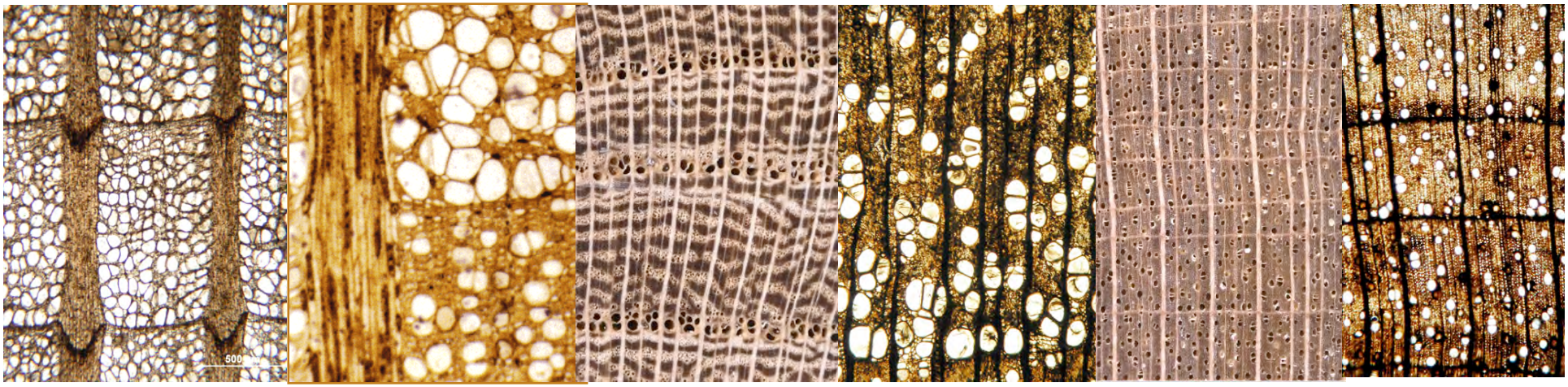
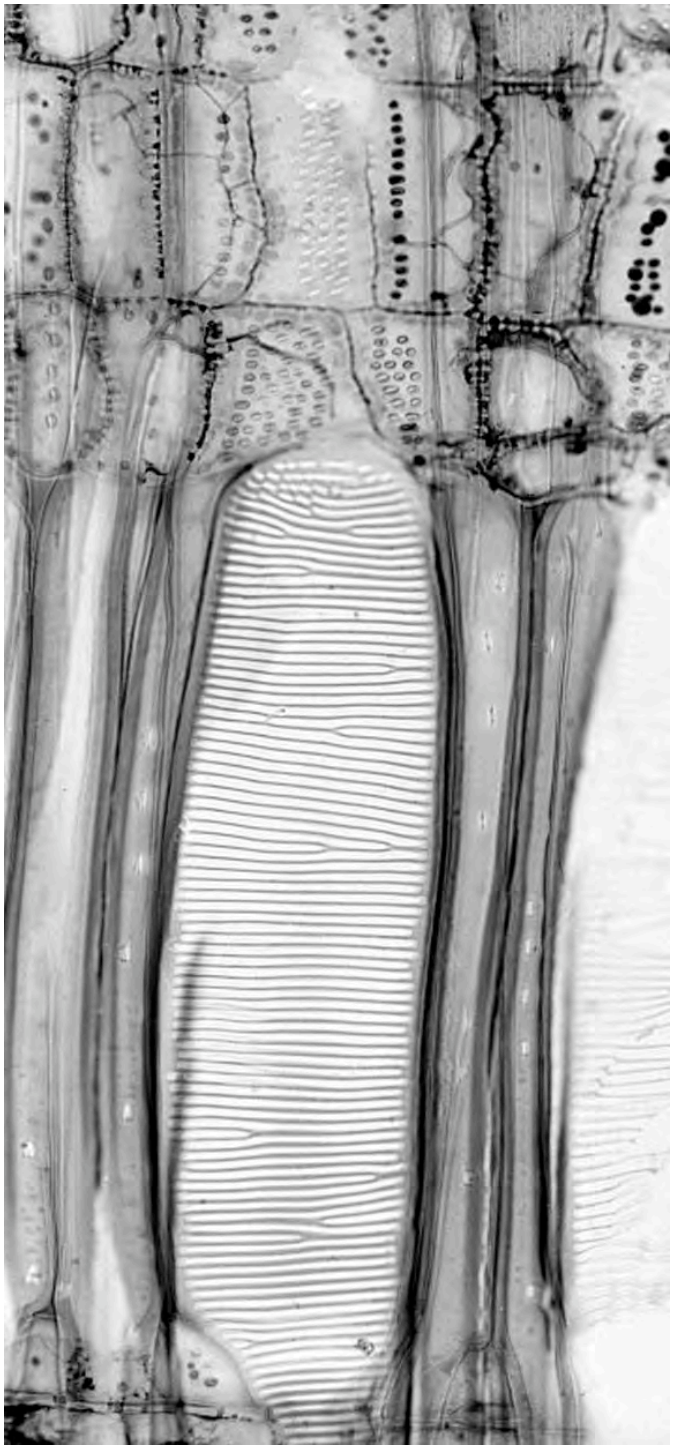
VARIATIONS IN WOOD ANATOMY PAST AND PRESENT



http://insidewood.lib.ncsu.edu/search

Miocene *Platanus,* Eocene *Platanus,*
Recent *Ulmus* - L. Westra, NHN, Eocene Ulmaceae,
Recent *Acer* - L. Westra, Eocene *Acer*

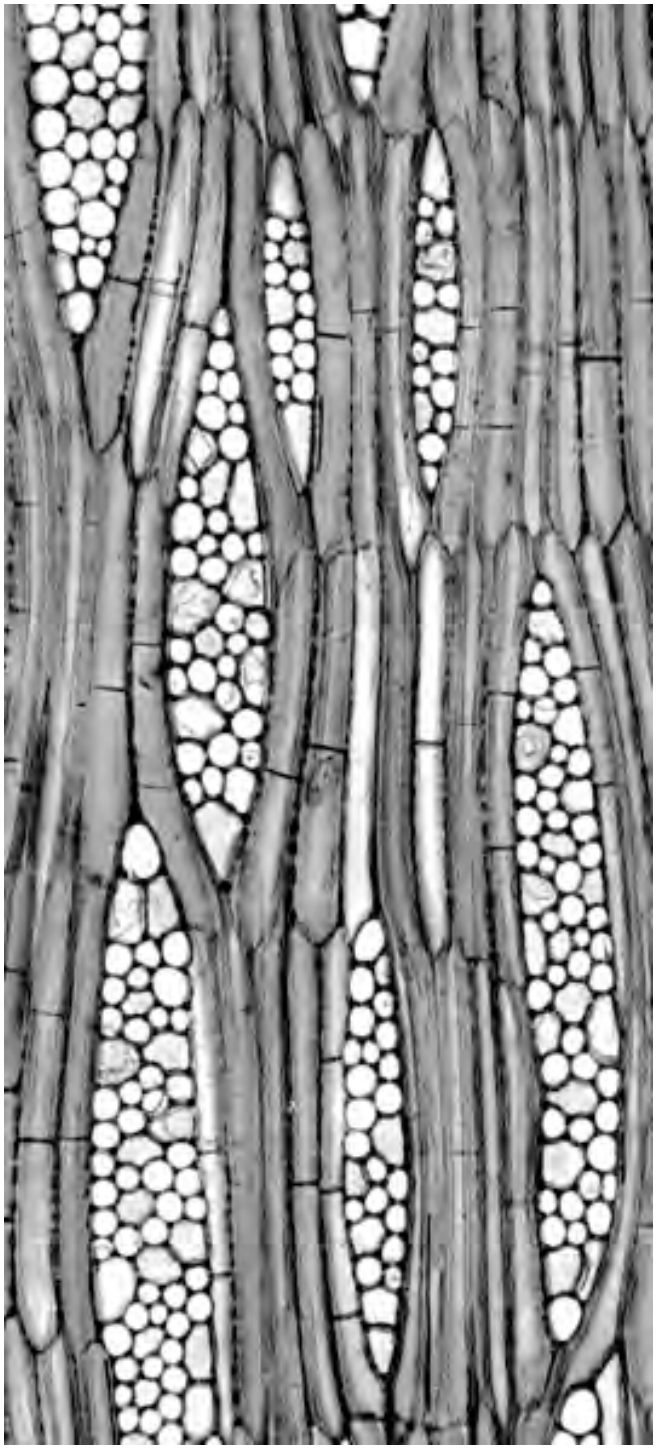


Long Tradition of looking at incidences of and correlations of wood anatomical features.

Baileyan Trends.
Correlations of Vessel Element Length, Perforation Plate Type, and Intervessel Pitting.

Ecological Trends.
Correlations of vessel diameter, density, helical thickenings, vessel groupings, porosity with habitat.

Photo by S. Noshiro, Perforation Plate in *Davidia*



Incidence Of Selected IAWA Hardwood Anatomy Features

http://insidewood.lib.ncsu.edu/search

InsideWood Recent Woods (N = 5,590)

Support from NSF
BRC July 1, 2003 -- June 30, 2005
DBI August 1, 2005 - July 30, 2007

Past: One Side Trip into Fossil Wood Database (N = 1,591)

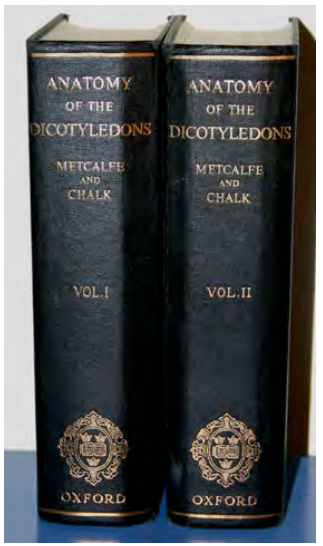
Back to 1950: Introduction to "Anatomy of Dicotyledons" (Metcalfe & Chalk).

Revisit question of how do vessel diameters vary by geographic region.

Wood Anatomy Database

Metcalfe

Chalk



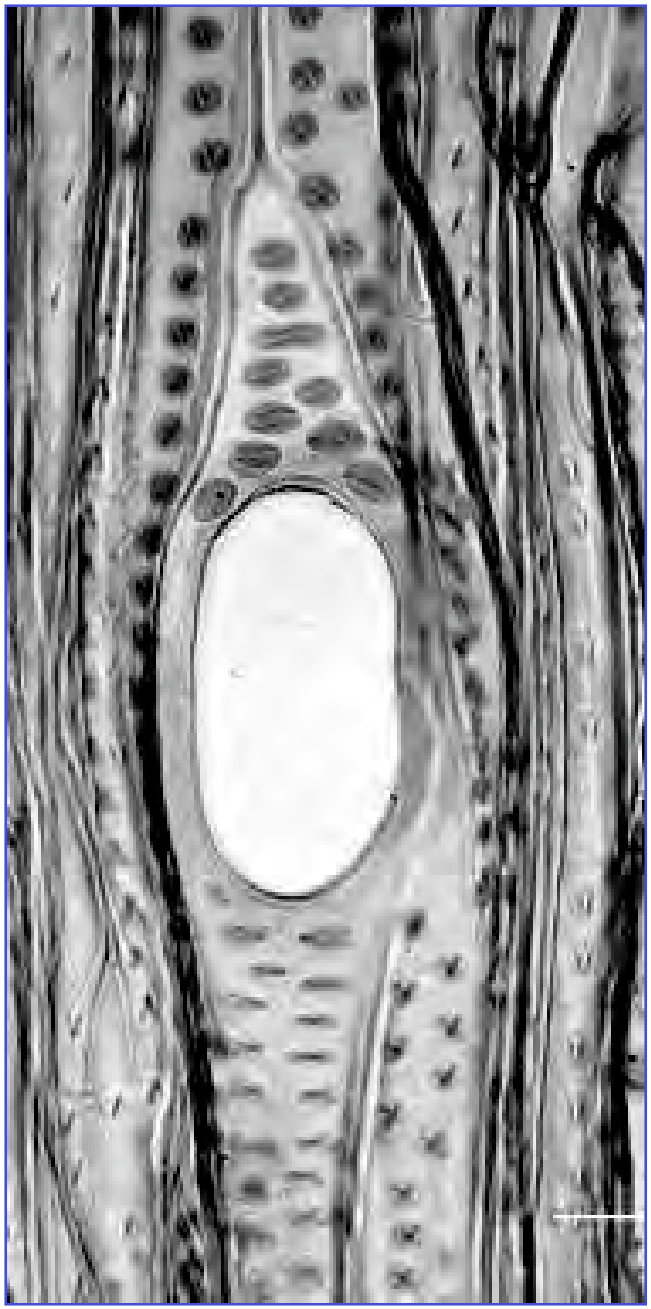
Starting point:

Multiple entry key data (86 features)
collected by L. Chalk, CFI Oxford

on mainframe 1981; on PCs 1986, subsequently

Translated to IAWA Features (203 features)

Translation With "?"



Database Constraints

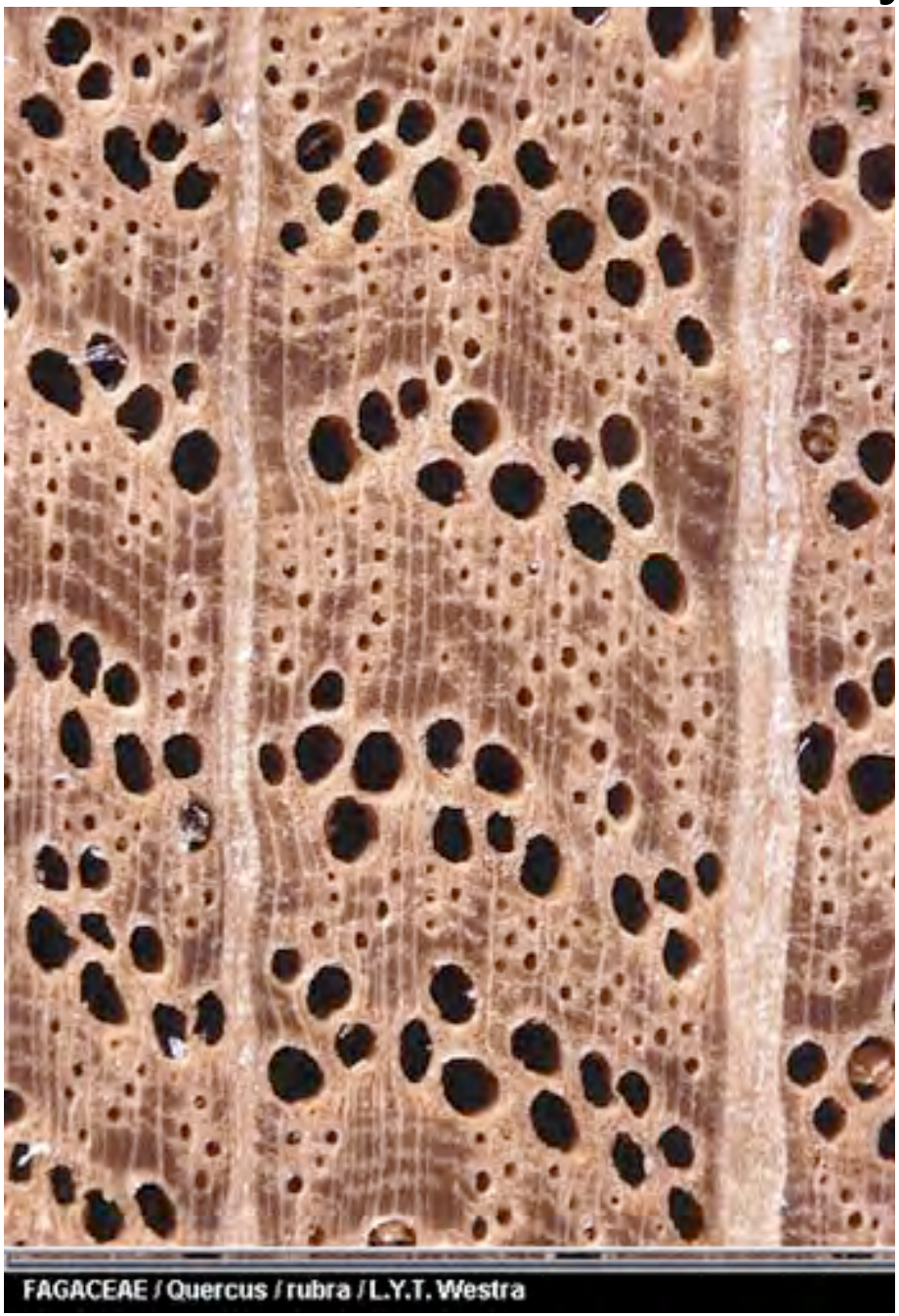
Still “?” for some features.

[Editing on-going, with a break taken starting June 30, 2006]

Number of descriptions does not equal number of species.

- Some species share similar anatomy so are represented by the same description.
- Some commercially important species have multiple descriptions.

Recent Woods: Porosity, Arrangement, Grouping

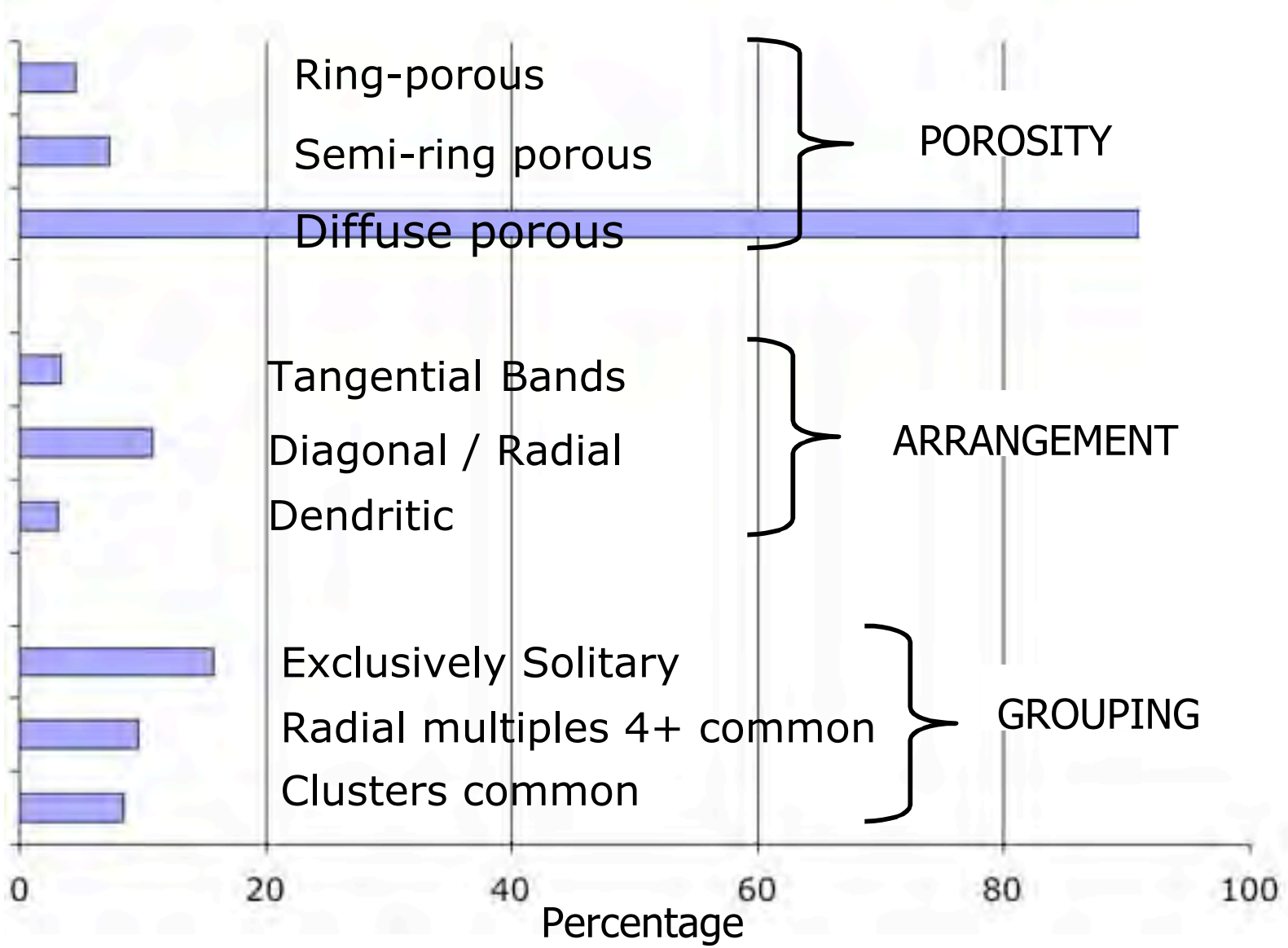


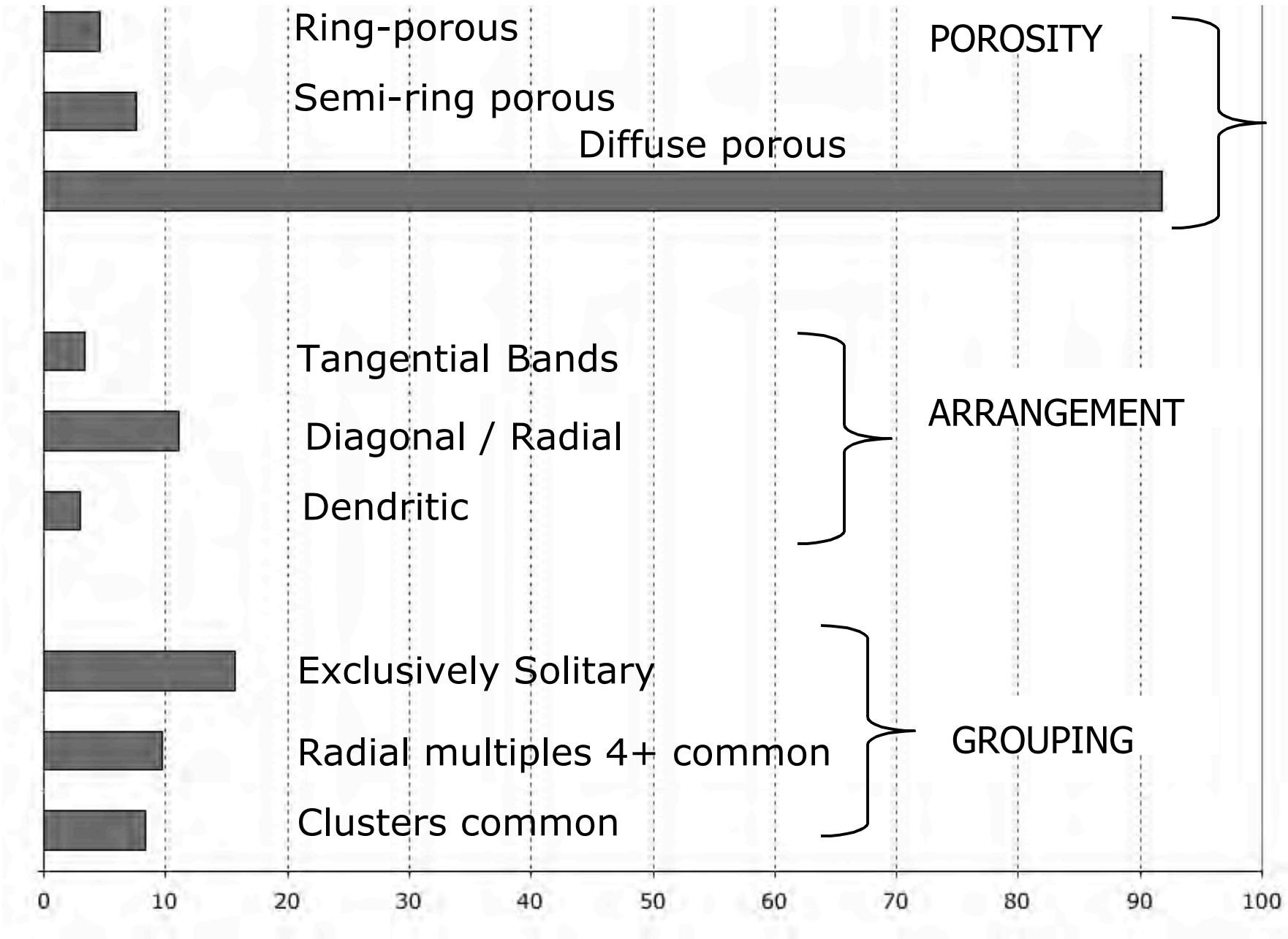
FAGACEAE / Quercus / rubra / L.Y.T. Westra

SAPINDACEAE / Acer / pseudoplatanus / L.Y.T. Westra

Porosity, Arrangement, Grouping

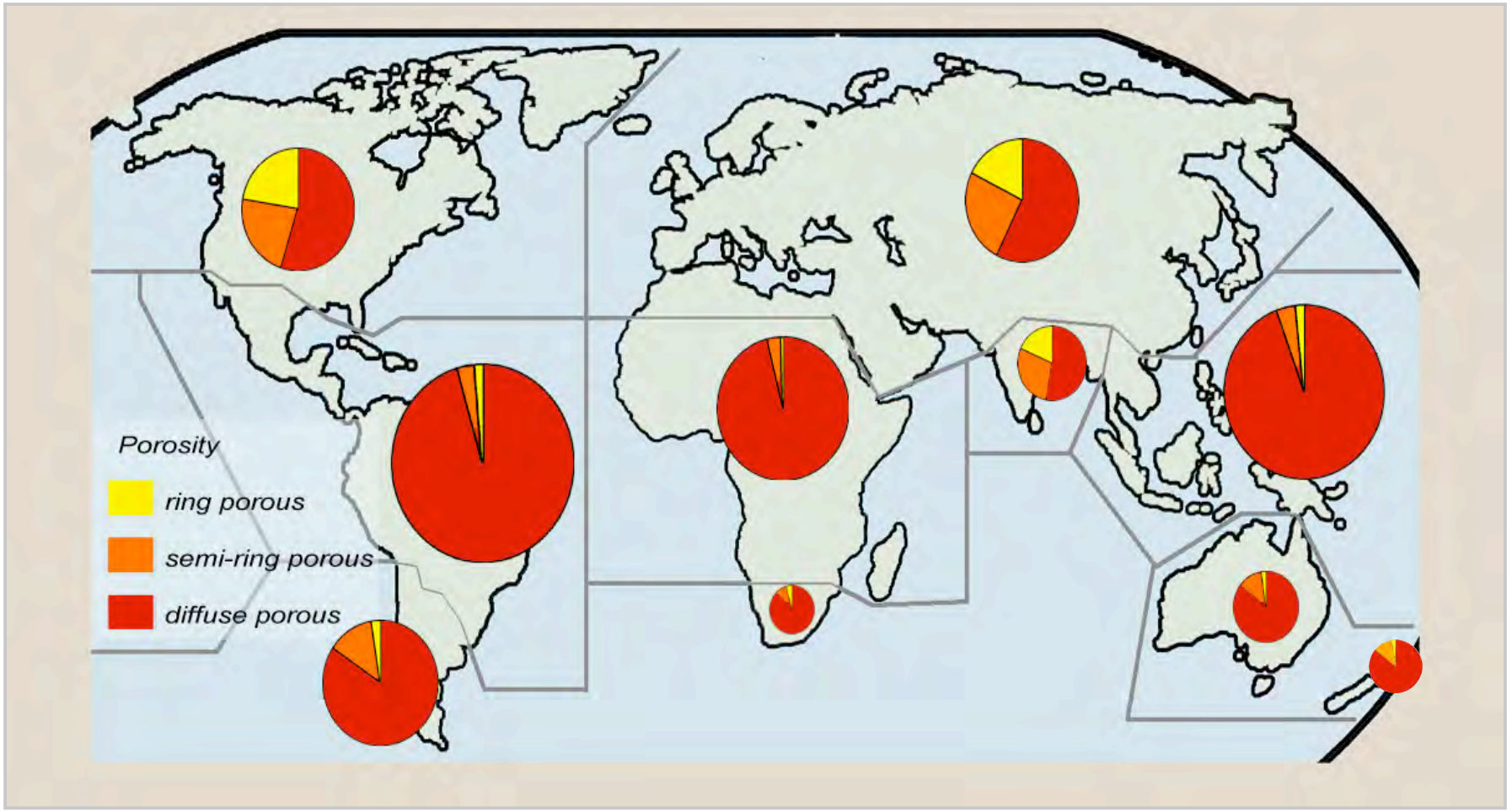
Default pattern: diffuse porous, random arrangement, vessels solitary and in short multiples




Ring-porous
Semi-ring porous
Diffuse porous
POROSITY
Tangential Bands
Diagonal / Radial
Dendritic
ARRANGEMENT
Exclusively Solitary
Radial multiples 4+ common
Clusters common
GROUPING
0
10
20
30
40
50
60
70
80
90
100

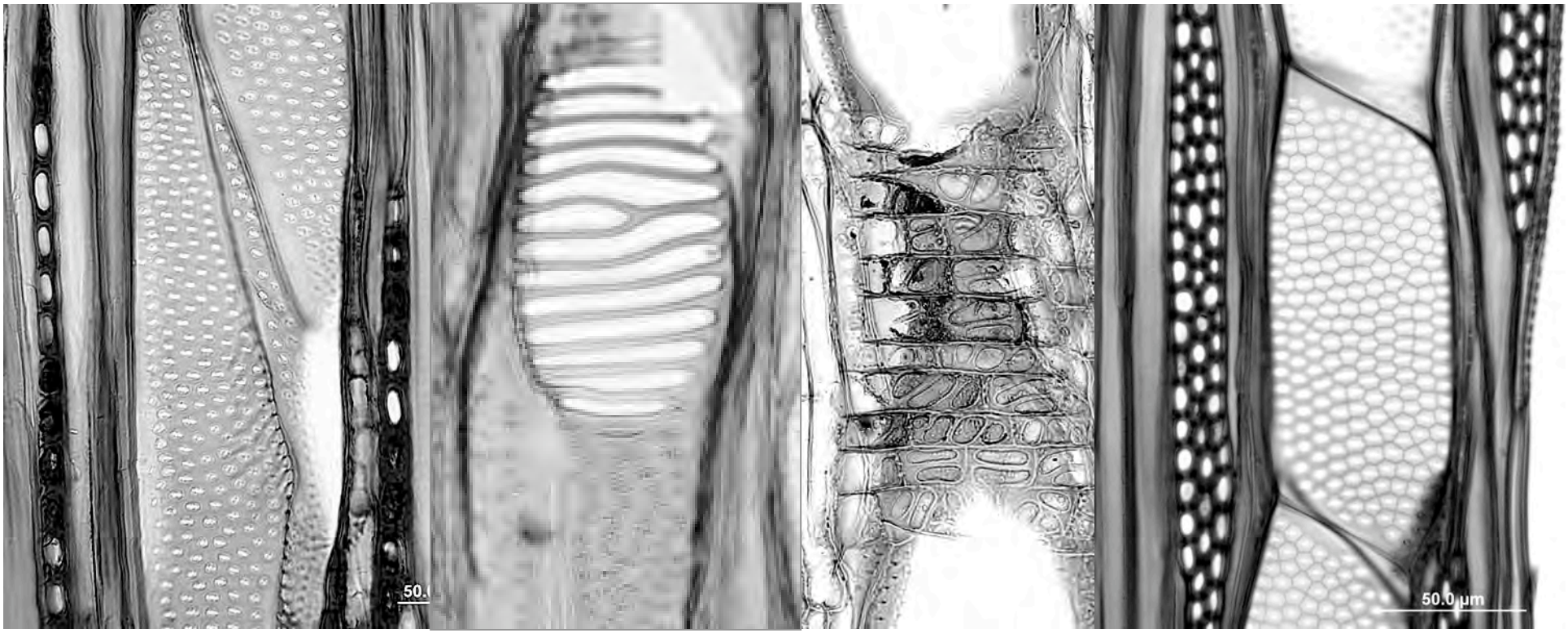
How Do Porosity Types Vary by Region?

Ring Porosity (yellow) N. Hemisphere Phenomenon



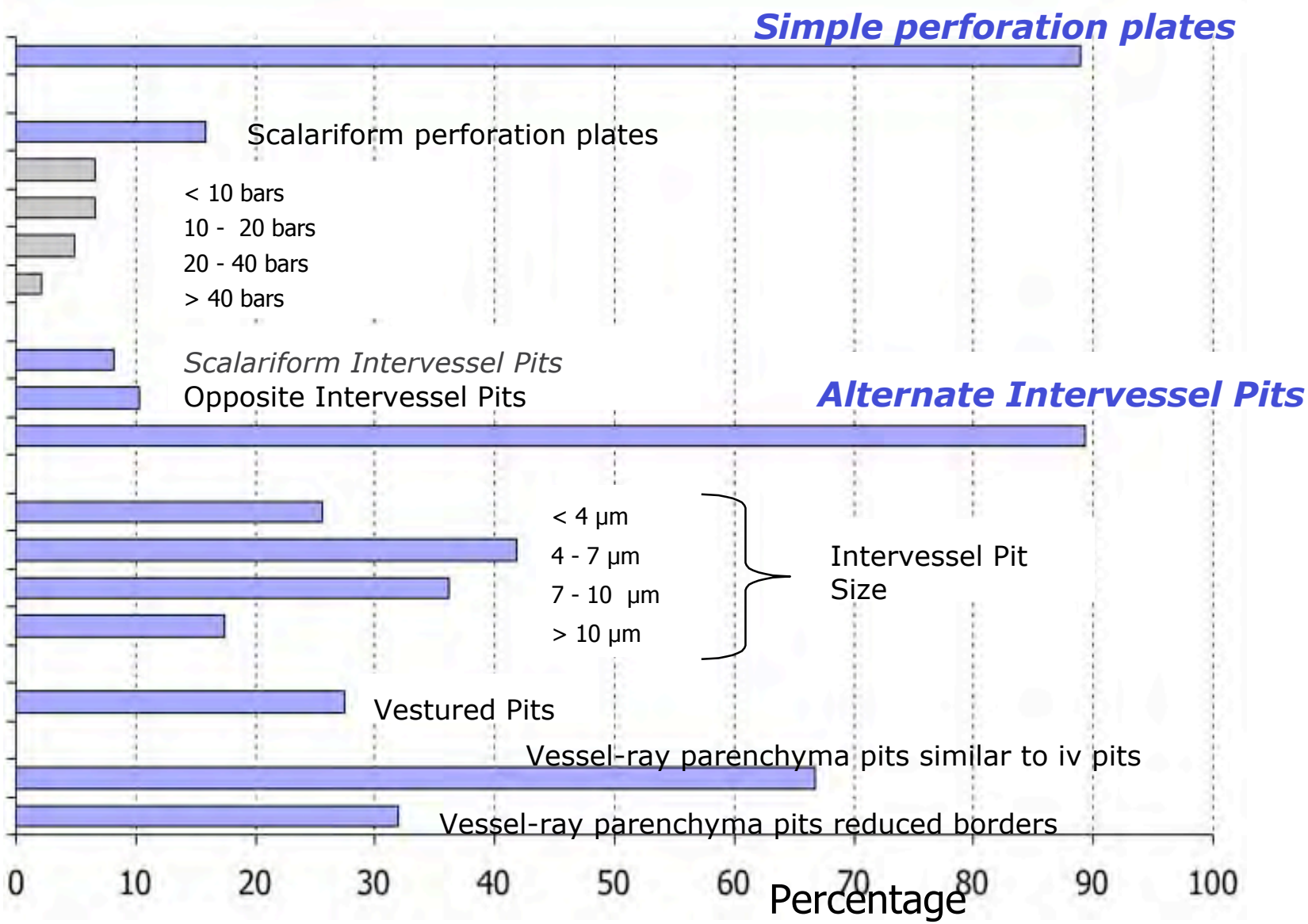
Absence of ring porosity in S. Hemisphere noted by Gilbert 1940

Perforation Plates and Pits

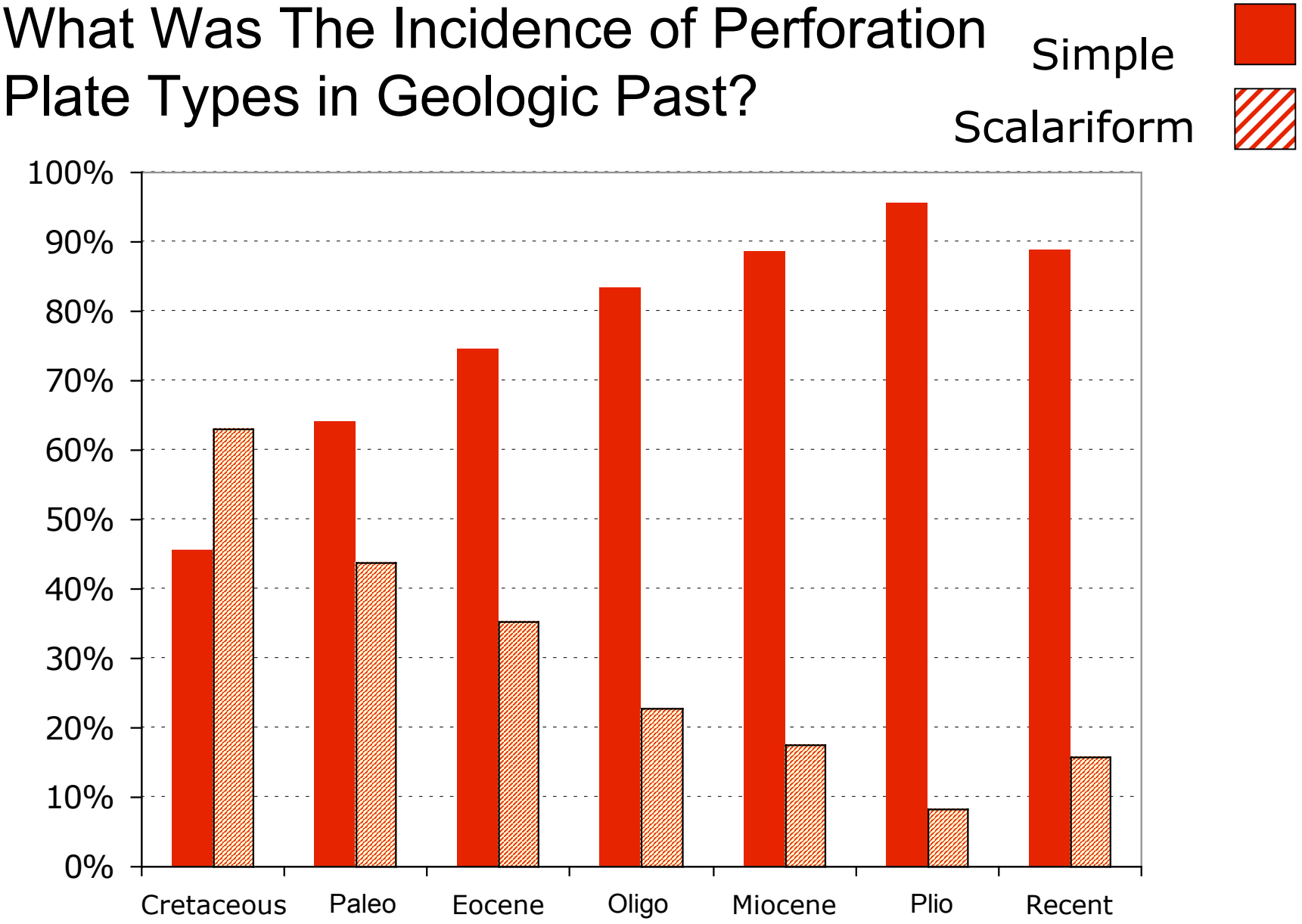


Perforation Plates and Pits in Recent Woody Dicots

Simple perforations and alternate intervessel pits
most common of all the hardwood features

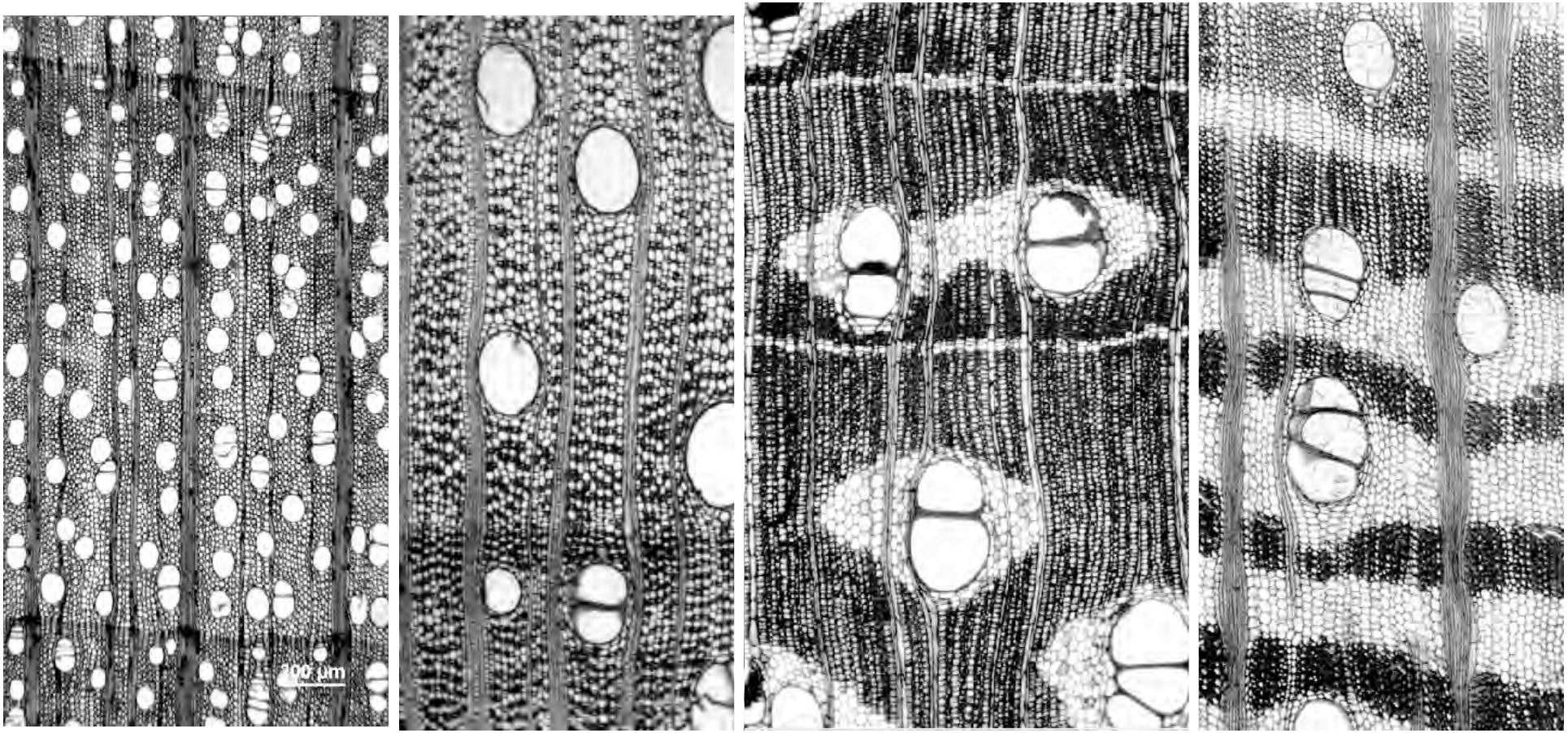


What Was The Incidence of Perforation Plate Types in Geologic Past?

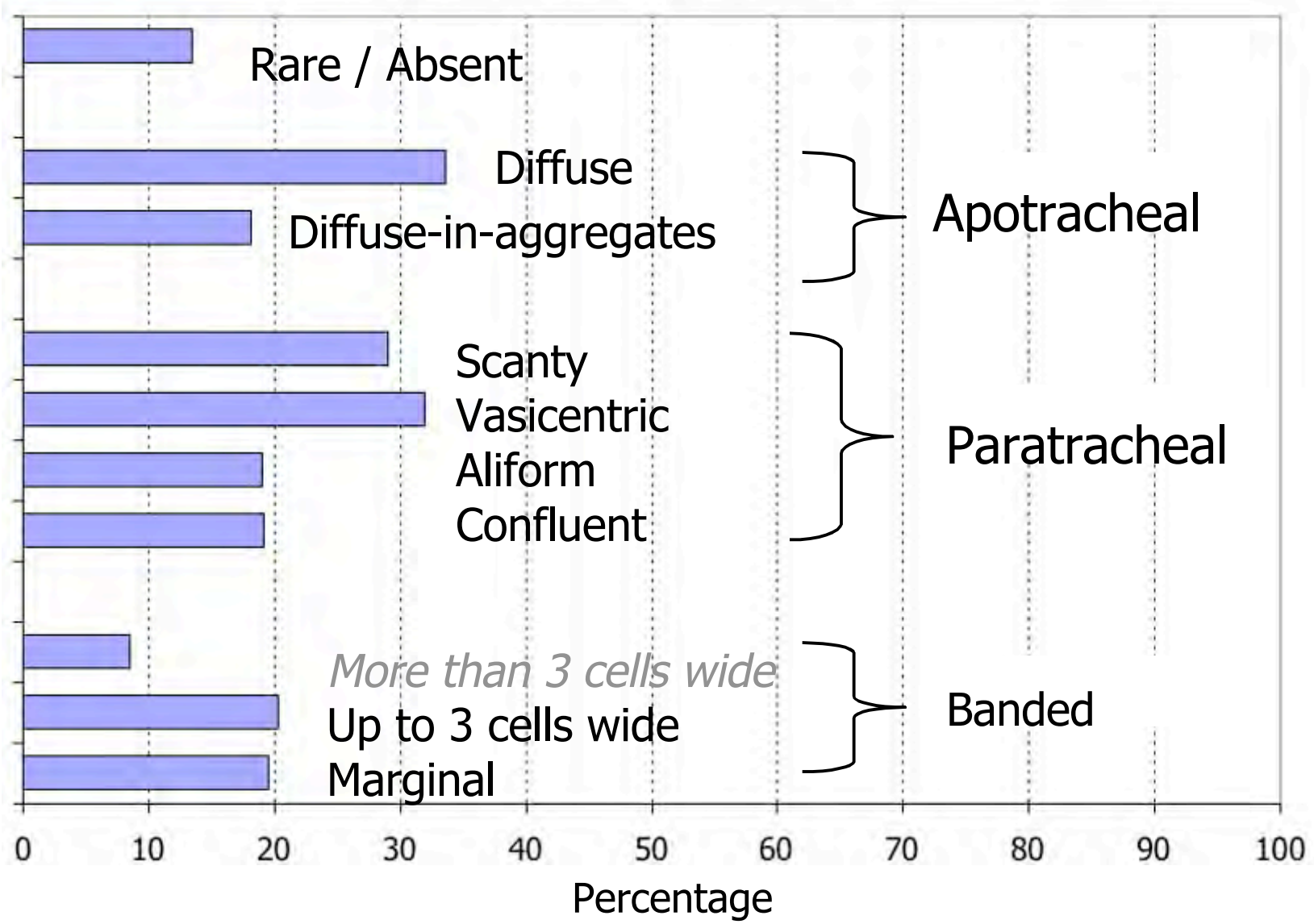


Cretaceous - Recent

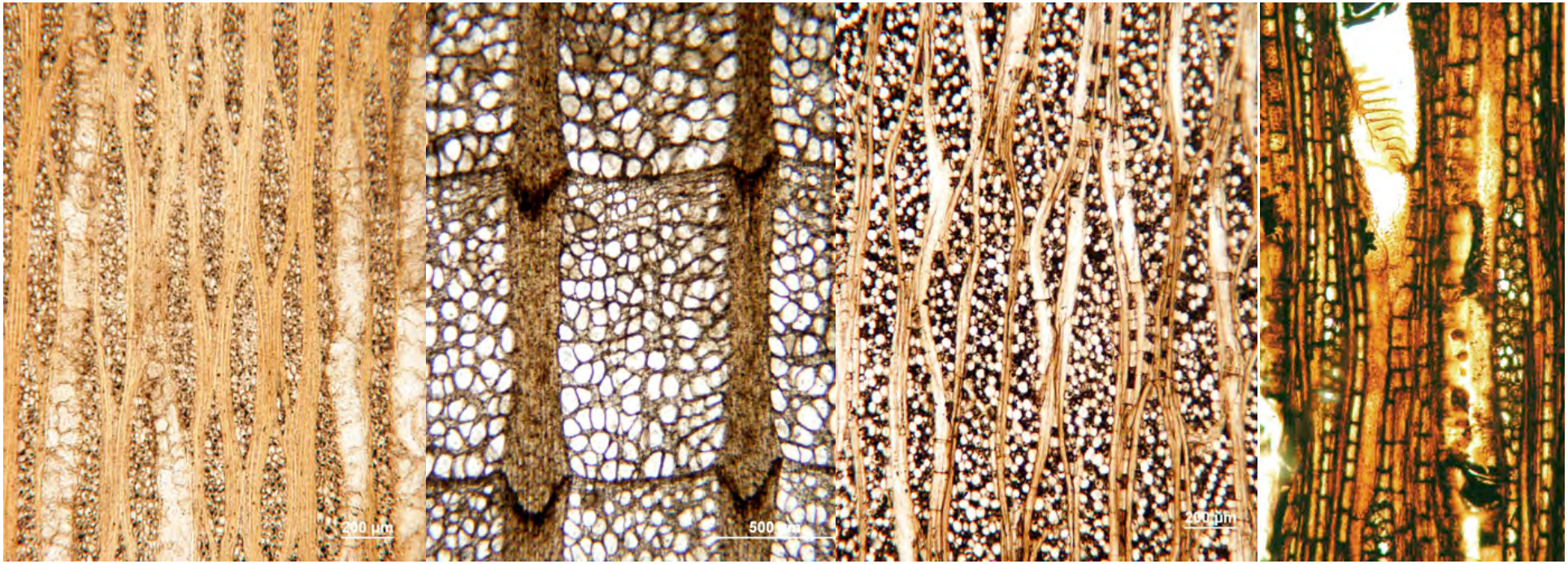
Axial Parenchyma



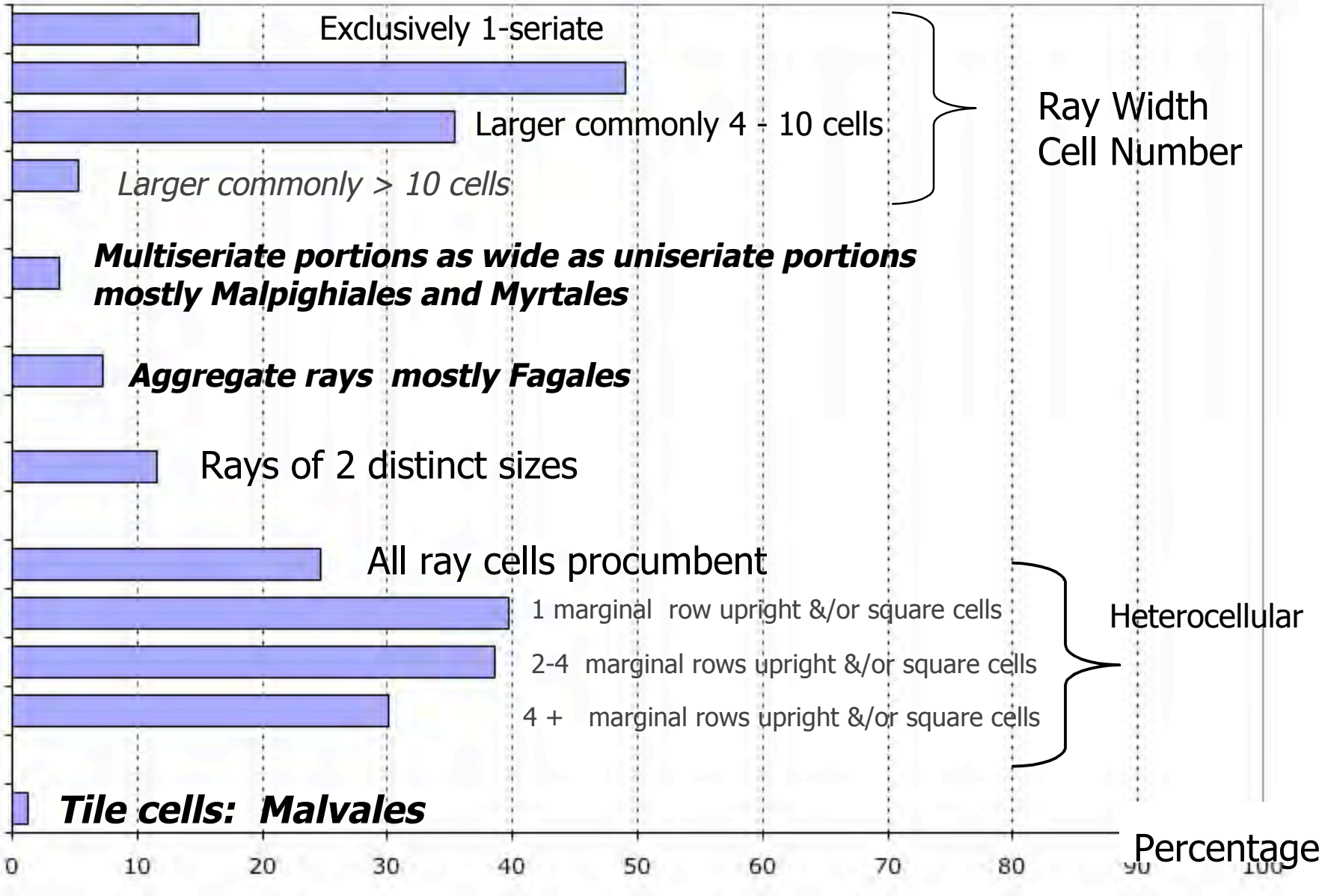
Axial Parenchyma features are of more 'balanced' occurrence than vessel features

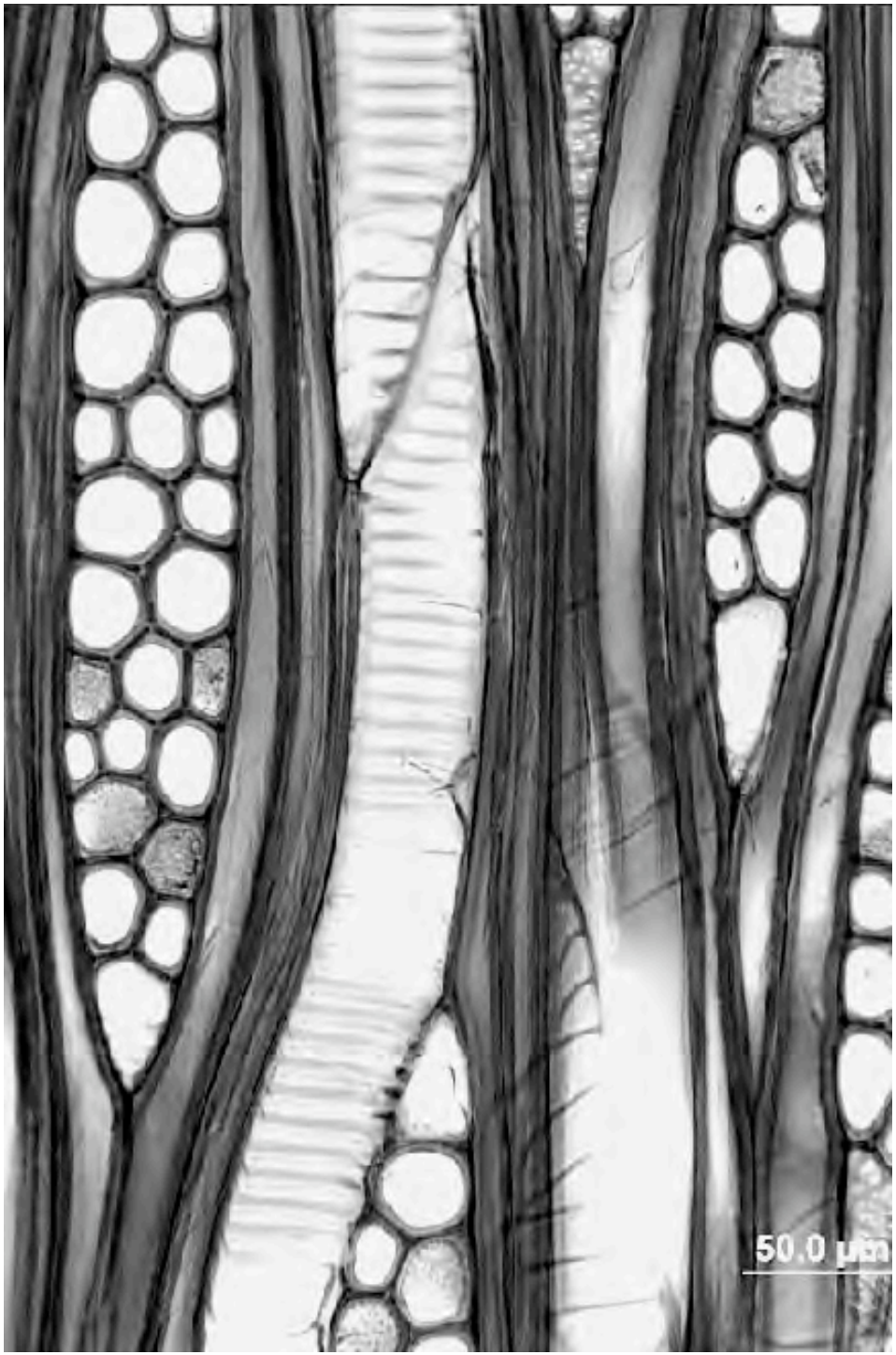


RAY CHARACTERISTICS

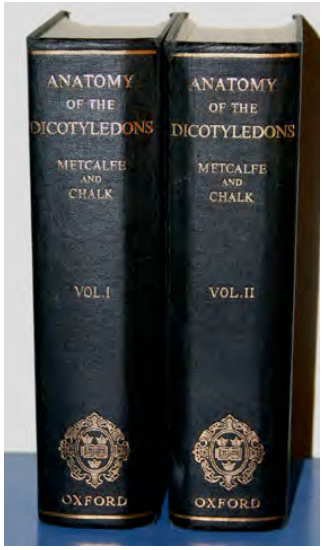


RAY CHARACTERISTICS





Baileyan Trends.
Correlations of Vessel Element Length, Perforation Plate Type, and Intervessel Pitting.



INTRODUCTION 1950 Anatomy of Dicotyledons.

"Data from about 1,800 woods classified .. into ..groups of increasing specialization."

Group I. Perforations Scalariform Only
M & C Intro: n = 206; InsideWood: n = 570

Group II. Perforations Simple and Scalariform
M & C Intro n = 91; InsideWood: n = 422

Group III. Perforations Simple; Storied Structure Absent
M & C Intro: n = 1,261; InsideWood: n = 3,914

Group IV. Perforations Simple; Storied Structure Present
M & C Intro: n = 243; InsideWood: n = 658

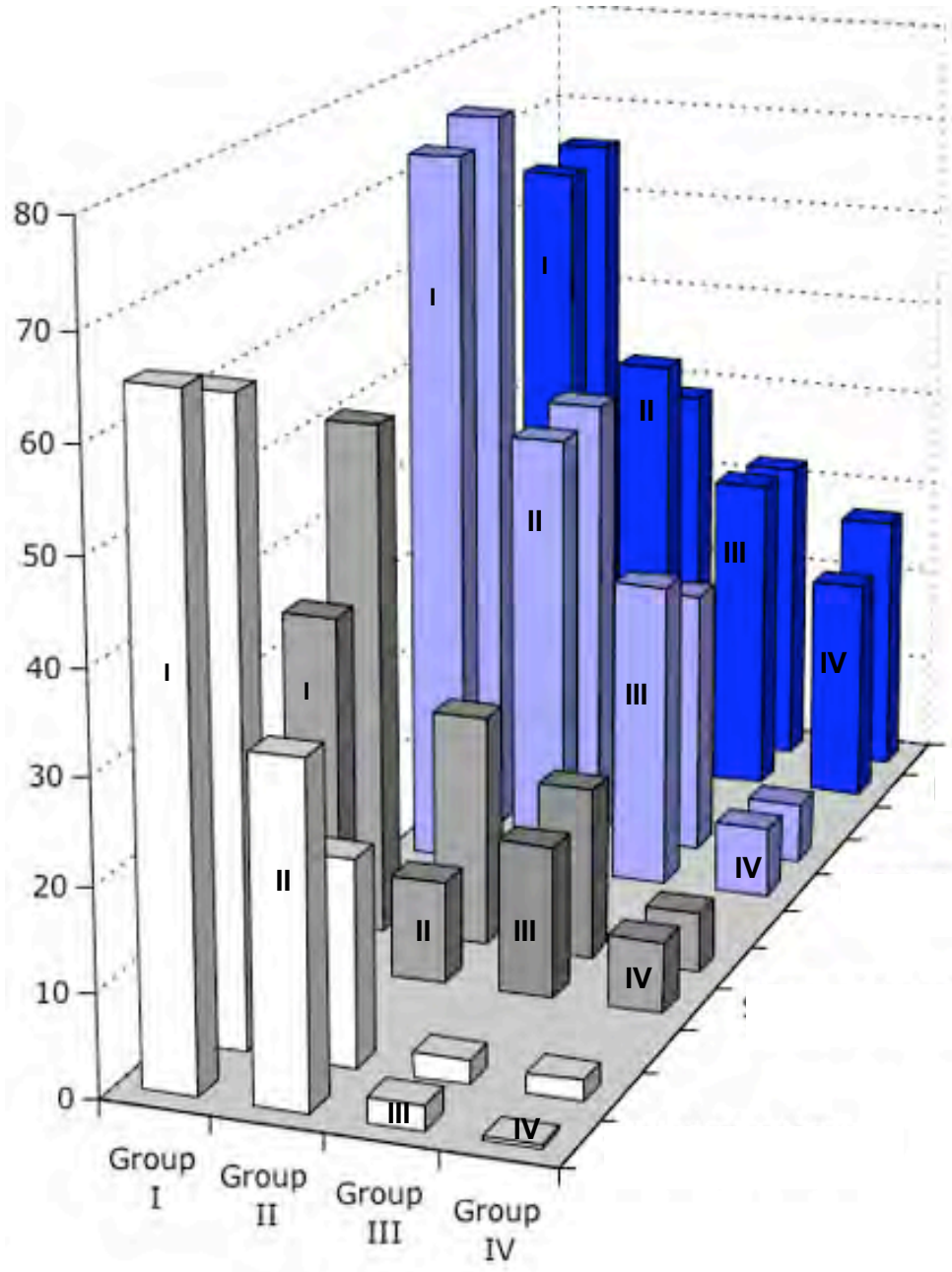


Table 3. What is the incidence of "*Features associated with a Low Level of Specialization*" in those four groups?

Diffuse axial parenchyma

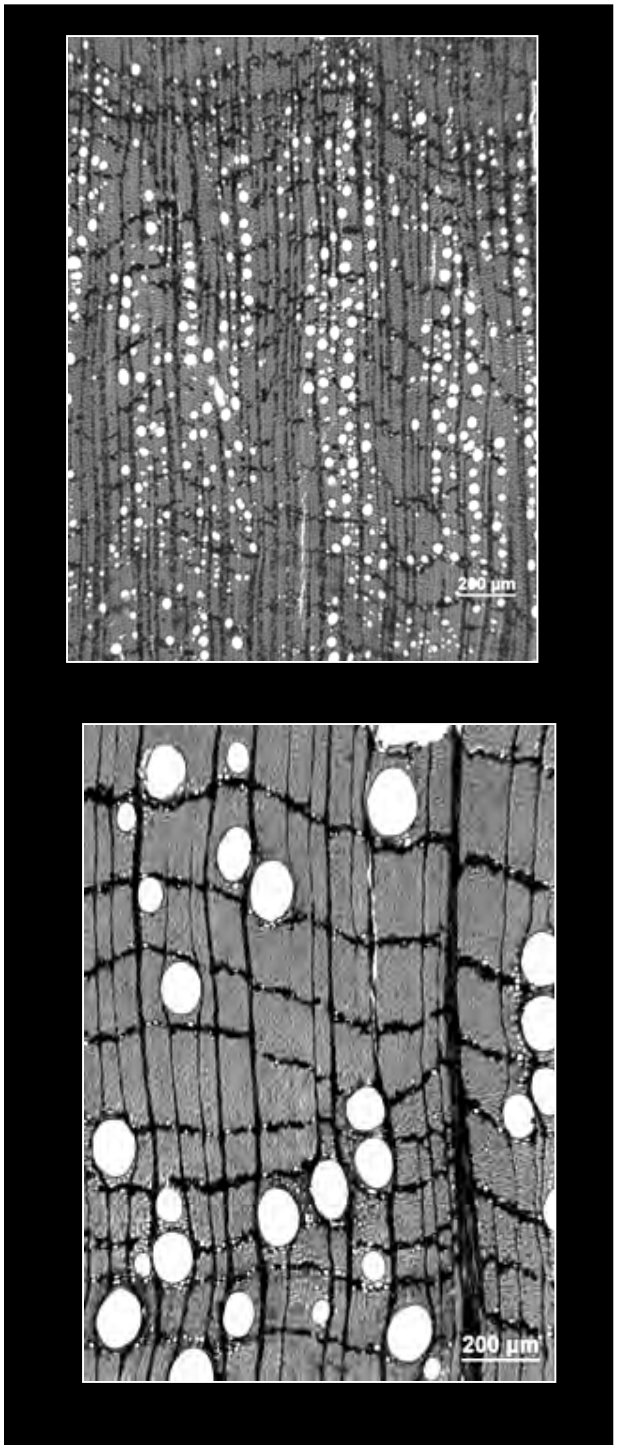
Fibers w/ distinctly bordered pits

Exclusively solitary vessels

Intervascular pitting scalariform to opposite

"*...progressive decrease from Group I to Group IV*"

(Table 3, Introduction: Metcalfe & Chalk 1950)



Ecological Trends.

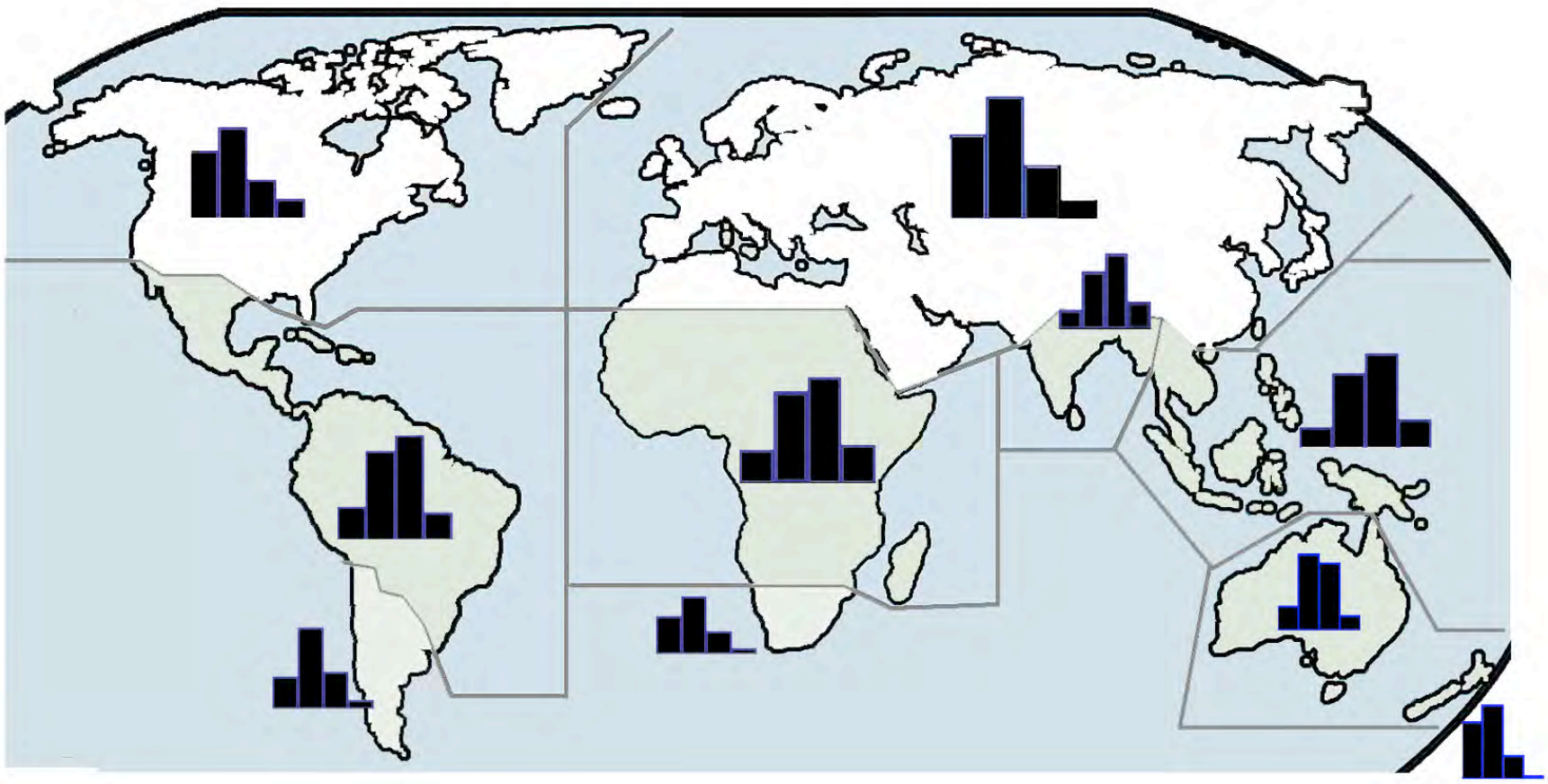
Correlations of vessel diameter, density, helical thickenings, vessel groupings, porosity with habitat. Done by geographic region and within taxa

Many narrow vessels
Vs
Few wide vessels

Casuarinaceae

Quantitative Vessel Features: Mean Tangential Diameters.

Categories: 1) < 50 µm 2) 50 - 100 µm 3) 100 - 200 µm 4) > 200 µm

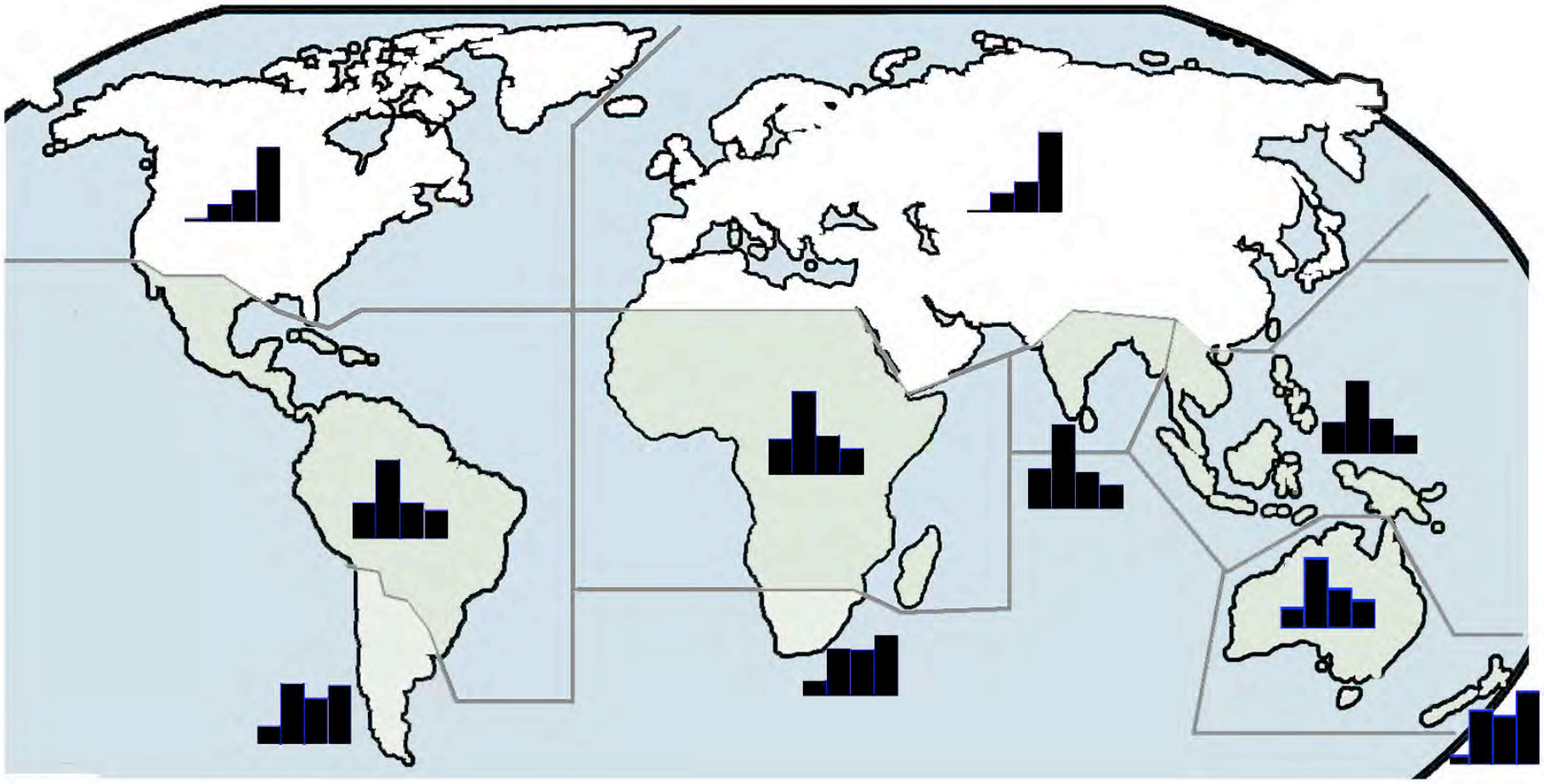


Temperate North America, Europe and Asia similar patterns

Tropical America,Tropical Africa, India, and Southeast Asia similar patterns.

Quantitative Vessel Features: Vessels Per Sq. MM.

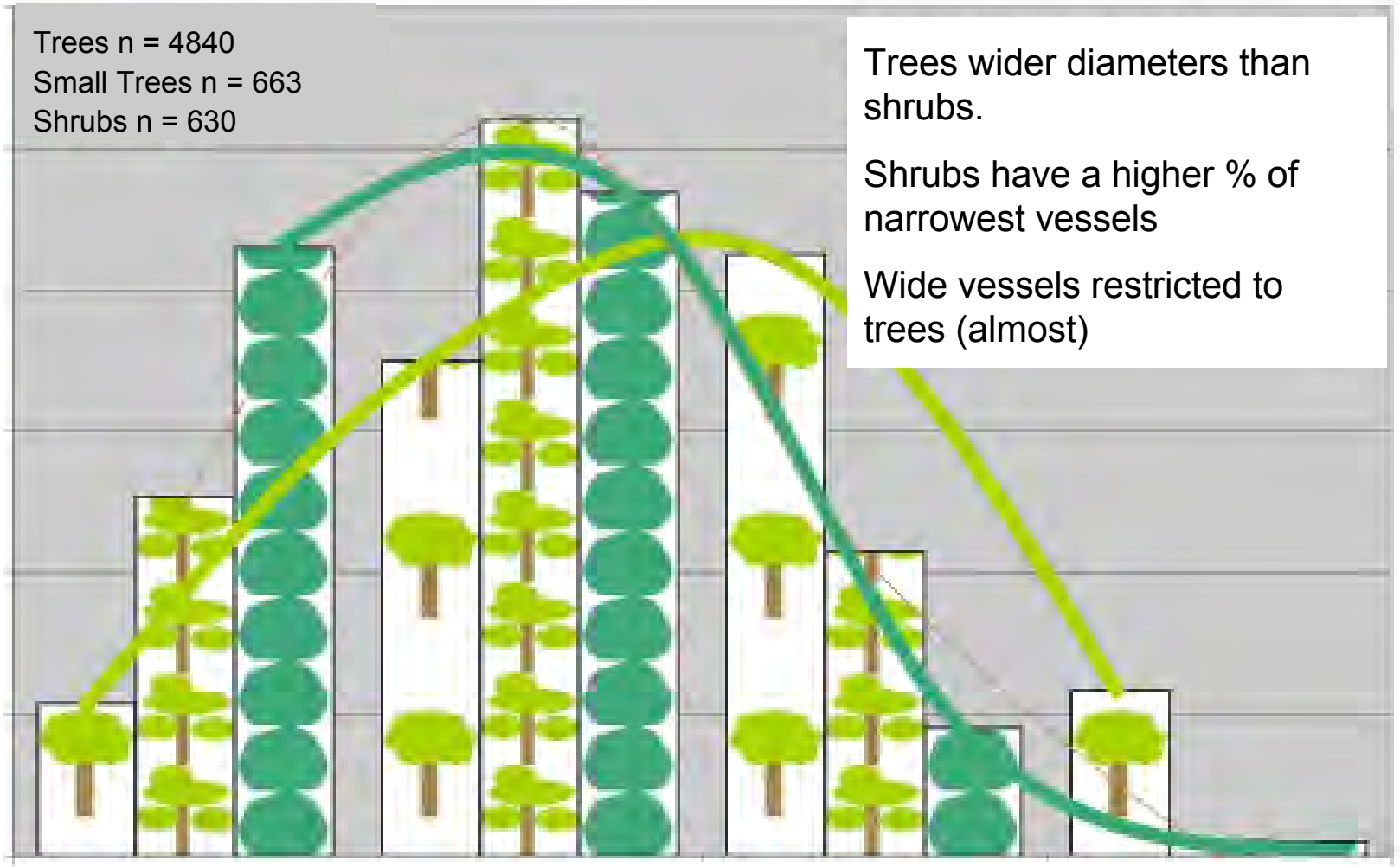
Categories: < 5 /mm^2 ; 5 - 20 /mm^2 ; 20 - 40 /mm^2 ; > 40 /mm^2



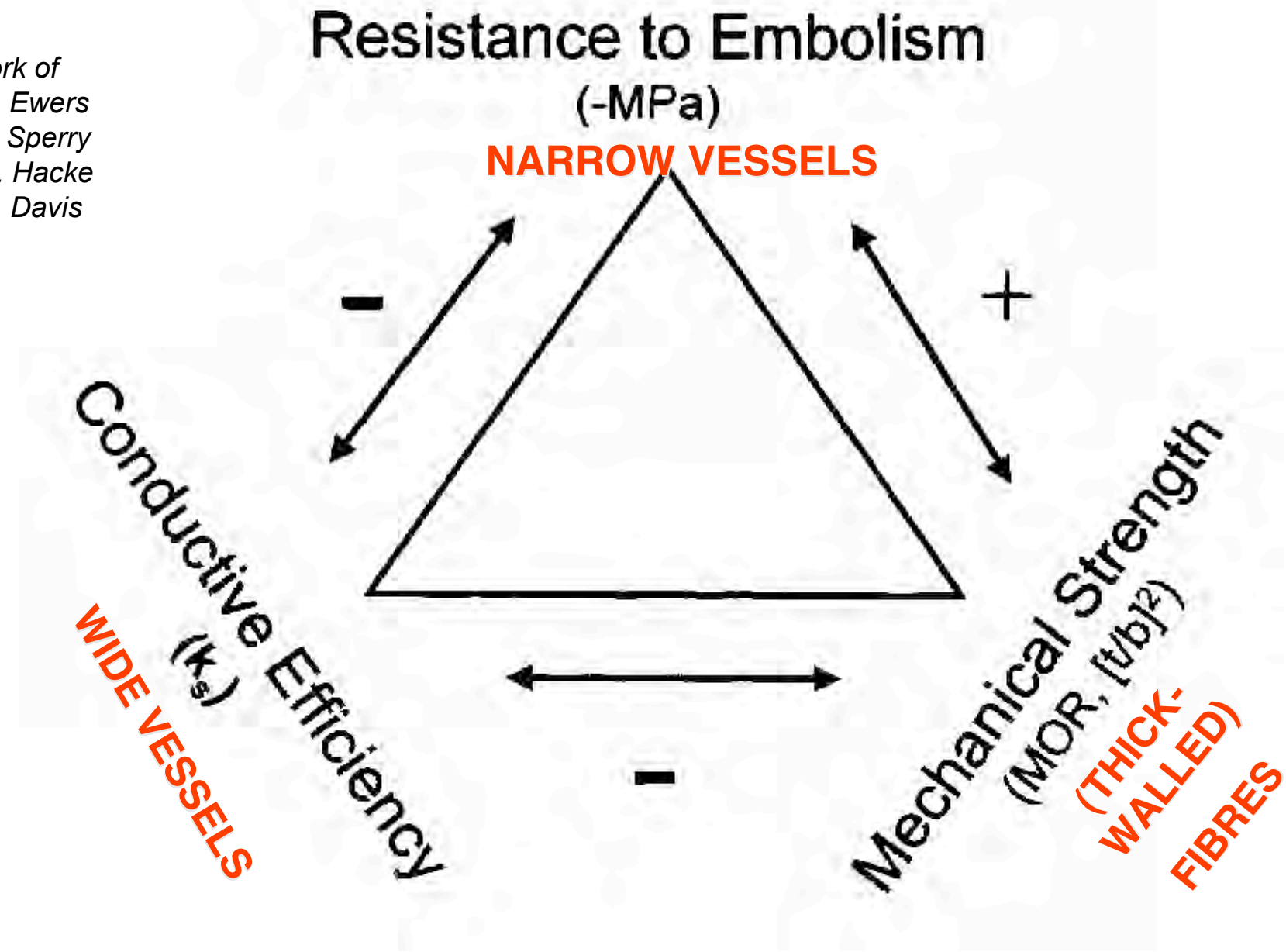
In North America, Europe, Asia woods with < 5 /mm^2 extremely rare, > 40 per mm2 the most common

Within Tropical America, Tropical Africa, India, SE Asia patterns are similar. 5-20/mm2 most common.

Vessel
Mean Tangential Diameter in Trees / Small Trees / Shrubs

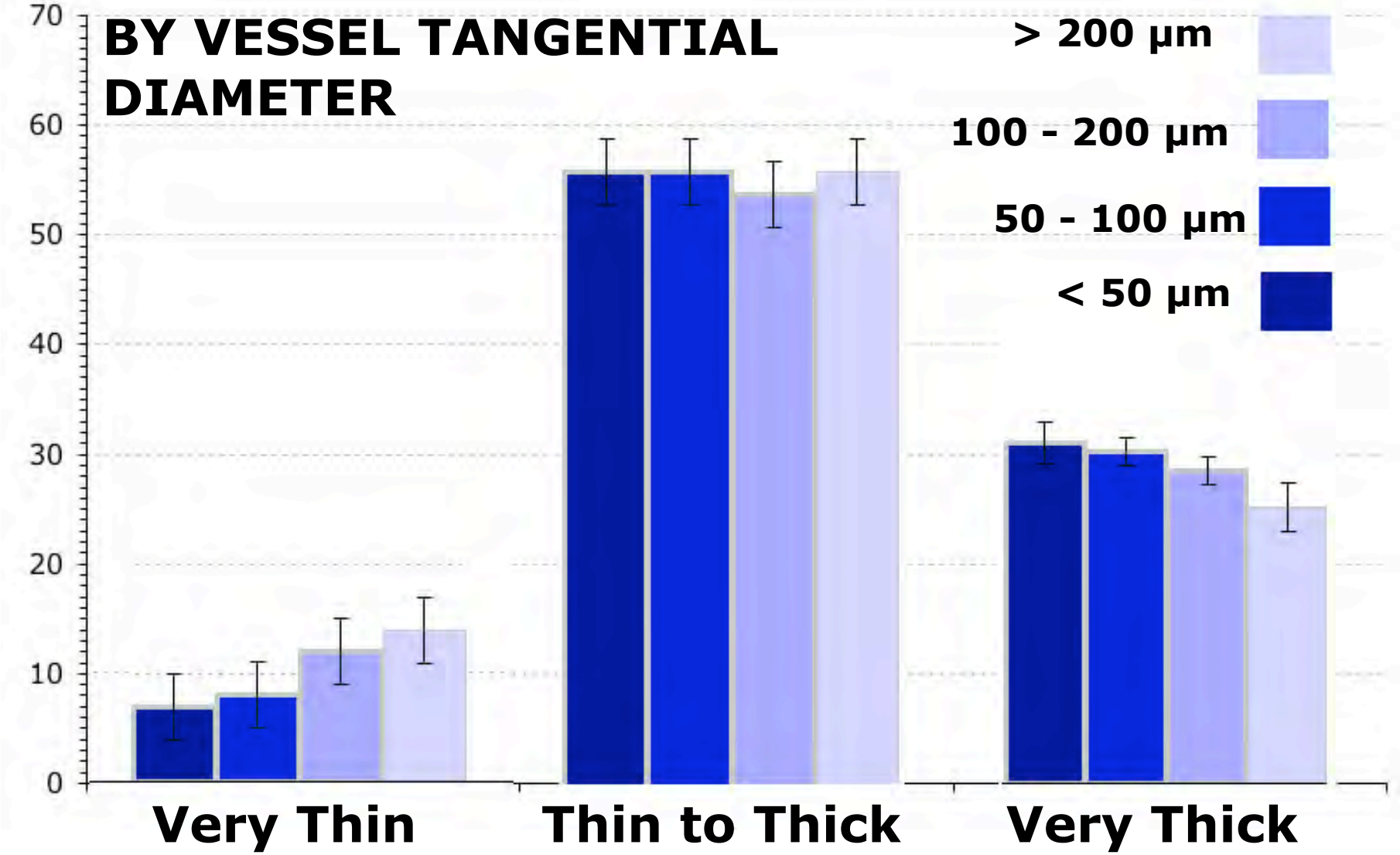


Work of
F. Ewers
J. Sperry
U. Hacke
S. Davis



Triangle of wood functions and trade-offs

INCIDENCE OF FIBER WALL THICKNESS CLASSES BY VESSEL TANGENTIAL DIAMETER



Conclusions

Have revisited questions on incidence of wood anatomical features, on a broad geographic scale, using large on-line database.

These data show same patterns of variation in vessel feature distribution related to habitat and habit, perforation plate type previously observed.

Real conclusion is need for more detailed analysis, more information on functional and phylogenetic significance of parenchyma features, and seeing how wood patterns vary within orders, families, and genera. .