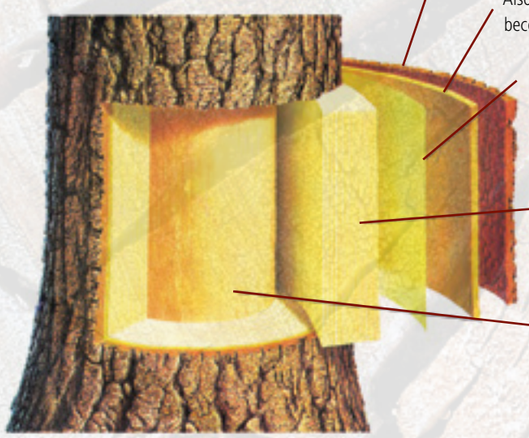
What is wood?

Wood is robust and versatile. However, even the best material has its limits. Consequently, Empa researchers are looking to transform wood into a high-tech material and thus broaden the range of applications for this natural resource. They tamper with the material's cell structure, where they deposit materials with a vast range of different properties. But before you read on about all the things you can do with wood in the next ten pages of this issue, let's take a closer look at this miracle natural material. How does a tree grow, for instance? What do tree rings tell us? And what does the structure of wood look like at microscopic level?

From bark to heartwood

The structure of a tree trunk



The outer bark
Protects the tree from heat, fungi and insects, and regulates evaporation.

The inner bark
Also called liber, is the tree's supply line. It soon dies, transforms into cork and eventually becomes part of the outer bark.

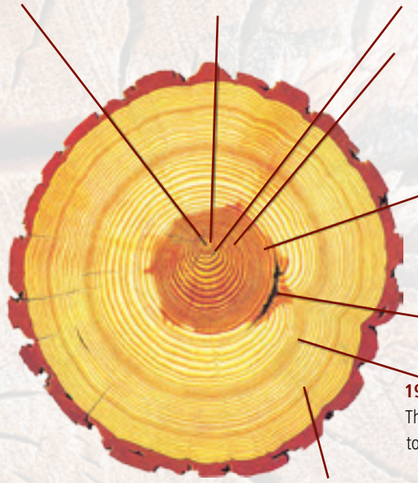
The cambium
The tree's growth tissue. This is where new bark and wood forms every year.

The sapwood
The tree's water supply line to the crown. On the outside, new wood forms; on the inside, the cells lose their vitality and transform into heartwood.

The heartwood
The tree's central supporting column. Although it is actually dead, instead of decomposing it retains its supportive strength as long as the outer layers are alive.

What tree rings can tell us

62 growth cycles using the example of a pine tree



1913
The tree is "born", the seed germinates.

1918
Undisturbed, the pine grows fairly quickly. The rings are wide and uniform.

1923
Once the tree is ten years old, something presses against it. It leans to one side and forms "reaction wood", which helps to withstand the pressure.

1933
The tree is growing straight again, but a neighboring tree is hogging the sunlight and water.

1936
Other trees nearby are felled. More nourishment and sunlight enable our tree to grow more quickly again.

1939
A ground fire rips through the forest. The tree survives, but has the scars to show for it. Every year, the damage is covered with new wood and it bulges.

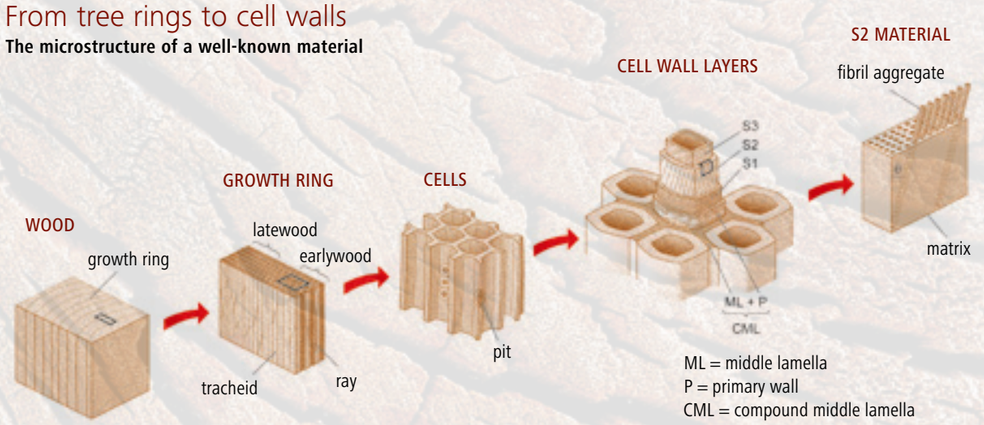
1951
The region is hit by a lengthy dry spell. The rings are close together and the growth rate falls.

1966
Another cluster of narrow tree rings might have been caused by an insect infestation. Insect larvae eat the tree's needles and buds.

1975
The pine is felled at the age of 62 due to disease.

From tree rings to cell walls

The microstructure of a well-known material



ML = middle lamella
P = primary wall
CML = compound middle lamella

Graphic: Schutzgemeinschaft Deutscher Wald, www.sdw.de / Empa

Video (German language)
«Wunderwerkstoff Holz – belastbar, vielseitig und nachwachsend»
https://youtu.be/i_SoteRa1fM