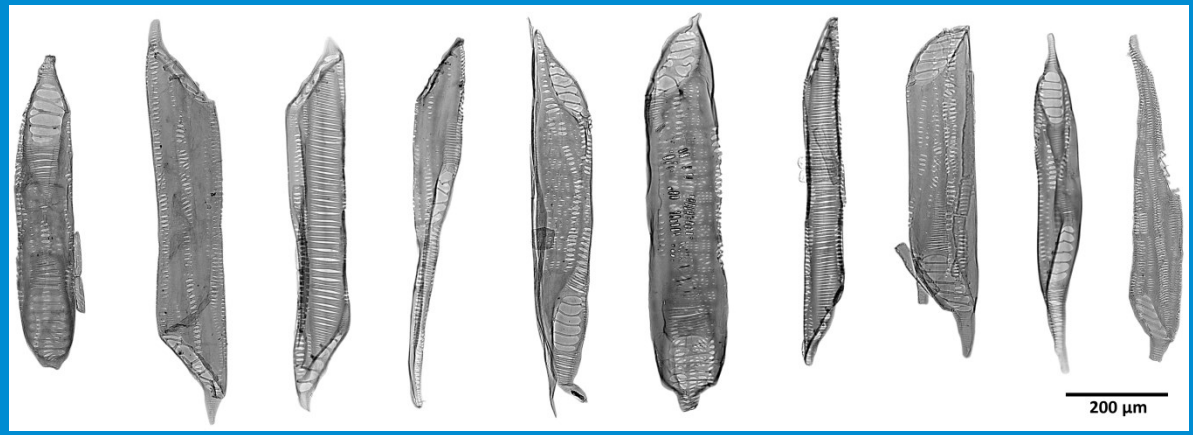
Wood Species Identification in Fibre Materials

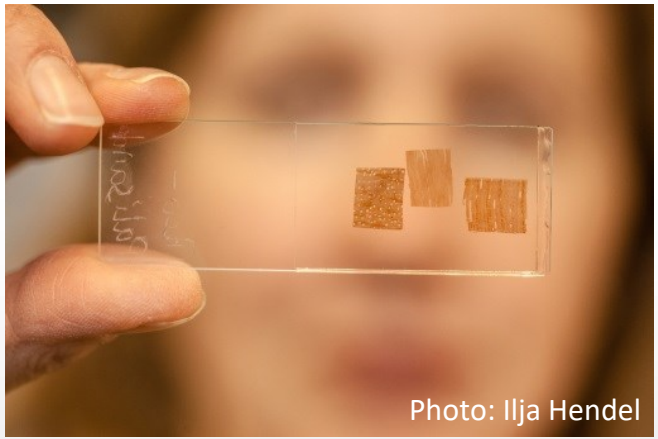
Dr. Andrea Olbrich, Dr. Stephanie Helmling, Jördis Sieburg-Rockel and Stephanie Wrage
Thünen-Institute of Wood Research

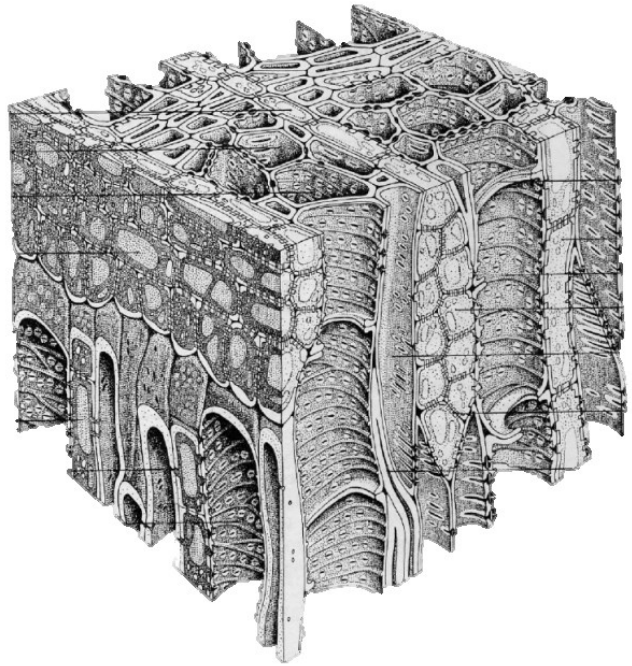


Wood+ – Summer School EDU-4
13th June 2023

Identification of Solid Wood

- Microtome sections of the three anatomical planes
- 3D-Information
- 80 – 100 characters





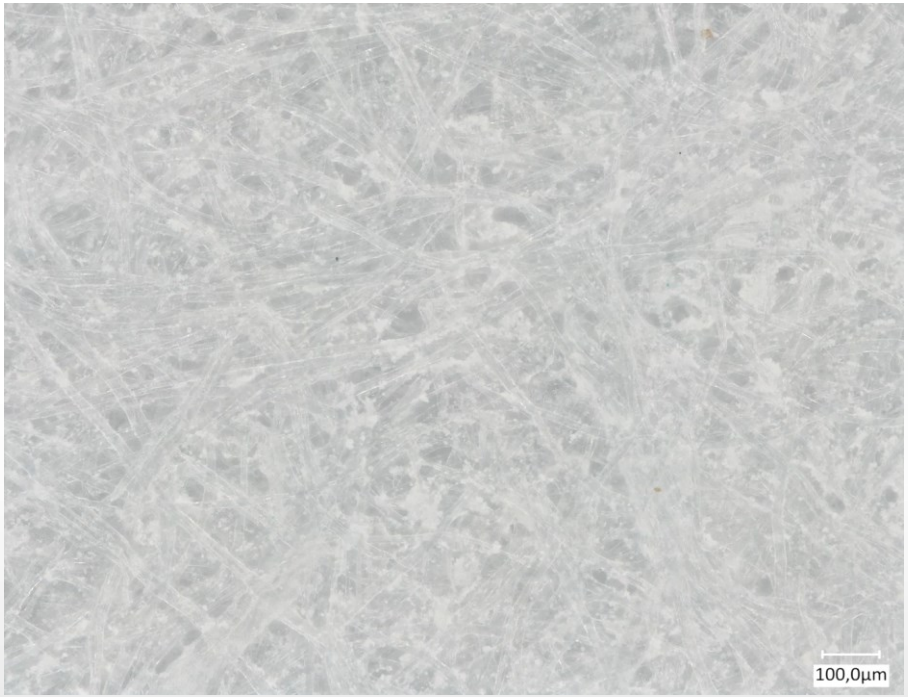
Wood Species Identification in Fiber Material

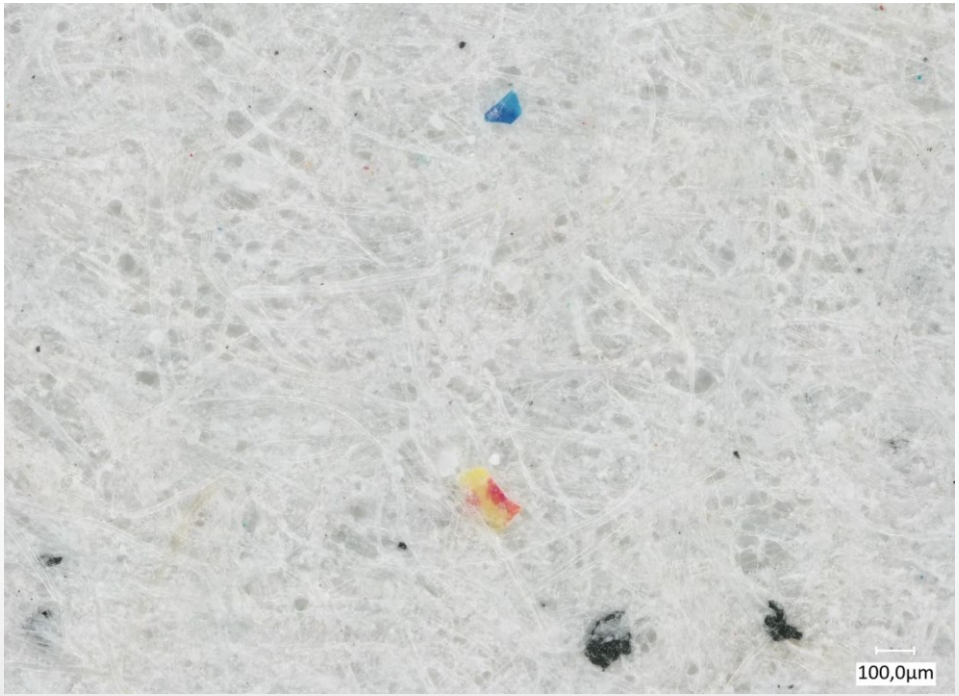
EUTR

Wood Species Identification in Fiber Material

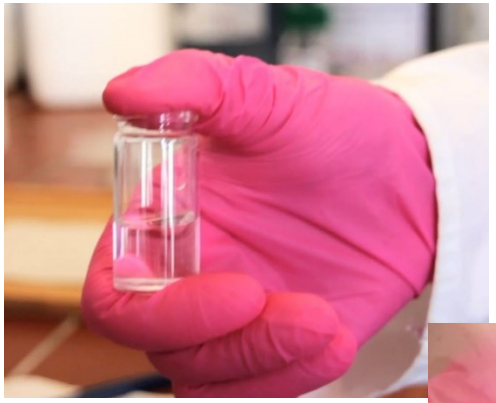
- Macroscopic evaluation is not possible
- Wooden tissue is dissolved
- Mostly mixed timbers
- DNA destroyed and washed out

Recycling Material?





Preparation of Fibre Materials for Microscopy – Paper

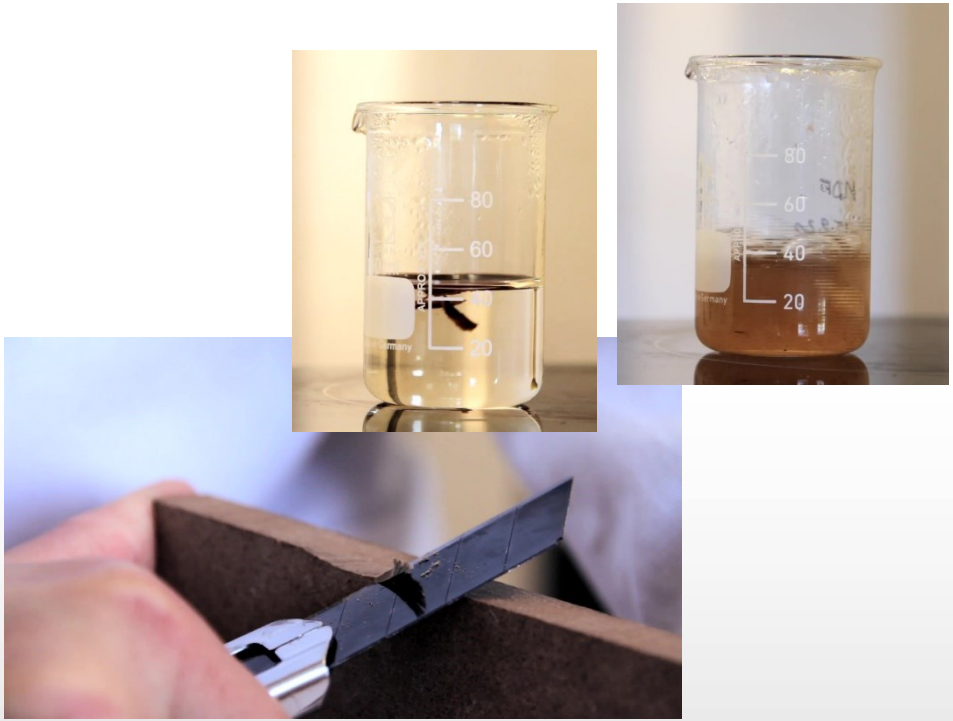


Preparation of Fibre Materials for Microscopy – Paper

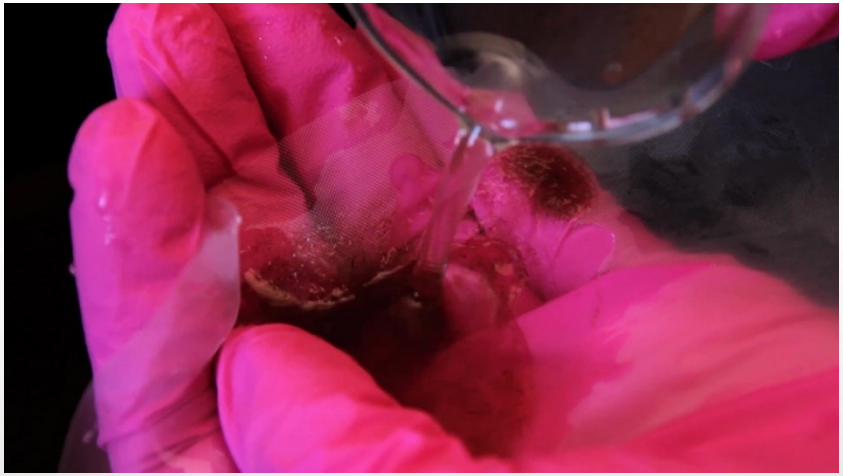
Staining

- Place 3 drops Alexander solution on a slide (Calcium nitrate)
- Mix with fibres
- Add 1 drop Herzberg solution (Zinc iodine chloride solution)
- mix
- Cover with coverslip

Preparation of Fibre Materials for Microscopy – Fibre Board



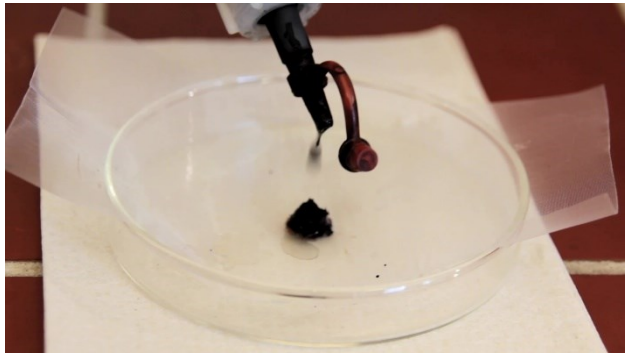
- Boil the MDF samples in water until they dissolve
- Filter off the fibers

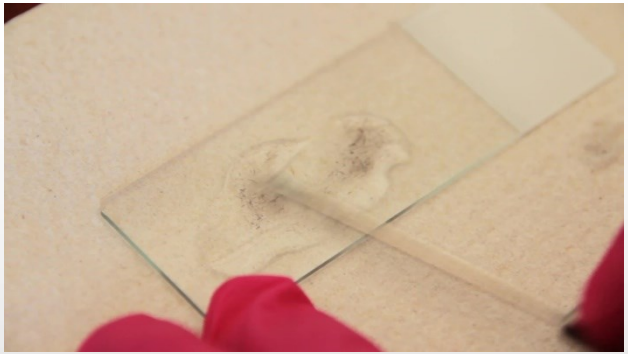


Preparation of Fibre Materials for Microscopy – Fibre Board

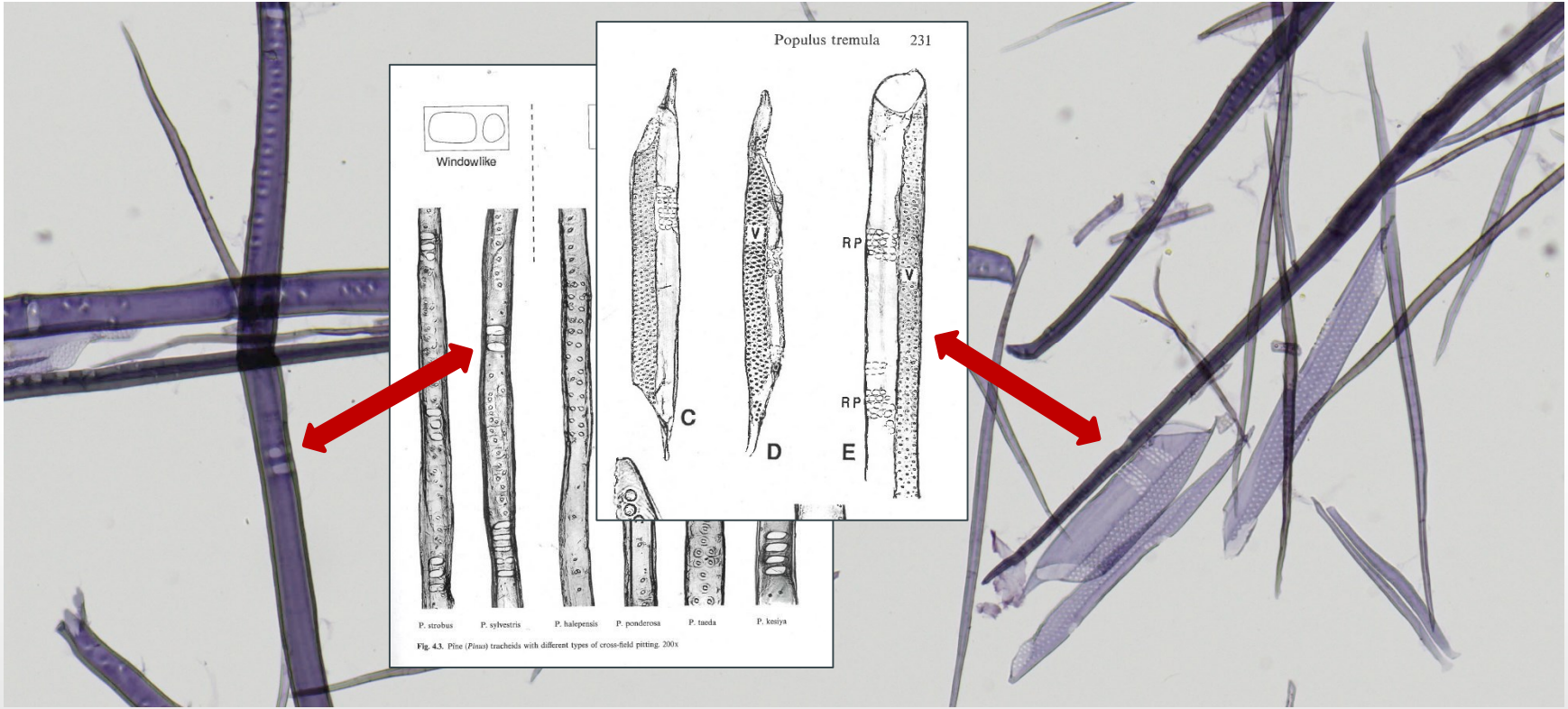
Staining

- Mix the fibers on the mesh with 3 drops of nigrosine solution (incubation for 10 minutes).
- Wash out excess staining solution
- Place the fibres on a slide
- Cover with glycerin and coverslip

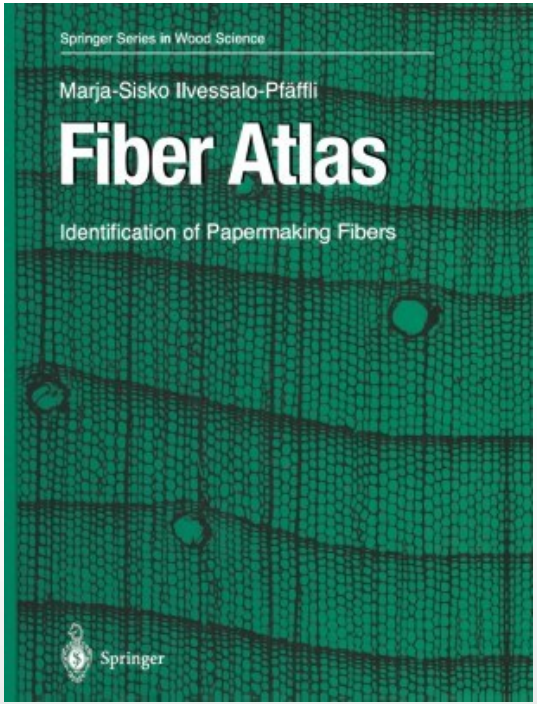




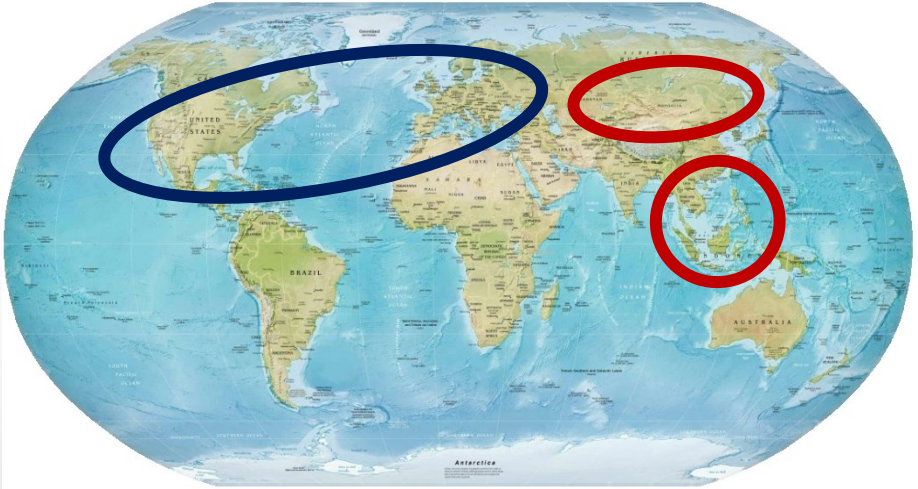
How to analyze an unknown sample?



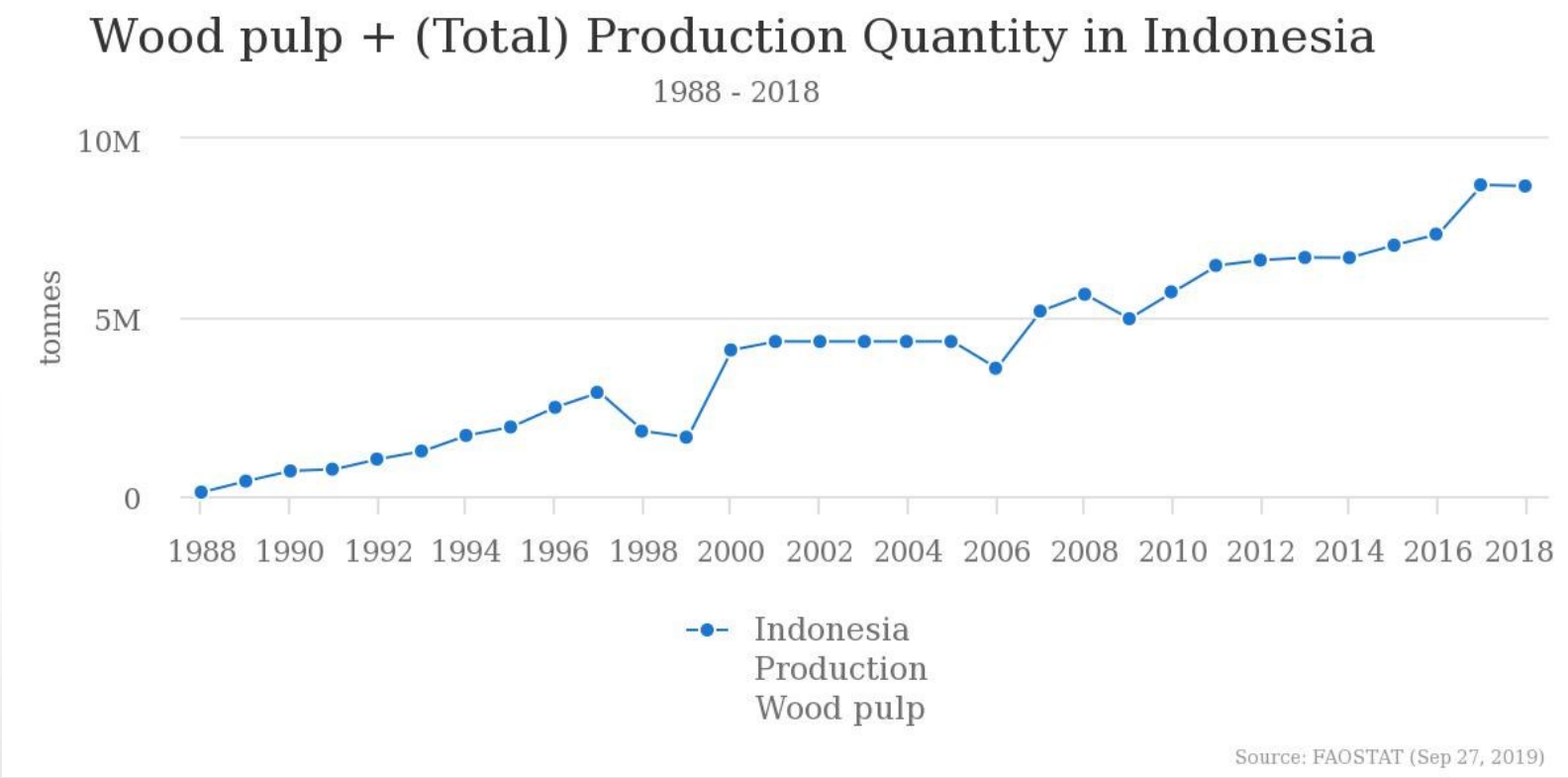
References



Ilvessalo-Pfäffli (1995) Fiber Atlas

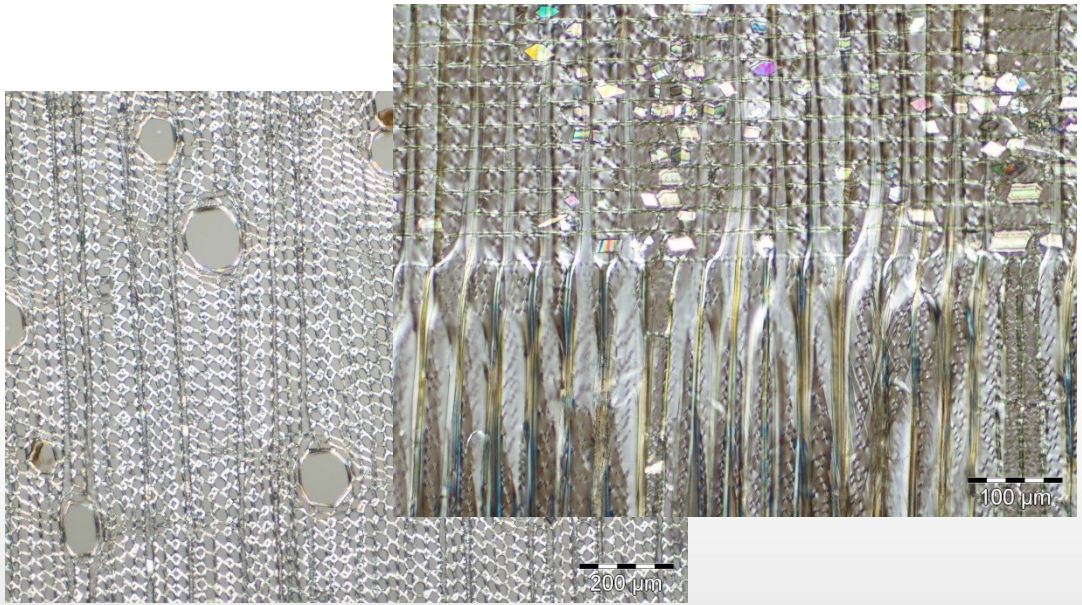


Pulp production in Indonesia



Wood-Chips von APP (Indonesien)

46 (of 59 samples) Ramin - CITES II

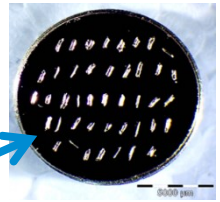


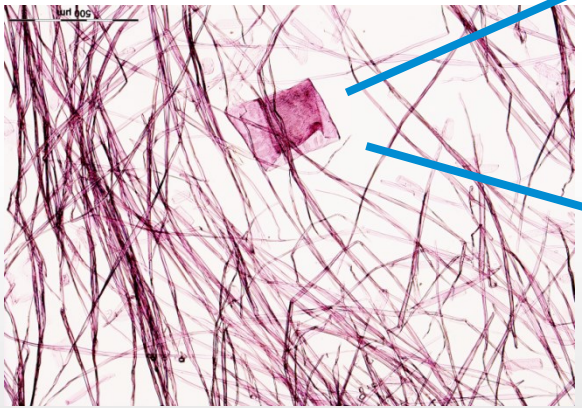
ASIA PULP & PAPER UNDER INVESTIGATION PART TWO
THE RAMIN PAPER TRAIL
GREENPEACE

www.greenpeace.org/ramintrail

References

- Maceration (CH_3COOH / H_2O_2)
- Preparation
- Microscopy





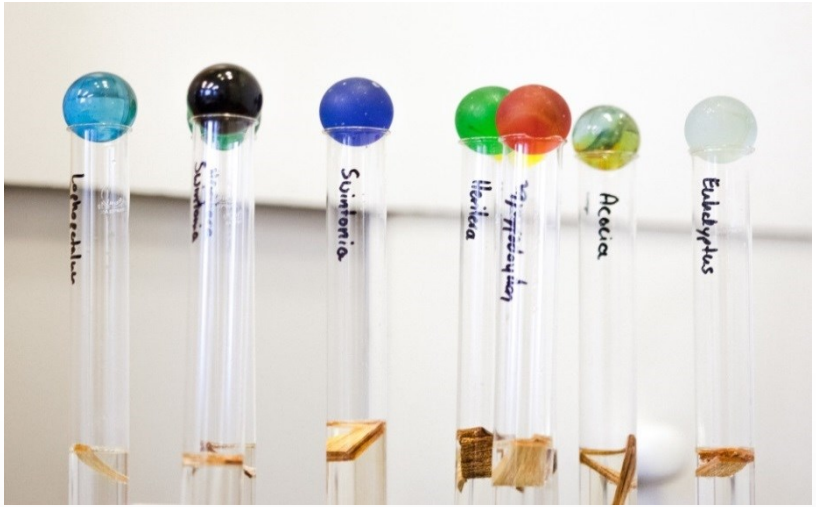
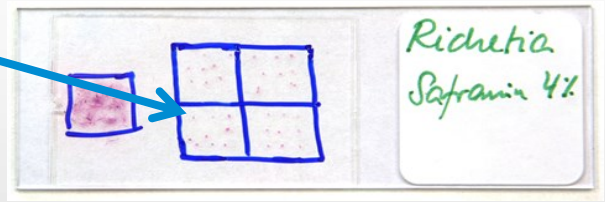
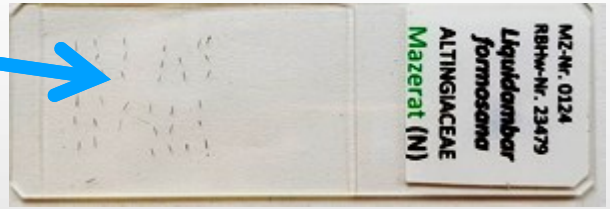
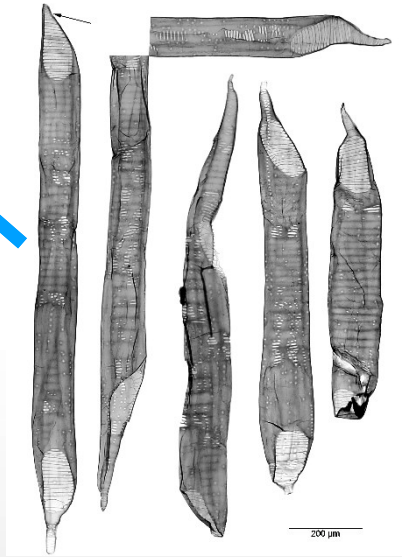


Photo: Ilja Hendel



Preparation of References

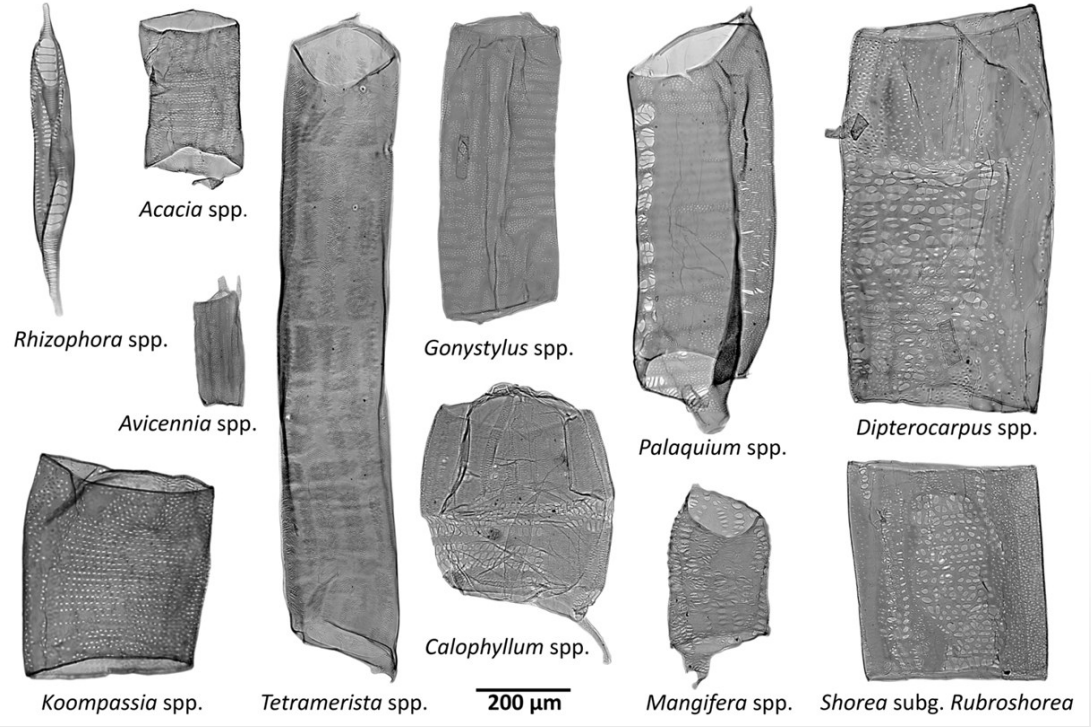




Characteristics of vessel elements

- Perforation plates
- Intervessel pits

  (size / arrangements)
- Vessel-ray pits (APS or VAS)
- Helical thickenings
- Tyloses
- Dimensions (length / width)

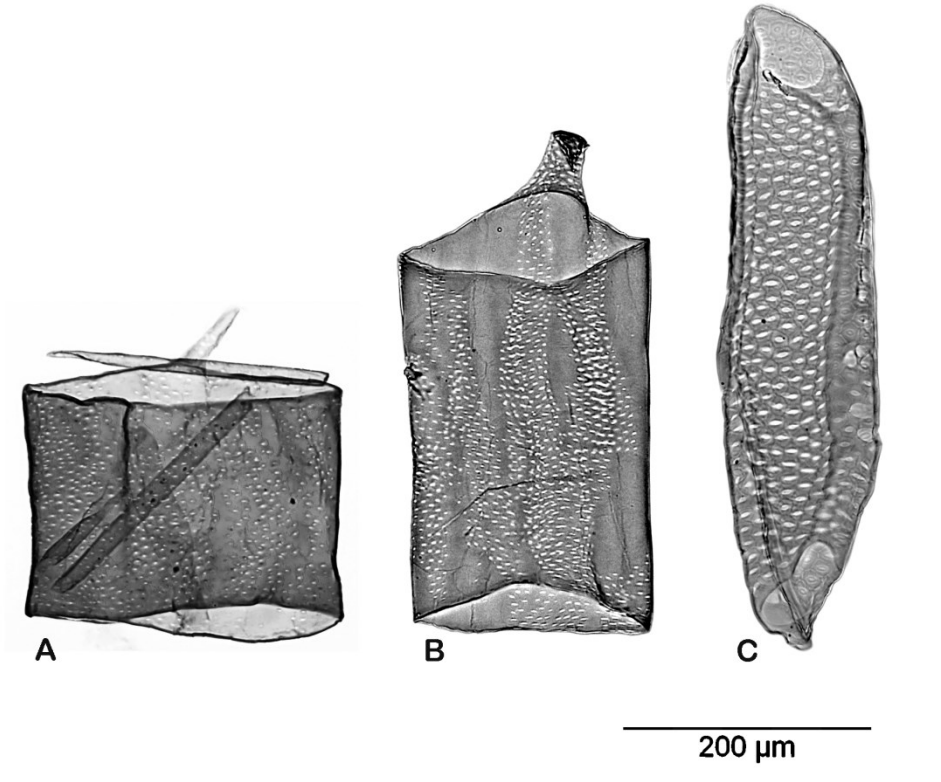


Shape of the vessel elements

A: drum-shaped

B: barrel-shaped

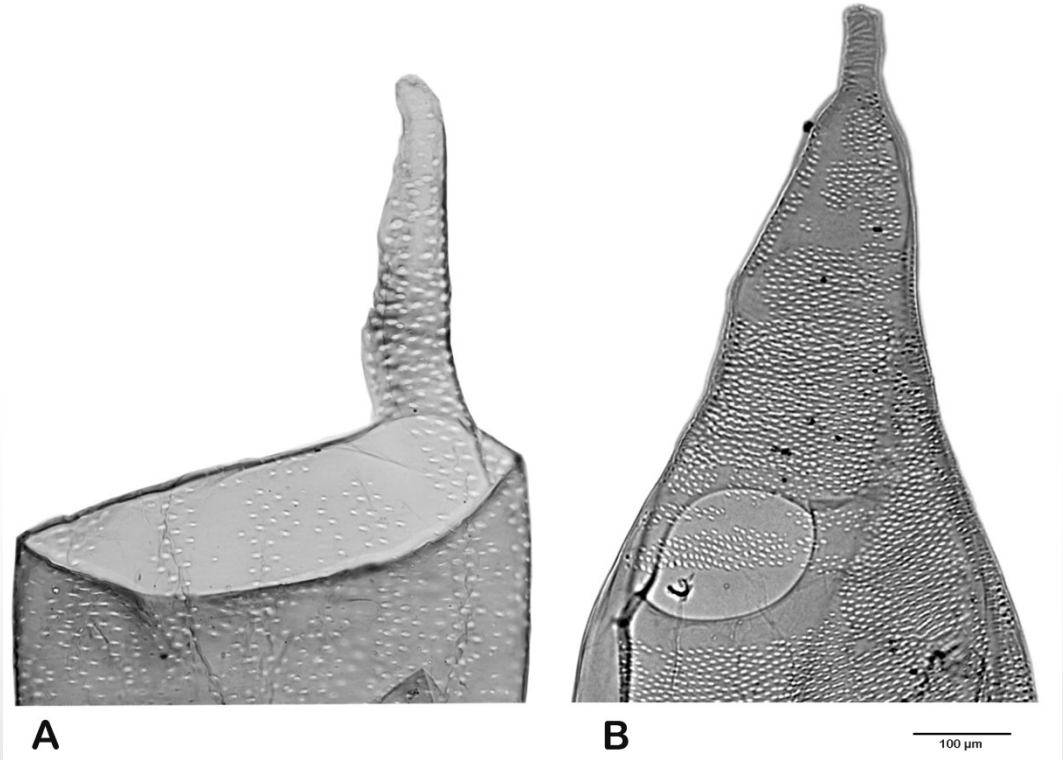
C: tube-shaped



Tails

A: with abrupt transition

B: with gradual transition (and laterally positioned perforation plate)



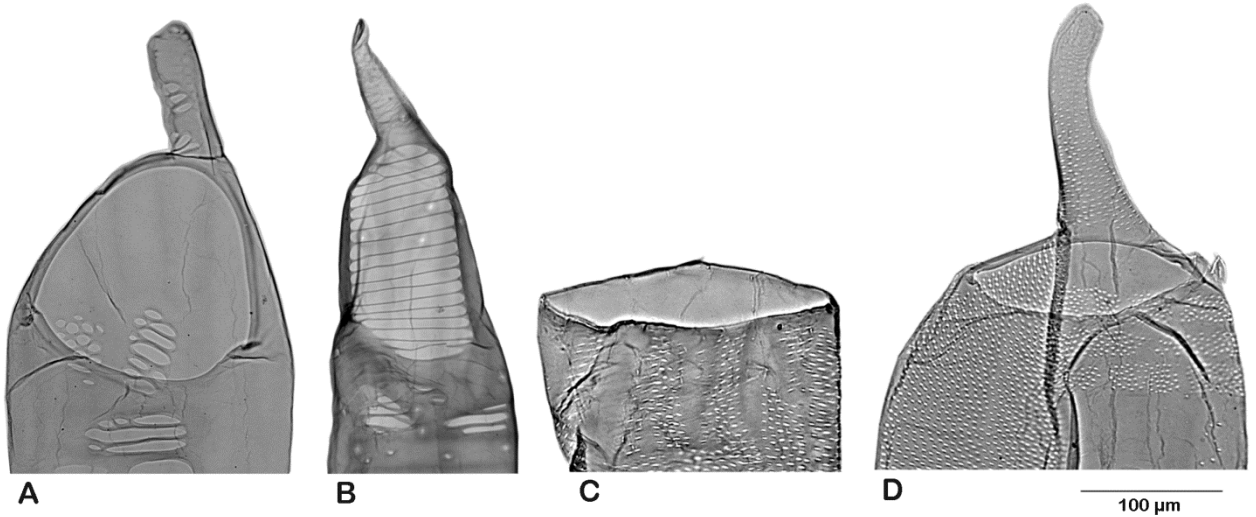
Perforation plates

A: simple

B: scalariform

C: opening horizontal, extending over the entire lumen

D: narrowed

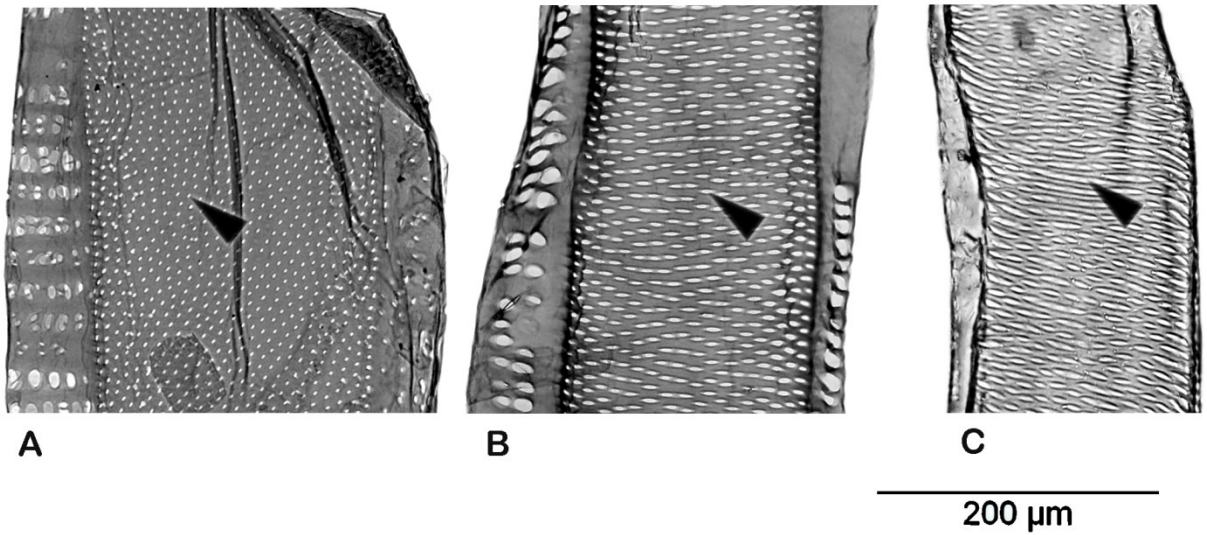


Intervessel pit apertures

A: circular to oval

B: slit-like

C: coalescent



Pit type

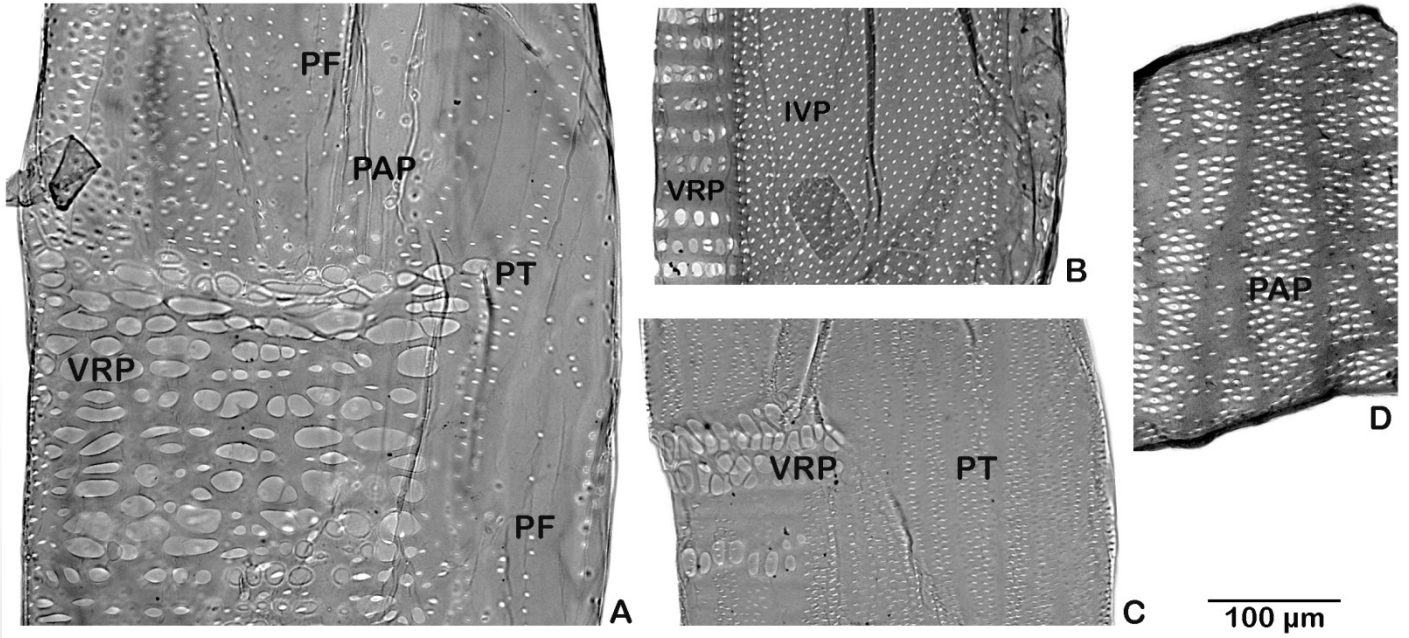
VRP: Vessel-ray pits

PAP: Pits to axial parenchyma cells

PF: Pits to fibers

PT: Pits to tracheids

IVP: Intervessel pits

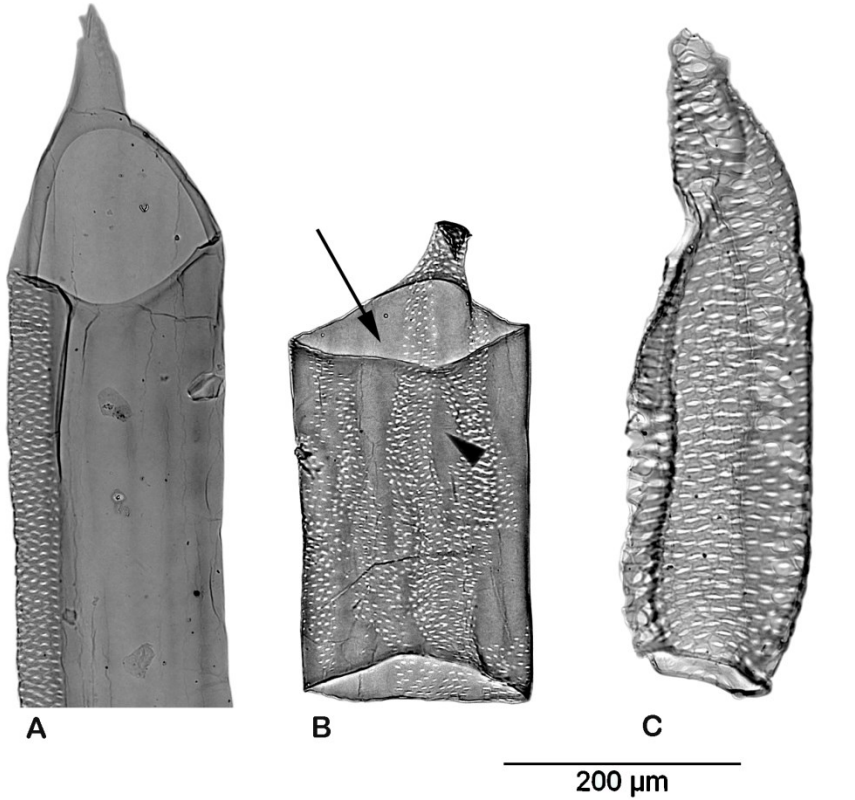


Areas without any pits

A: very large

B: large (arrow), small (arrowhead)

C: absent



Comparision with references

Campnosperma sp. (Anacardiaceae)

Trade names: terentang, kelinting, melumut, serentang (MY); pauh lebi, tumbus (ID); campnosperma (PG); nangpron, huasum sangtrang (TH); nisperillo, orey, sajo (PA).
DIN EN 13556:2003 code: not listed.
CITES regulations: not protected.
Geographic distribution: South and Central America, Madagascar, Seychelles, Sri Lanka, the whole Southeast Asia, Micronesia and Melanesia.

Vessel elements: long and slim (tube-shaped), length about 650 µm, width about 190 µm.

Tails: either short or long with gradual transition; larger tails often covered with pits.

Perforation plates: simple and more rarely scalariform (with 6–36 bars; Richter & Dallwitz 2000); extending over the entire lumen; inclined (parallelogram or trapezium).

Intervessel pits: alternate; vertical diameter 4–6–10 µm; present over a wide area; apertures oval to slit-like.

Vessel-ray pits: VAS; large; apertures window-like, sometimes subdivided into smaller units but still large; shape varies from elongated to oval or circular.

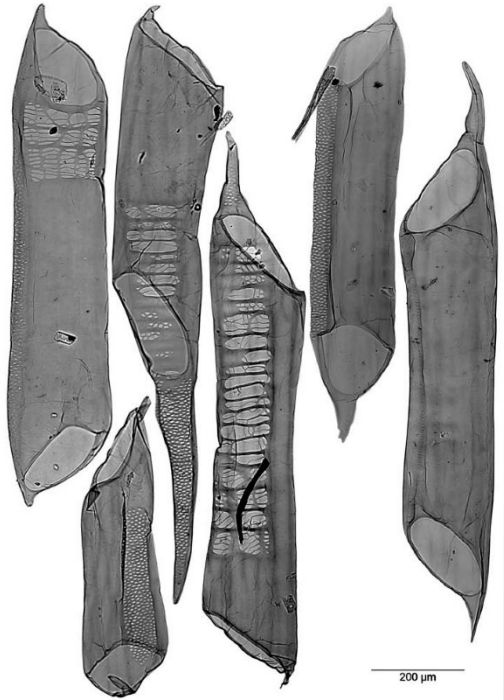
Pits to fibers: rarely present, arranged in short single vertical rows.

Areas without any pits: regularly present; very large.

Tyloses: present.

Helical thickenings: absent.

Quantitative data:
Vessel elements (361–)646(–873) µm long, and (139–)192(–220) µm wide; l/w ratio 3.7.
Intervessel pit borders (4.0–)6.2(–9.6) µm in vertical diameter; pit apertures (0.8–)1.5(–3.4) µm.
Fibers 950 µm long, 24.5 µm wide. Fiber wall thickness 7.7 µm (weighted averages).



Campnosperma sp.

Comparision with references - Gonystylus spp. - CITES II

***Gonystylus* sp.** (Thymelaeaceae)

Trade name: ramin (DE, GB, MY, ID).
DIN EN 13556:2003 code: GYBN (*G. bancanus* (Miq.) Kurz).
CITES regulations: protected (Annex II).
Geographic distribution: Indomalesia and West Pacific islands (Fiji).
The wood was often used for furniture, broomsticks and moldings.

Vessel elements: of medium size or large (length 410 µm, width 210 µm); often elongated (barrel-shaped), rarely drum-shaped.

Tails: often short and rarely long; both with abrupt transition.

Perforation plates: simple, mostly extending over the entire lumen; horizontal or slightly inclined and narrowed.

Intervessel pits: alternate; vertical diameter 3–5 µm; present over a wide area and in the tails.

Vessel-ray pits: APS; cross-fields in horizontal series (3–6 pit rows per ray cell); apertures oval, sometimes slit-like.

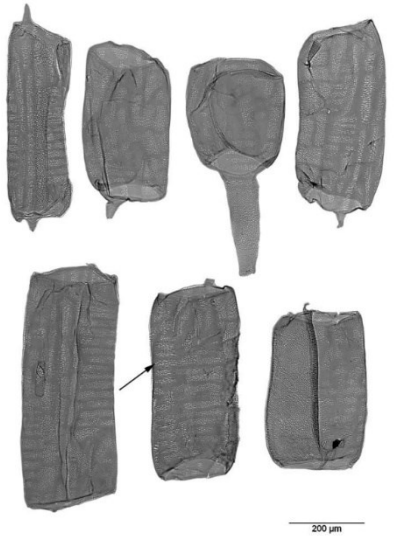
Pits to axial parenchyma cells: cross-fields arranged in vertical series, separated by pitless strips.

Areas without any pits: regularly present; rather small, sometimes larger.

Tyloses and helical thickenings: absent.

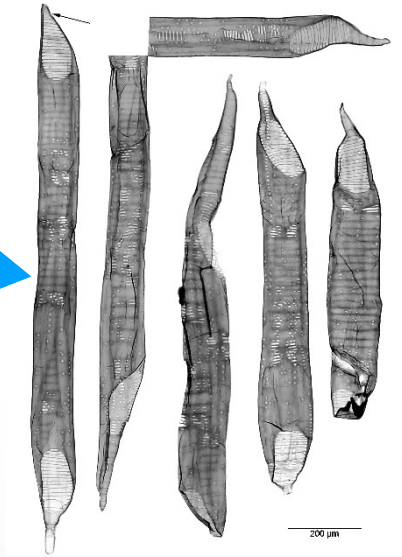
Notes on identification: Vessel elements of *Gonystylus* spp. are similar in their appearance to those of *Durio* spp. and *Lophopetalum* spp. Corners of cross-fields of vessel-ray pits often rounded (arrow) as pits in the corners are often missing (*Lophopetalum* spp.: cross-fields rectangular, "corner pits" present, p. 276).

Quantitative data:
Vessel elements (292–)412(–607) µm long, and (92–)214(–262) µm wide; l/w ratio 2.0.
Intervessel pit borders (2.6–)3.4(–5.3) µm in vertical diameter; pit apertures (0.5–)1.0(–2.0) µm.
Fibers 1160 µm long, 29.0 µm wide. Fiber wall thickness 7.4 µm (weighted averages).



Gonystylus sp.

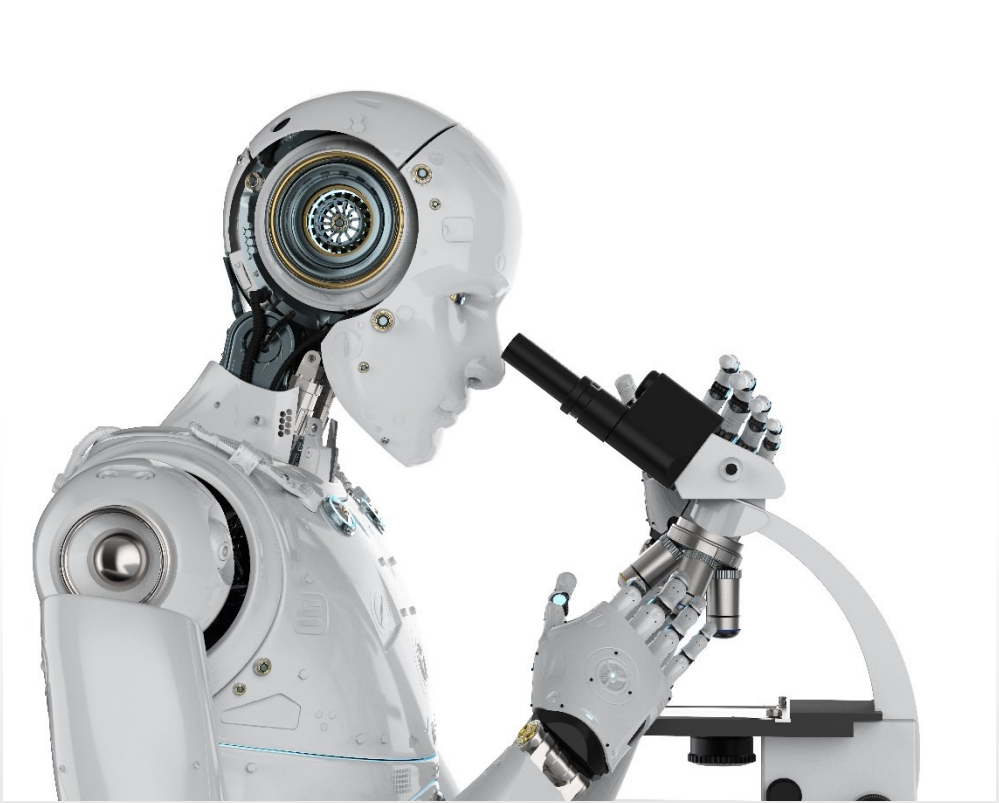
References



Helmling S, Olbrich A, Heinz I, Koch G (2018) Atlas of Vessel Elements - Identification of Asian Timbers. IAWA Journal 39 (3)

Free download: DOI: 10.1163/22941932-20180202

Can we automate the identification?

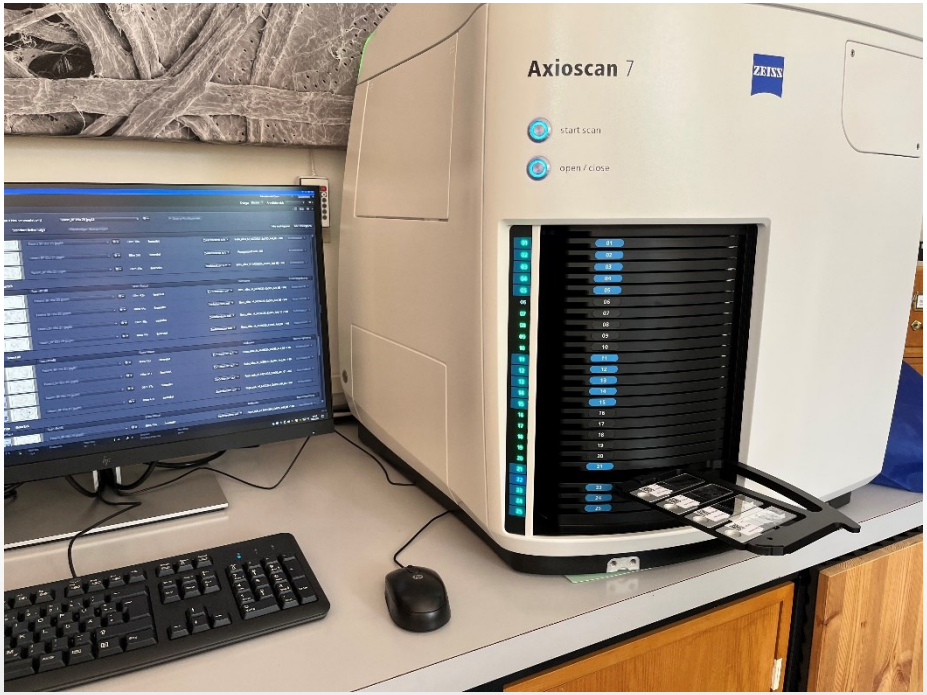


Fraunhofer ITWM

THÜNEN

FNR
Fachagentur Nachwachsende Rohstoffe e.V.

Generation of the data basis



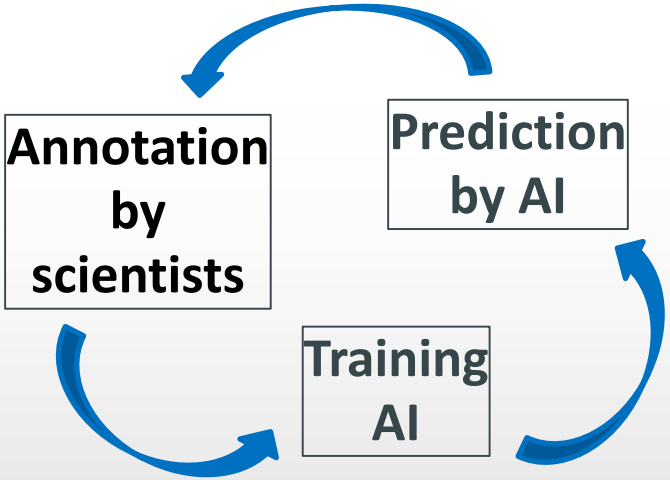
System Structure - Convolutional neural network

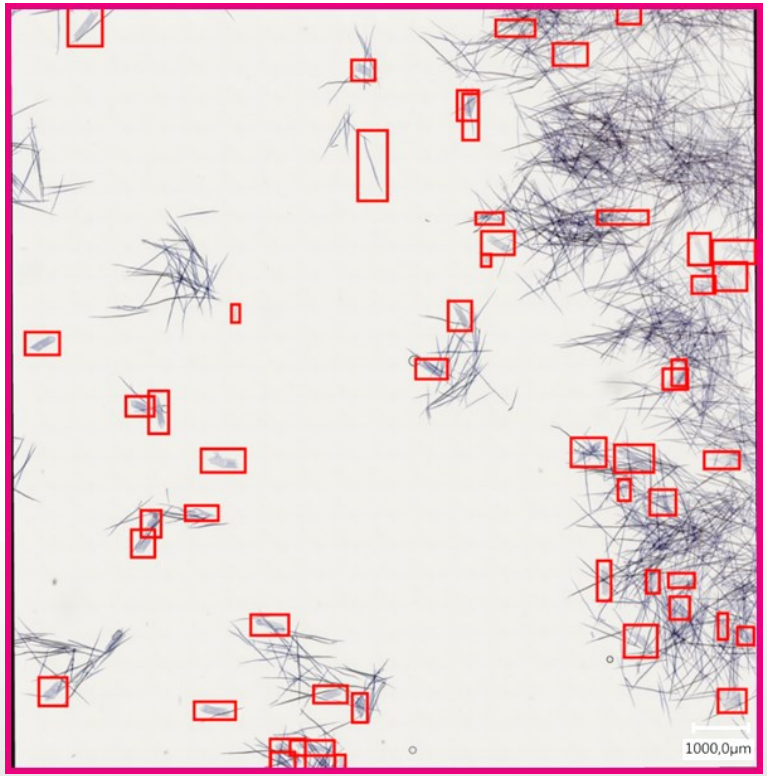
1. **Detection step:**
   - Mono fraction samples
   - Vessel detection

System Structure - Convolutional neural network

1. Detection step:

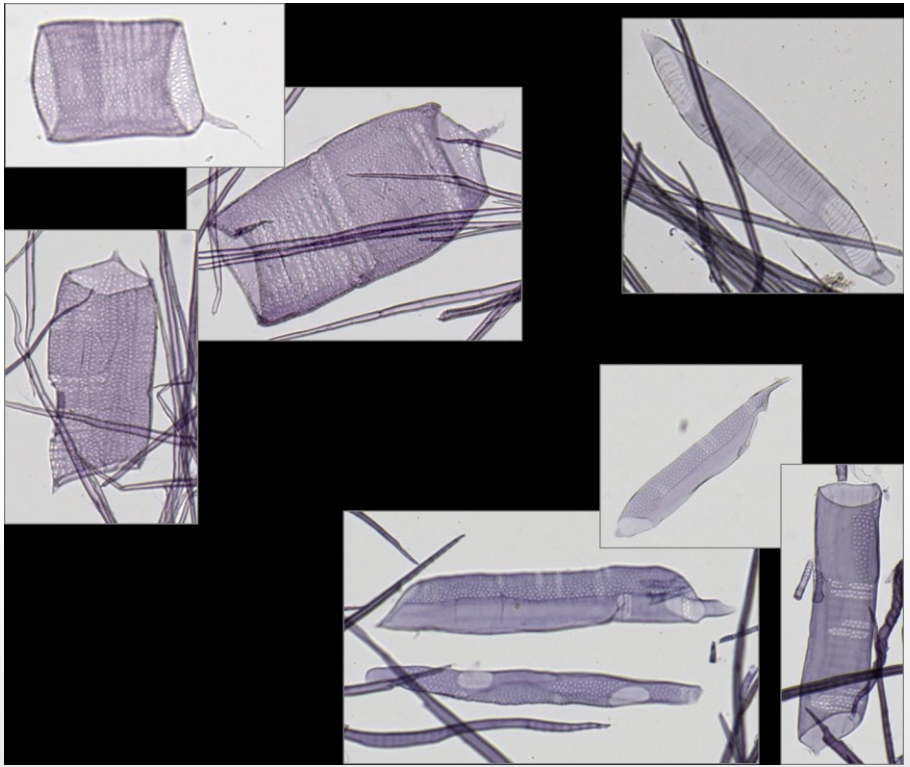
- Mono fraction samples
- Vessel detection





System Structure - Convolutional neural network

1. Detection step:
   - Mono fraction samples
   - Vessel detection
2. Classification step:
   - Detected vessel elements Training - Validation



System Structure - Convolutional neural network

1. Detection step:
   - Mono fraction samples
   - Vessel detection
2. Classification step:
   - Detected vessel elements Training - Validation
   - Classification training
   - Confusion matrix

Outlook

- Generation of the data basis is in process
- Dectection of vessel elements is in the 8th round of training
- Training of classification continues

AI Project Team

Fraunhofer ITWM

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Lars Gradert

Thank you for your attention!