



Combining the Science and Design of Plant Cells and Structures

FP1303: Design Application and Aesthetics of
Biobased Building Materials

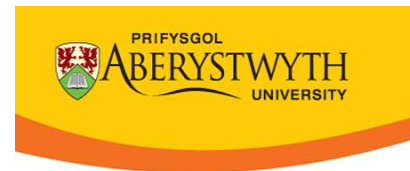
28th February 2017
Dr Morwenna Spear





Introduction

- The BioComposites Centre is collaborating with
 - IBERS at Aberystwyth University and
 - Cardiff School of Architecture
- Plants and Architecture cluster of the NRN-LCEE
- Looking at the interactions between buildings, plants and materials





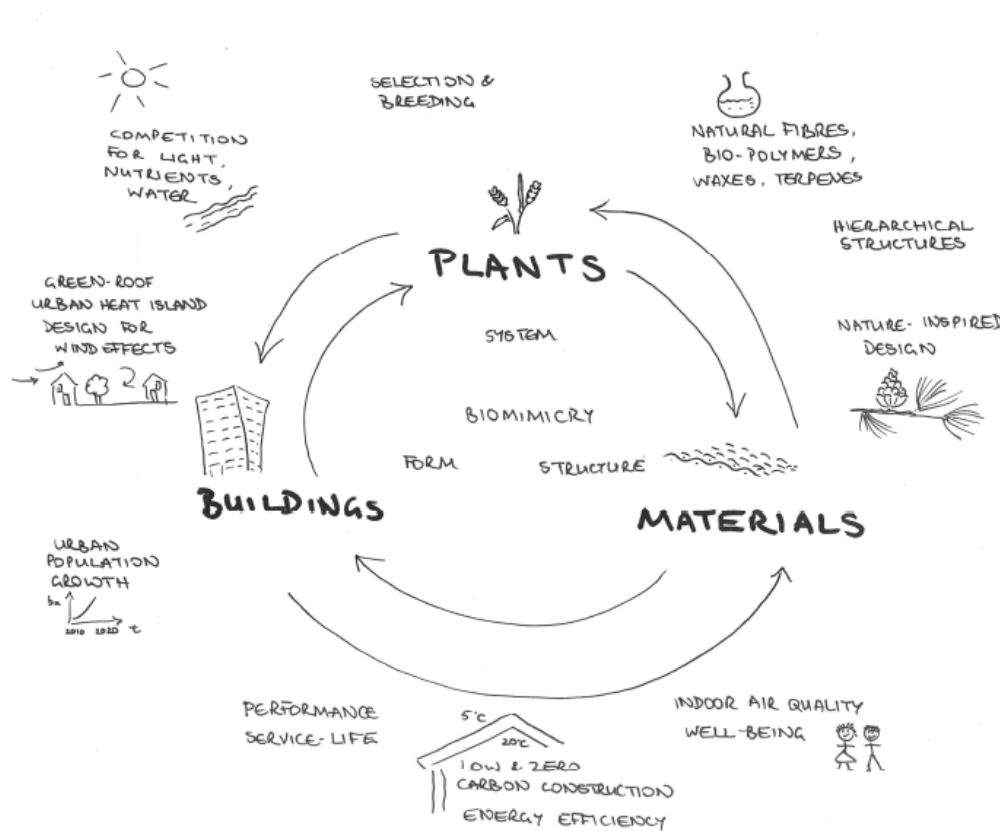
What that probably means to a wood scientist:



Image: Russwood

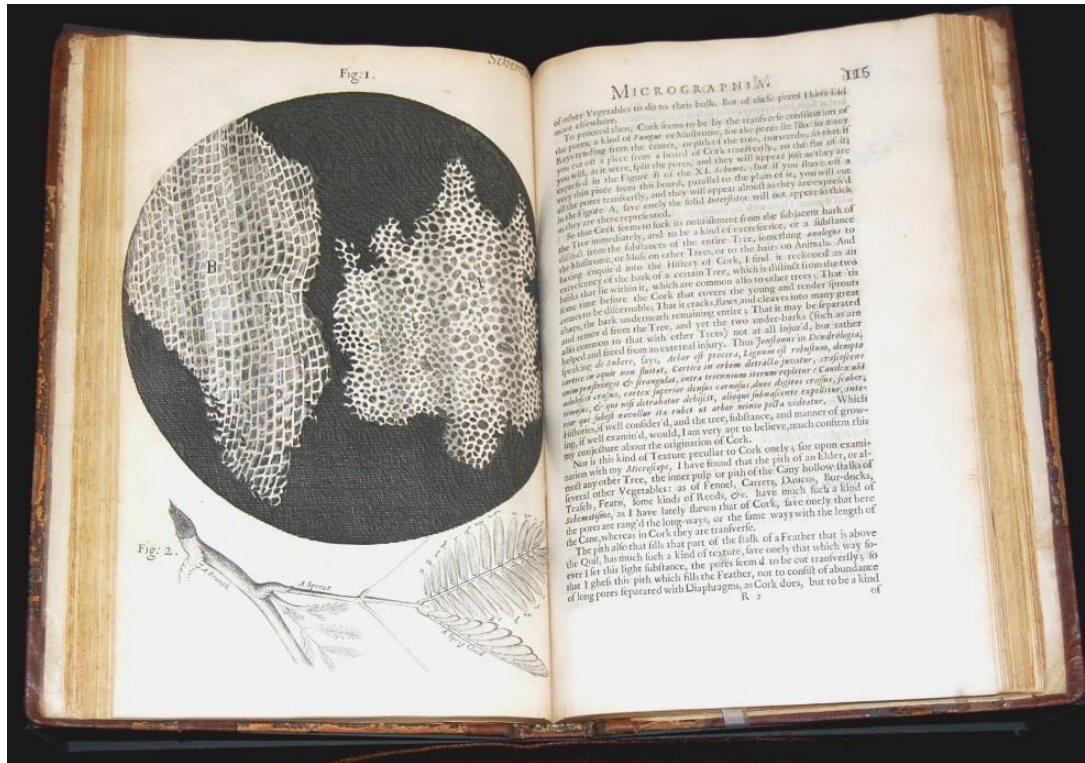


What it means to the cluster:





Starting at the beginning





Robert Hooke

- 1635-1703
- Curator of experiments at the Royal Society of London
- Credited for identifying the cellular structure of cork
- Micrographia, publ 1665
- Hooke's Law 1660
- The monument



Schem.x.

Fig:1

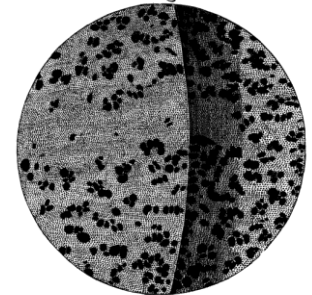


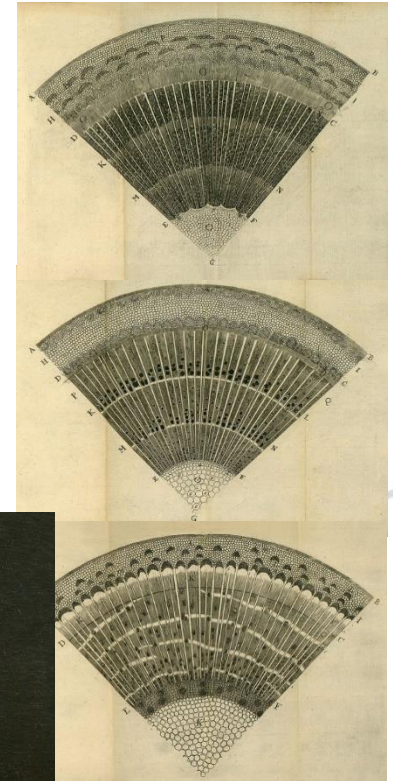
Fig:2:





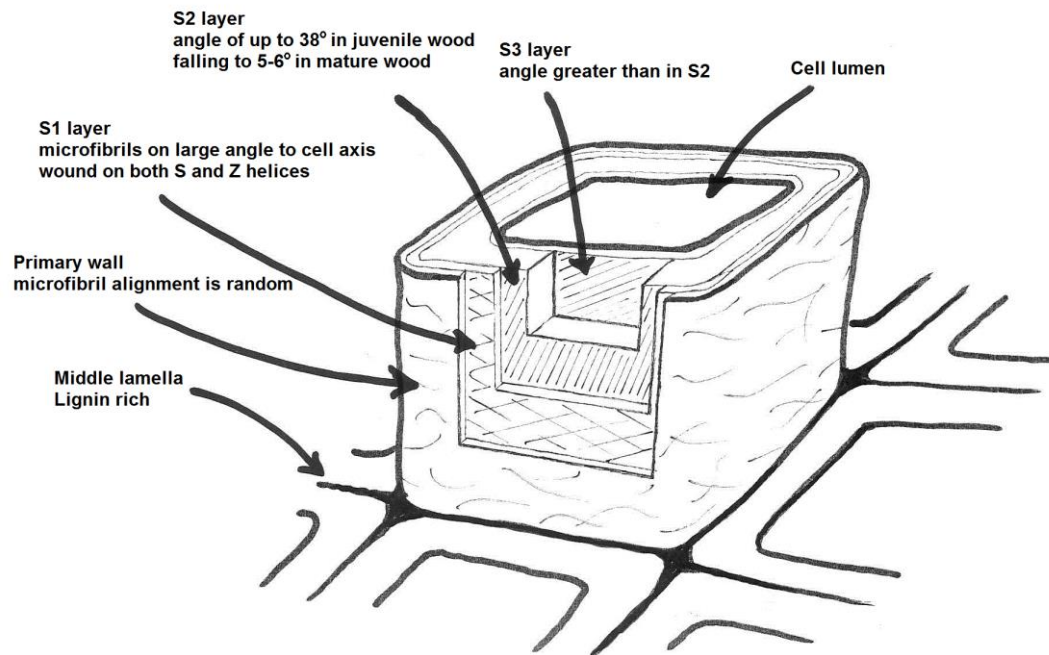
And others

- Nehemiah Grew
- 1641-1712
- The Father of plant anatomy
- *The Anatomy of Plants*, publ 1682
- Marcello Malpighi
- 1628-1694
- Published *Anatome plantarum* through Royal Society of London, volumes in 1675 and 1679





Cells as structures

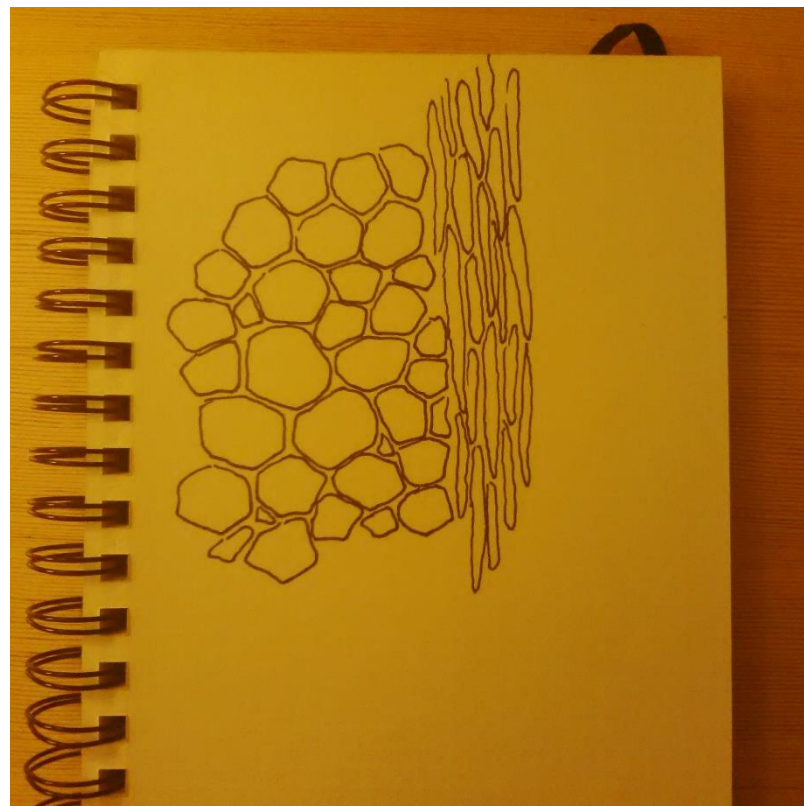


But this is the
ultrastructure of a
tracheid...



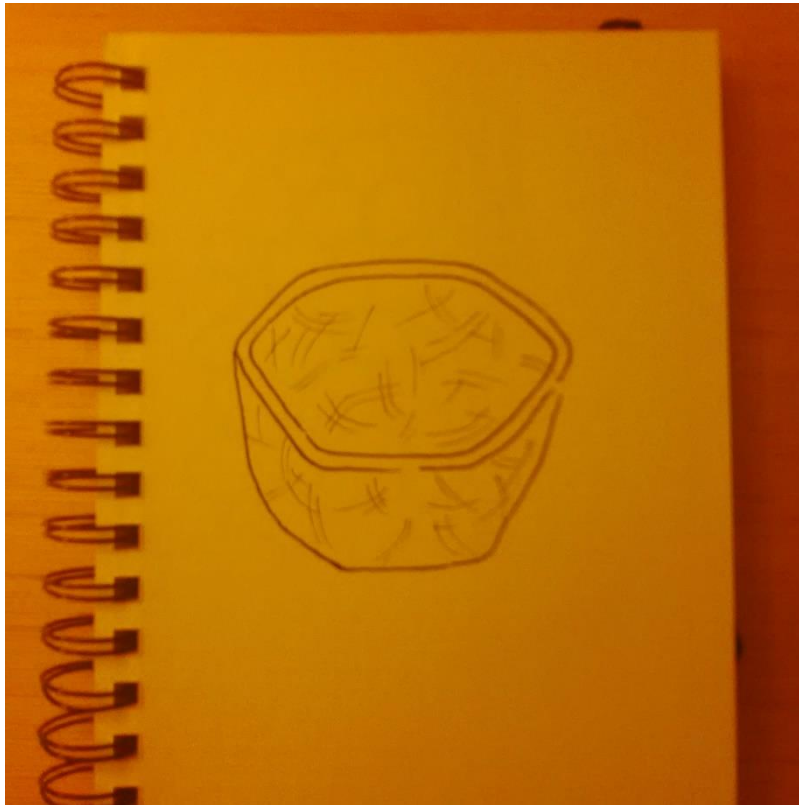


Cells in structures

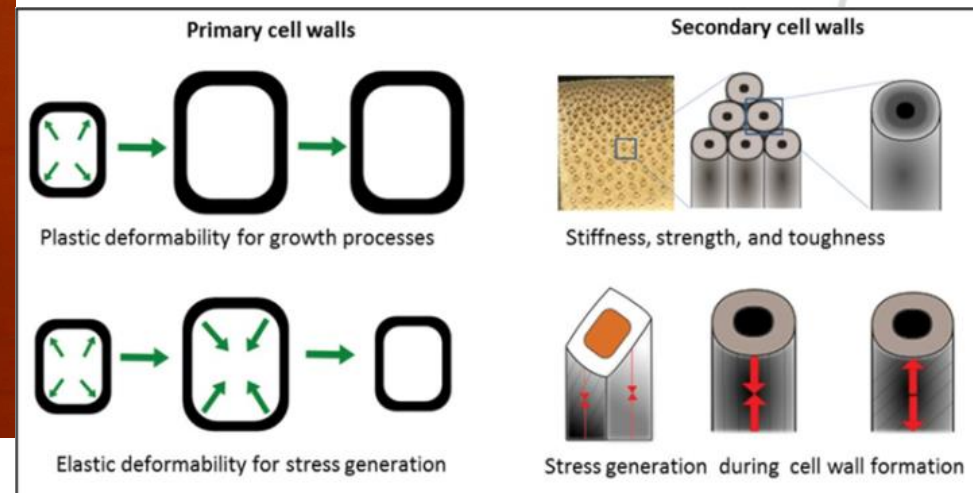




Cells in structures

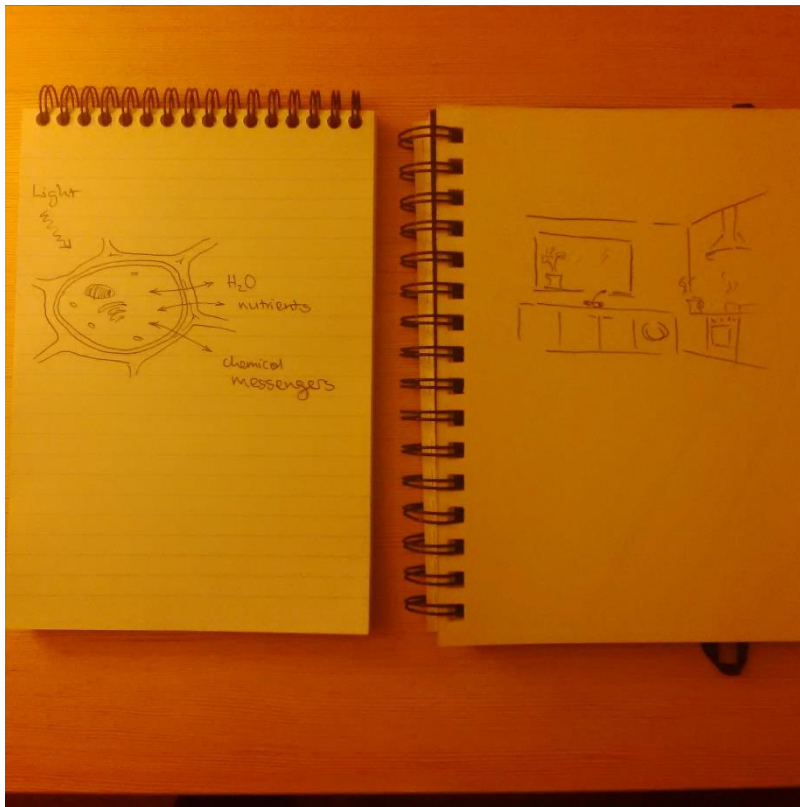


- Parenchyma cell, e.g. in the pith of an annual plant
- Primary wall
- Optimised for hydrostatic pressure





Cells as building envelopes



- Structure
- Protection
- Communication
- Permeability
- Regulation of the environment





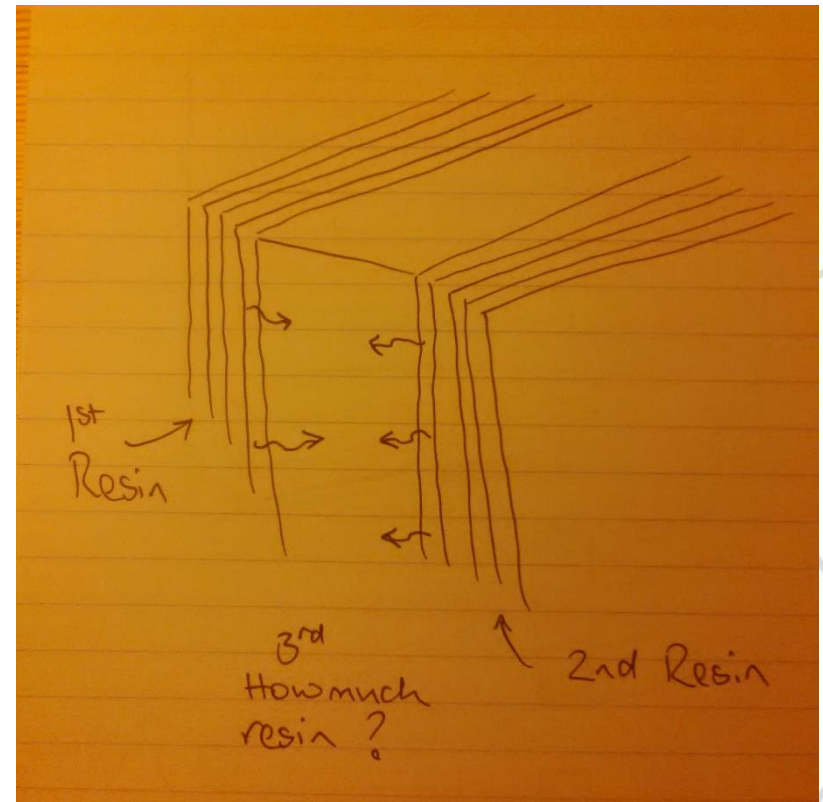
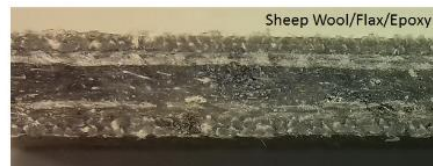
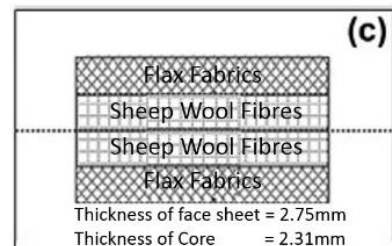
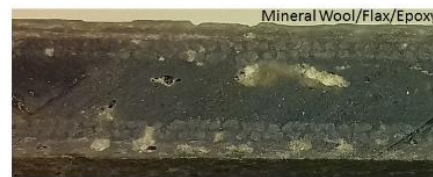
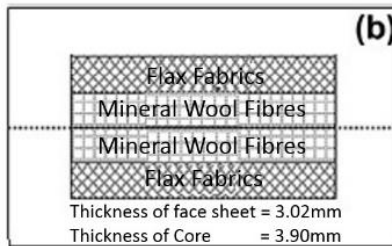
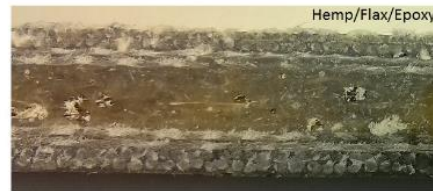
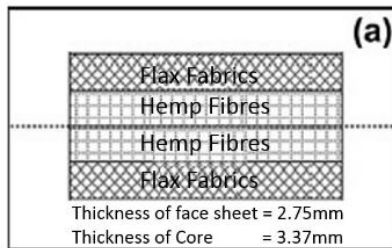
Building materials

- Multifunctional components
- Example 1
- Composite panel with insulation and structural properties





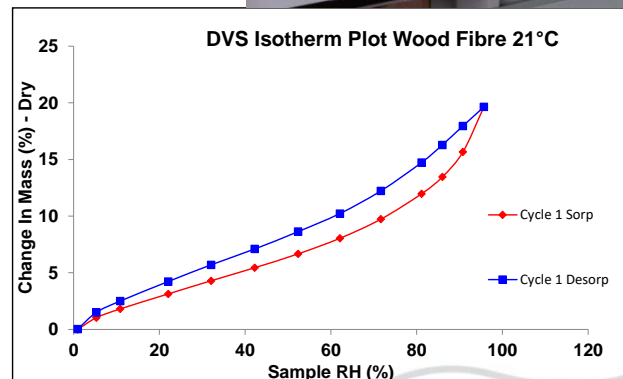
Building materials





Building materials

- Example 2
- Wall panels with environmental regulation
- VOC scavenging
- E.g. sheep's wool (Curling et al. 2014 ...)
- Breathability
- Moisture buffering





Water uptake – grain orientation



Incorrect plank grain

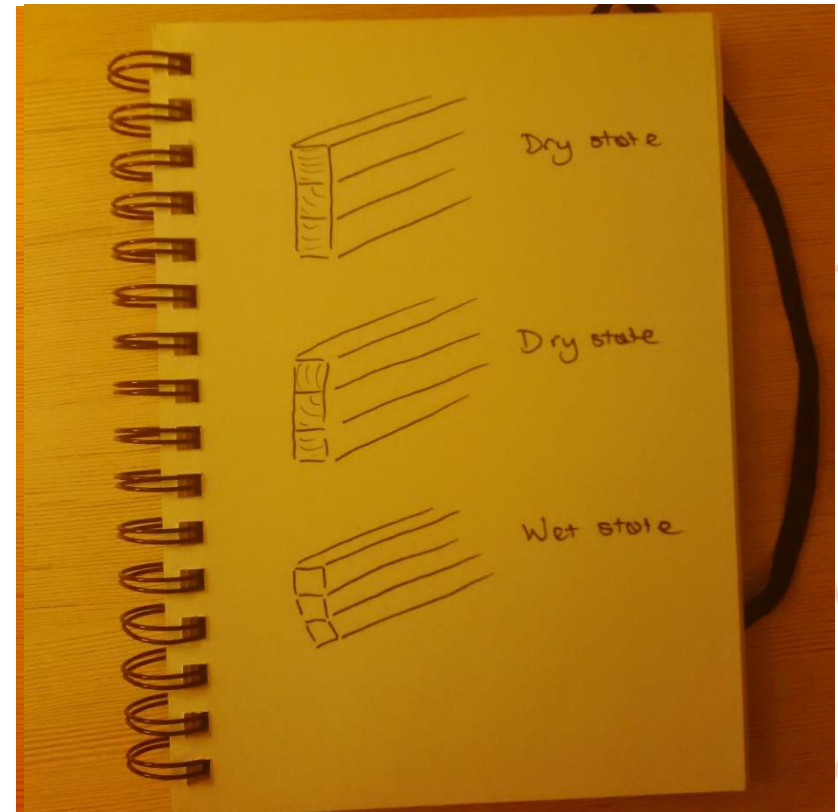


Correct plank grain



Building materials

- Passively controlled ventilation
- Multi-functional panels with actuators
- Examples with two-ply veneer laminates
- What about solid wood?





Building materials

- Green walls and roofs
- Can we design for moisture regulation?
- Actuators within the substrate to maximise water gain during rainfall
- And to slow rate of water loss in drought



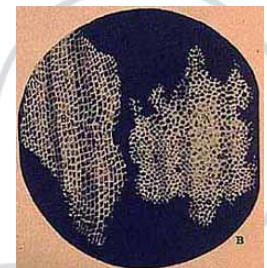


Plenty of opportunities

- Microstructure is only one aspect of bioinspiration
- Opportunities to use bioinspired designs to improve green building and horticulture
- Opportunities for wood and natural fibre composites in architecture

"... I made use of microscopes and some other glasses and instruments that improve the senses... only to promote the use of mechanical helps for the Senses, both in the surveying the already visible World, and for the discovery of many others hitherto unknown"

- **Micrographia,**
Robert Hooke (1665)





International Panel Products Symposium

Call for papers:

- Innovation in wood based panels
- Panel performance, durability, weathering
- Resins and bioresins
- Novel feedstocks and recycling
- Processing technologies
- VOCs and emissions in service

**4th & 5th
October
2017**

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