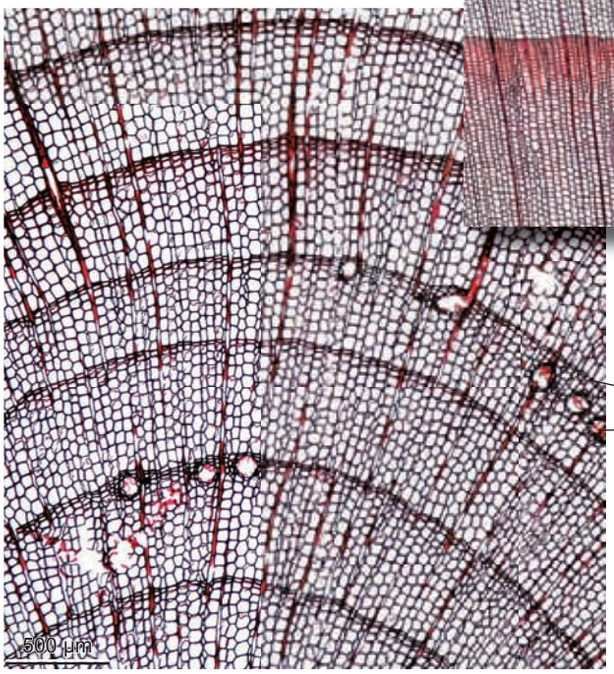
The wood anatomy of **branches and twigs** reflects changing physiological conditions and mechanical forces (5.1, 5.4, 5.8). Their relatively small vessels - in relation to the stem - indicate some physical tension. Genetic differences between the taxa are easily recognizable in those branches and twigs which are not subject to much mechanical stress.

Stem wood generally represents mechanically stable conditions (5.2, 5.5, 5.9). Therefore, genetic differences between taxa are best expressed in stem wood. Its anatomy is mainly influenced by the amount of water flow from the roots to the crown, and by major mechanical forces.

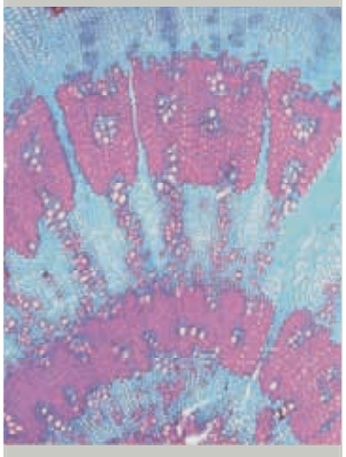
Left: 5.1 Norway Spruce twig wood (Picea abies). Small cells and distinct latewood are characteristic of this wood - 1 cm diameter, five years old.



5.2 Norway Spruce stem wood (Picea abies). Medium-sized cells and large rings are typical of this tree - 10 cm diameter.



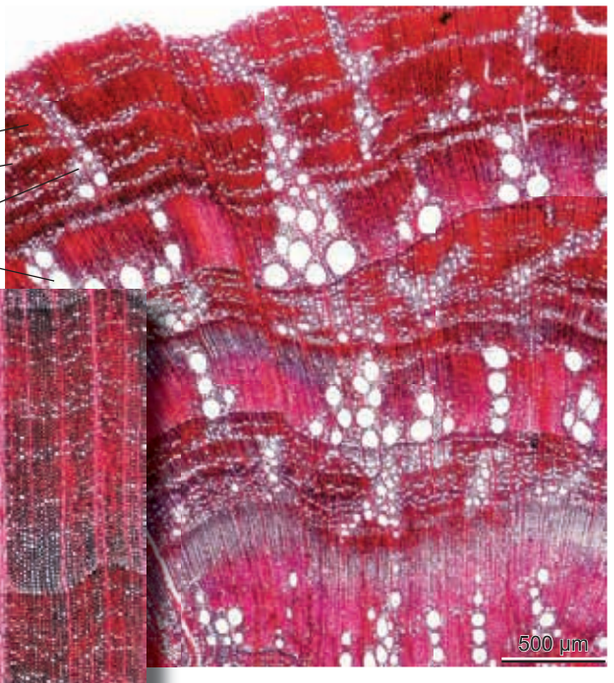
Left: 5.3 Norway Spruce root wood (Picea abies). Big, thin-walled cells and a small latewood zone are characteristic of these roots - 2 cm diameter.

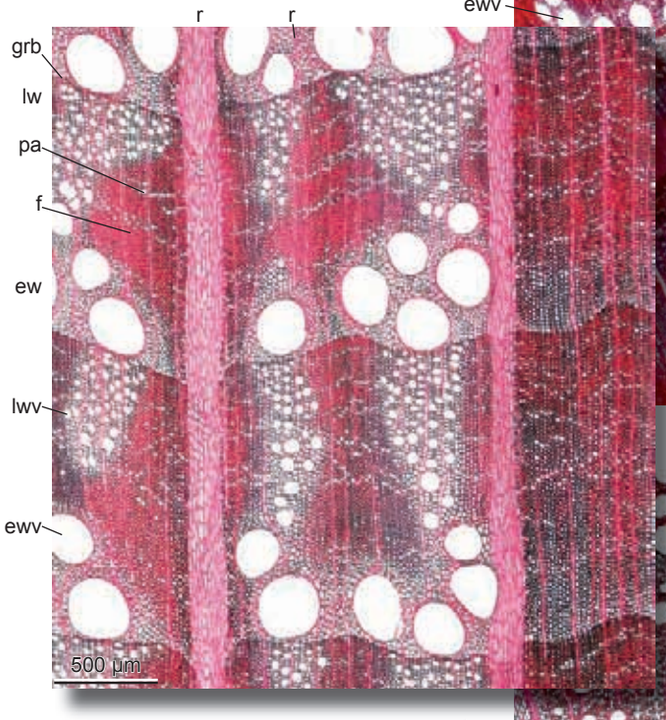


Root wood is subject to great anatomical variability because of extremely variable soil conditions (5.3, 5.6, 5.7). Genetic differences between taxa are only recognizable, if at all, in the cell wall structure. Root wood is mainly influenced by the amount of water to be transported and by very variable forces of tension.

Within individuals, the wood-anatomical differences between stem, roots and twigs reflect the environmental conditions. When roots are exposed, they adopt a stem structure, whereas twigs buried in the ground take on root structure (5.10-5.14).

Right: 5.4 Sessile Oak twig wood (Quercus petraea). Dense tissue, a ring-porosity with fairly small vessels and distinct annual rings are characteristic of this wood.



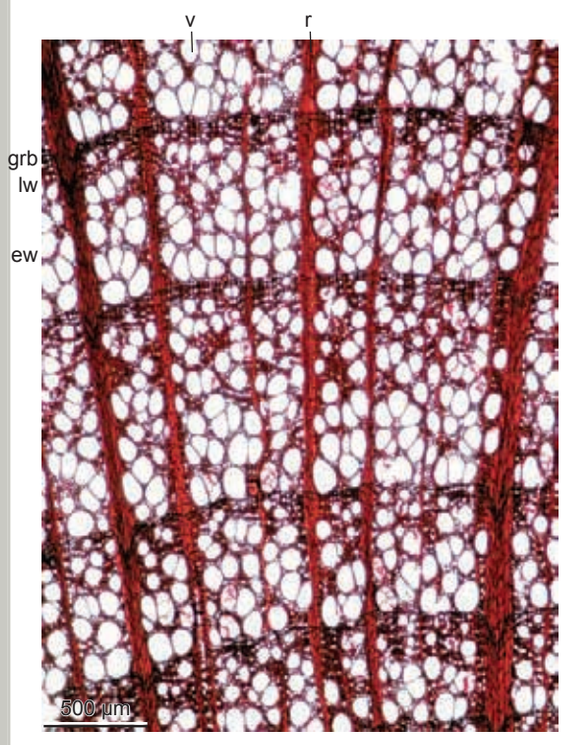


5.5 Sessile Oak stem wood (Quercus petraea). Well-structured wood, ring-porosity and very distinct rings are characteristic of the stem.

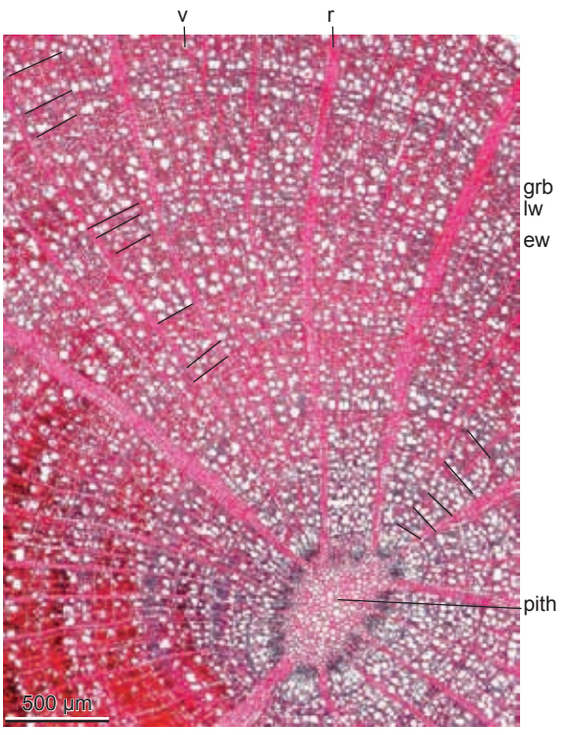
Right: 5.6 Sessile Oak root wood (Quercus petraea). A diffuse vessel distribution and the lack of distinct annual rings are characteristic.

continued next page

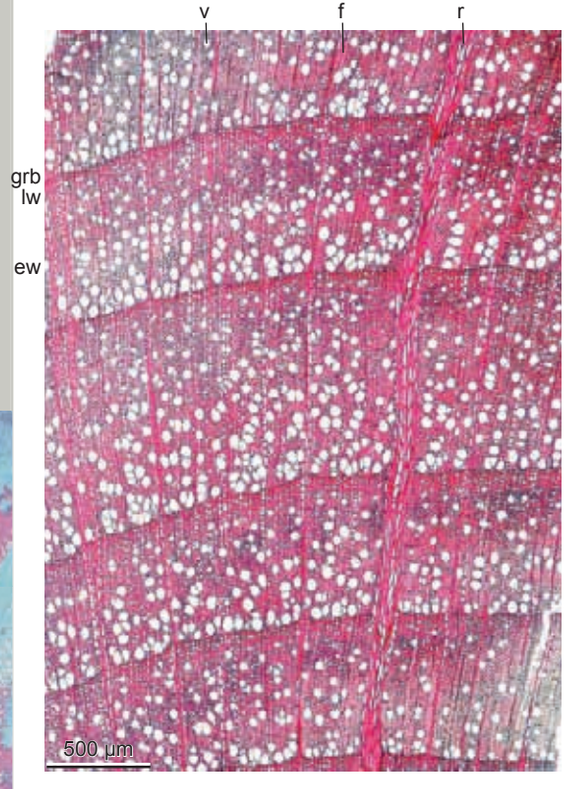
Modification of the Xylem Within a Plant
Deciduous Tree: Root, Twig and Stem



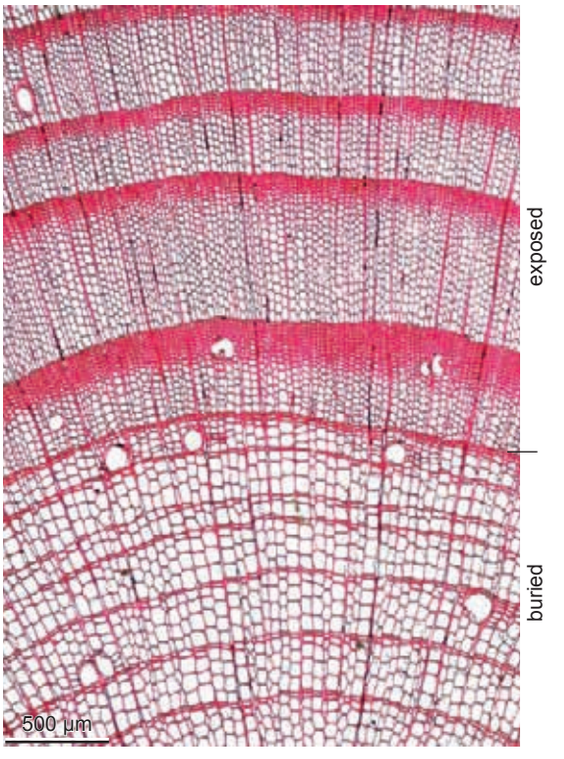
5.7 Common Beech root wood (Fagus sylvatica) with a large number of big vessels.



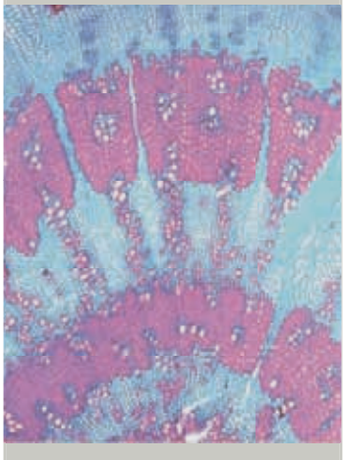
5.8 Common Beech twig wood (Fagus sylvatica) with dense tissue and many small vessels.



5.9 Common Beech stem wood (Fagus sylvatica) with dense tissue, semi-ring-porosity and very distinct annual rings.

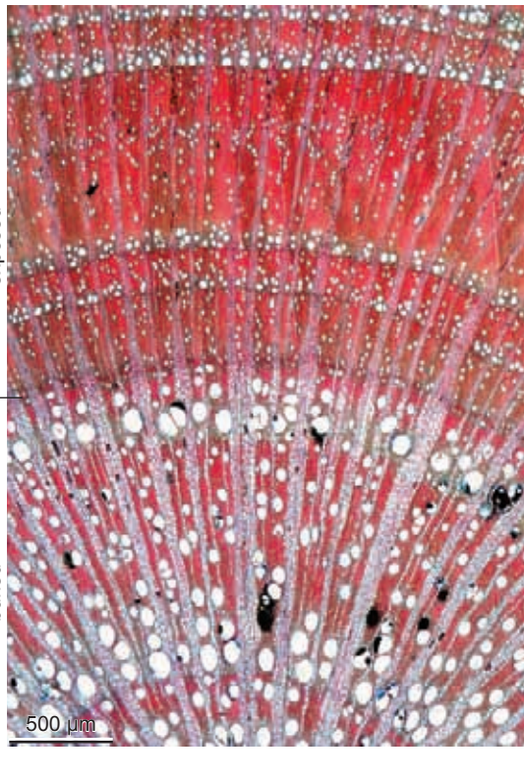


5.10 Exposed Mountain Pine root (Pinus mugo). Large, thin-walled cells are characteristic of the root structure.

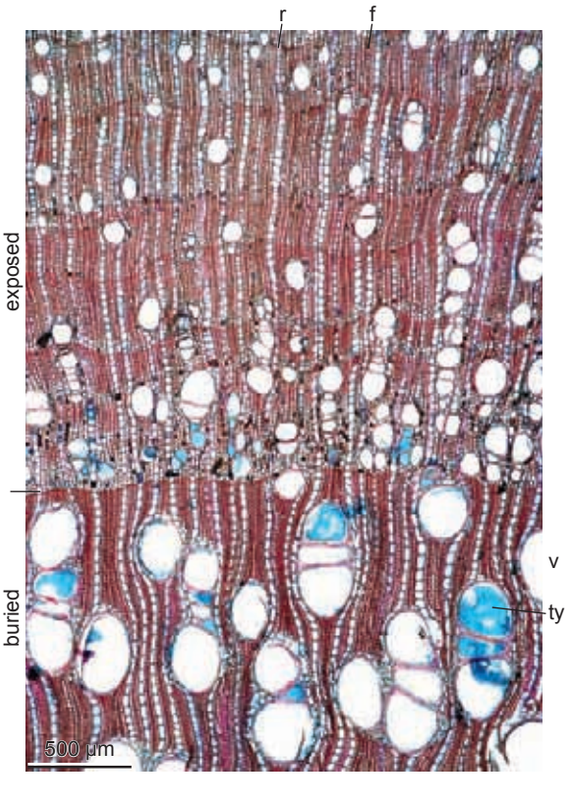


5.11 Exposed adventitious Cottonwood tree roots (Populus sp.). The stem was buried by flood sediment. Under the dark and wet conditions, a new root system was initiated. Many years later, this particular part was exposed by erosion.

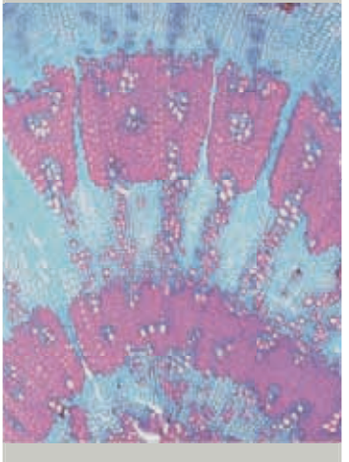
5.12 Exposed Common Beech roots (Fagus sylvatica). Externally, they look like roots, but the xylem produced in the root phase is different from that formed when the roots were not exposed. Beech forest, Zürich, Switzerland.



5.13 Root/stem wood of an exposed Peach Tree root (Prunus persica). The ring-porosity with large earlywood vessels is characteristic of the root structure, while dense fiber tissue and small earlywood vessels are typical of the stem structure.



5.14 Lotus Tree root/stem wood (Ziziphus lotus) of an exposed root, which has grown in a riverbed in the arid climate of Oman. Characteristic of the root wood are very big vessels and the absence of annual rings, whilst small vessels and annual rings are typical of the stem wood.



Modification by Aging: Changing Growth Forms

Morphological changes of tree and leaf shapes reflect the aging process. Tree growth forms emphasize the phenomena of tree aging, for example, a leading, dominant shoot is typical of young conifers (Roloff 2001) while old trees show a flat crown, e.g. in fir, cedar, araucaria and others (5.15-5.18). Wood anatomical characteristics may differ with age (5.19, 5.20). In a few genera, such as in *Ilex* and *Hedera*, leaf shape varies, depending on the shoot's age (5.21, 5.22).

5.15 A young Monkey-puzzle Tree (Araucaria araucana). The top shoot grows vertically. Lonquimai, Patagonia, Argentina.

5.16 An old Monkey-puzzle Tree (Araucaria araucana). The top of the crown is flat. Lonquimai, Patagonia, Argentina.

5.17 A young, fast grown Spanish Fir (Abies pinsapo). The top shoot grows vertically. The tree has not reached the final height. Arboretum Birmensdorf, Switzerland.

5.18 Old, slow growing Spanish Firs (Abies pinsapo). The crown tops are flat and don't grow higher anymore. Sierra da Ronda, Spain.

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