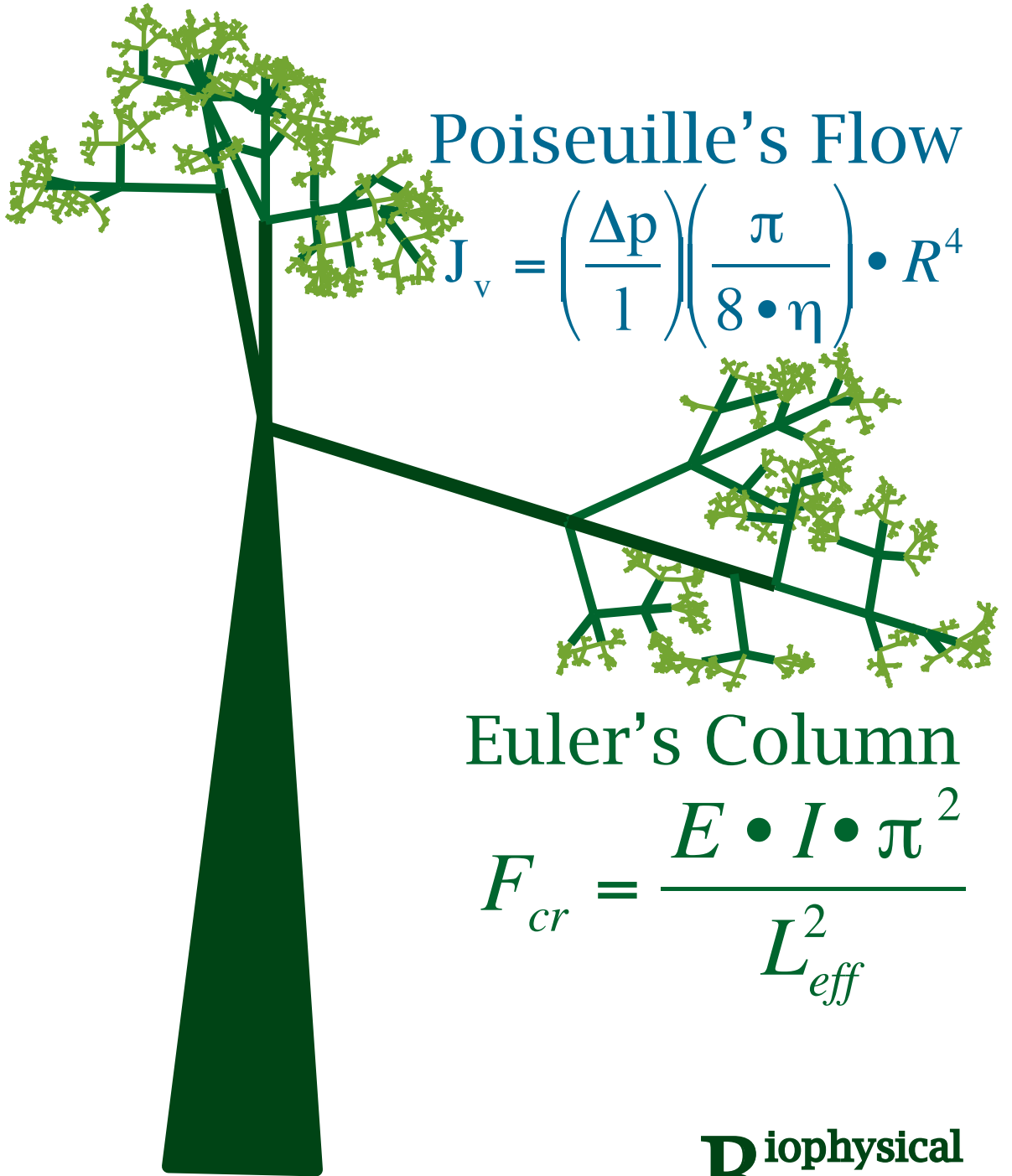


How High Can a Tree Grow?

Tensile Water



Poiseuille's Flow

$$J_v = \left(\frac{\Delta p}{l} \right) \left(\frac{\pi}{8 \cdot \eta} \right) \cdot R^4$$

Euler's Column

$$F_{cr} = \frac{E \cdot I \cdot \pi^2}{L_{eff}^2}$$

Current Topics in Biophysics
(SC/BPHS 2090 2.0)

Biophysical
Currents



Cooksonia is one of the first land invaders known from the fossil record. It appeared about 428 million years ago (Ma), and grew to a height of about 6.5 cm.

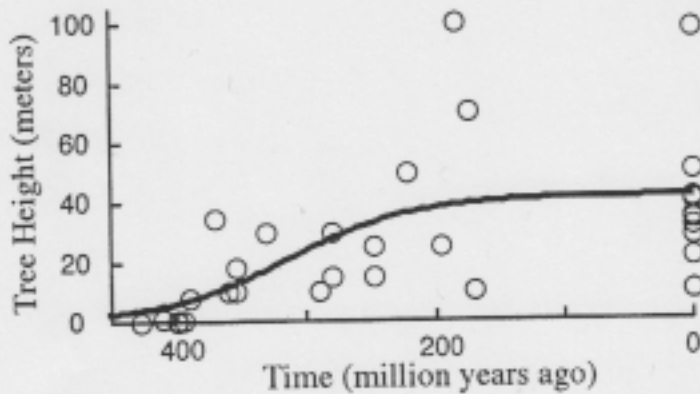
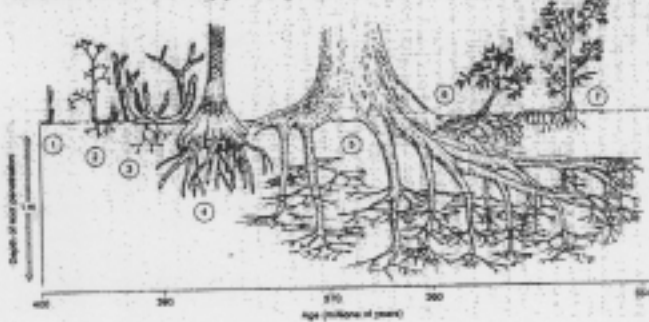


Aglaophyton major grew upwards from horizontal rhizomes, attaining a height of about 20 cm. It appeared about 400 Ma.



Rhytnian appeared at the same time (400 Ma), and attained a height of about 18 cm.

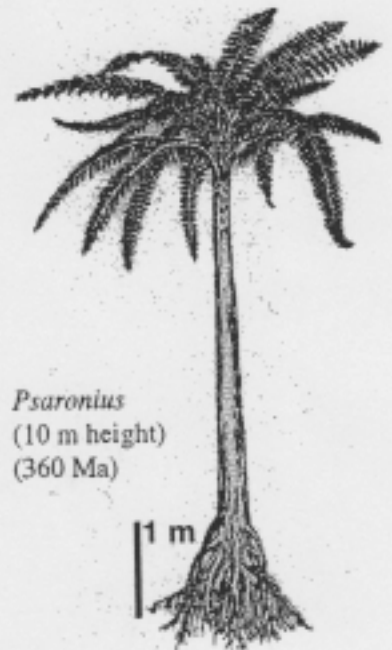
With the development of roots, providing a source of water and mechanical support, greater heights could be attained.



Lepidodendron
(35 m height)
(380 Ma)

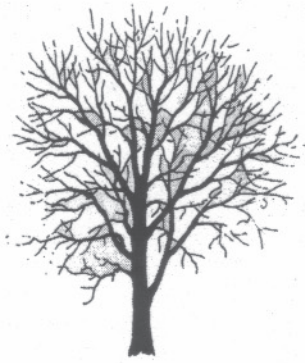


Calamites
(18 m height)
(354 Ma)

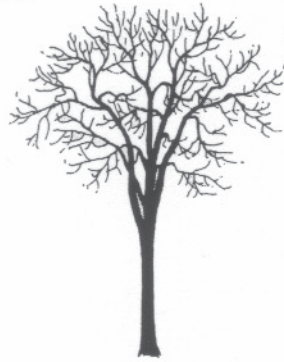


Psaronius
(10 m height)
(360 Ma)

⁽¹⁾Source: Willis, K.J. and J.C. McElwain 2002. *The Evolution of Plants*. Oxford University Press.



Populus tremuloides
trembling aspen

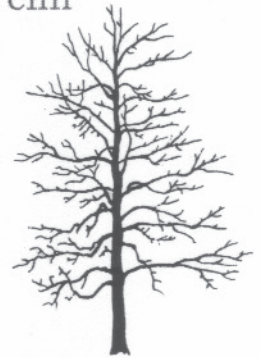


Ulmus thomasii
rock elm



Betula alleghaniensis
yellow birch

Ulmus americana
elm

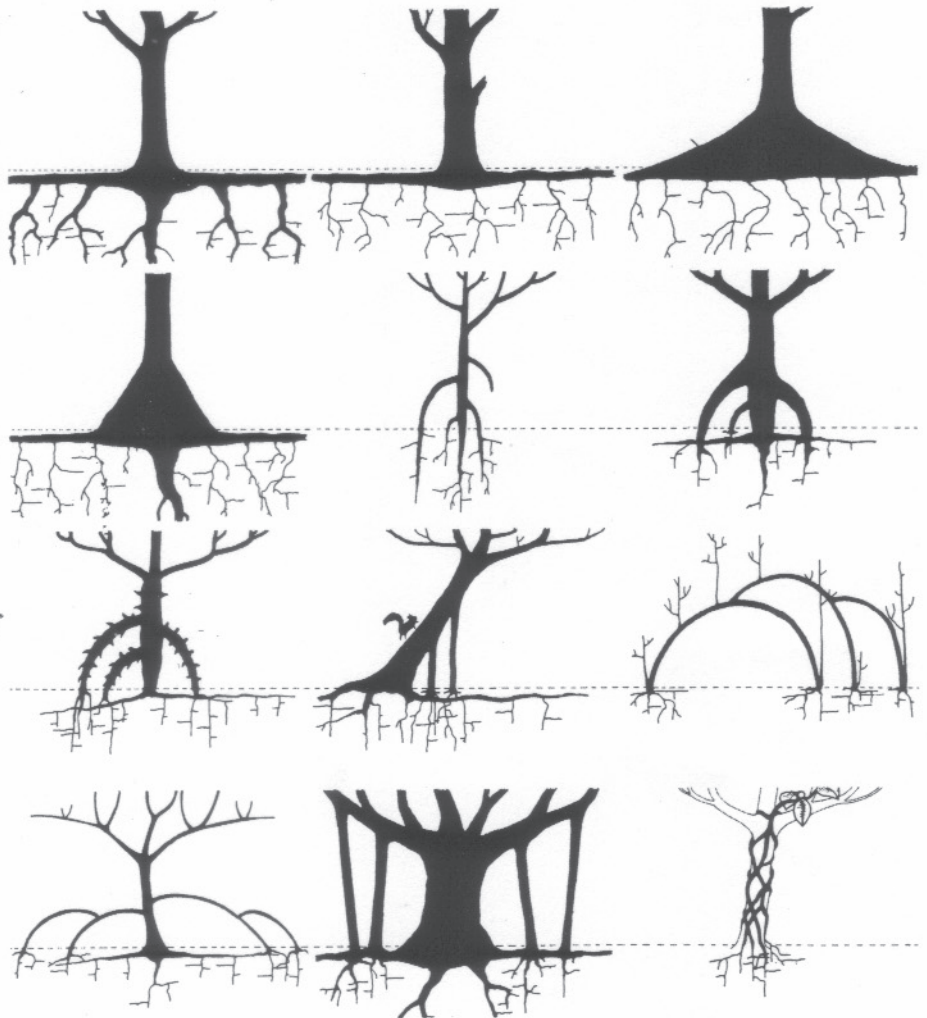


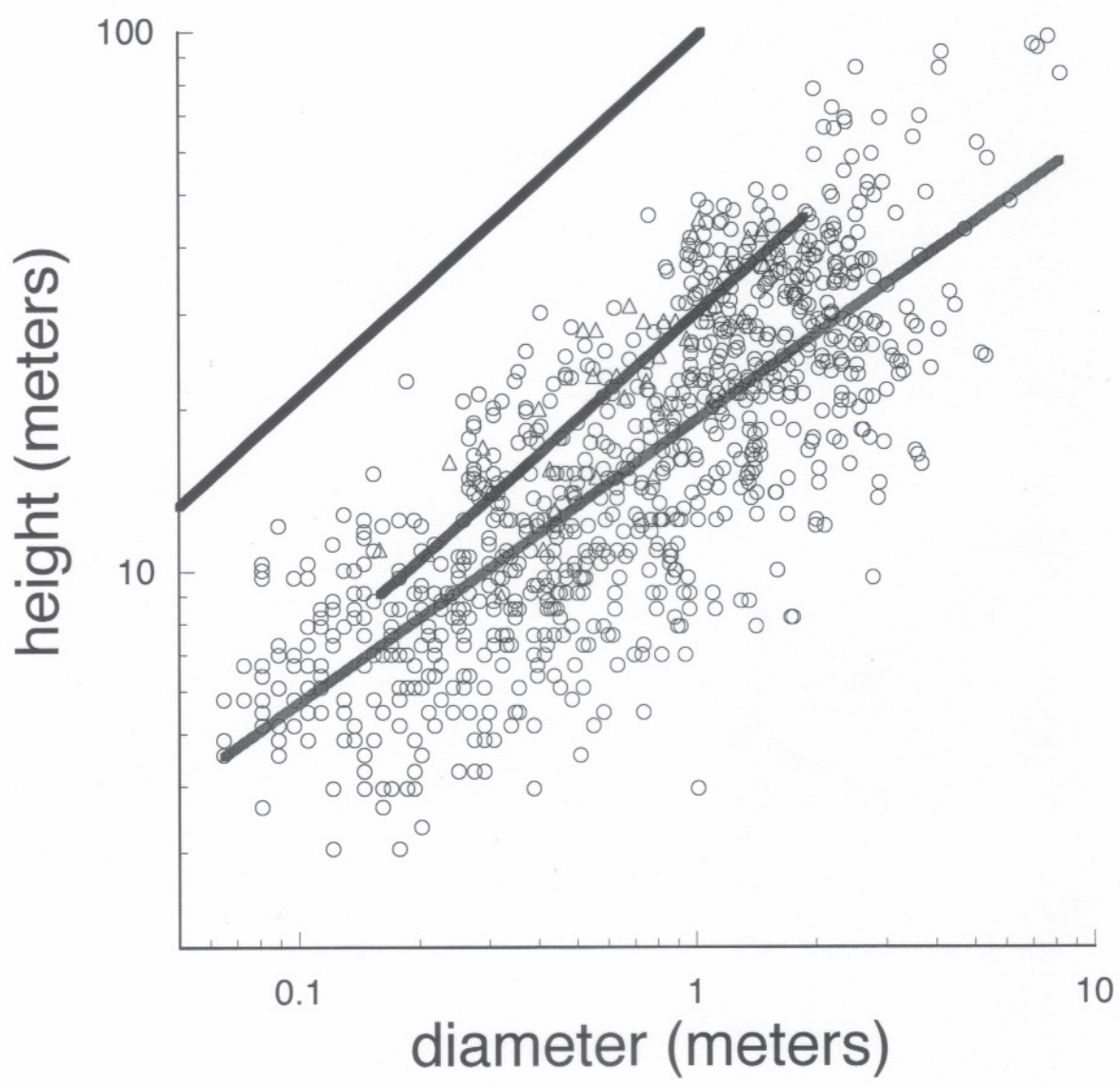
Pinus strobus
white pine

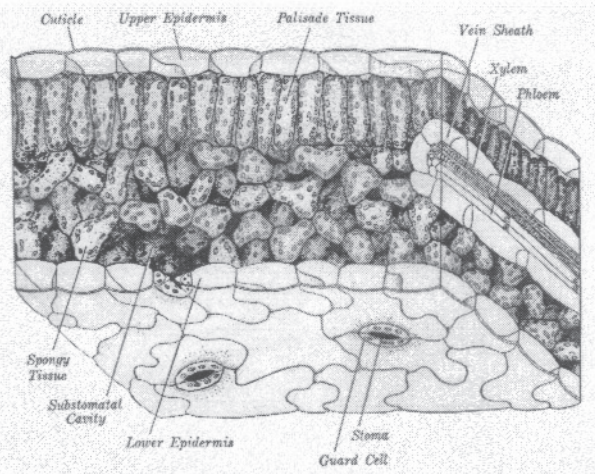
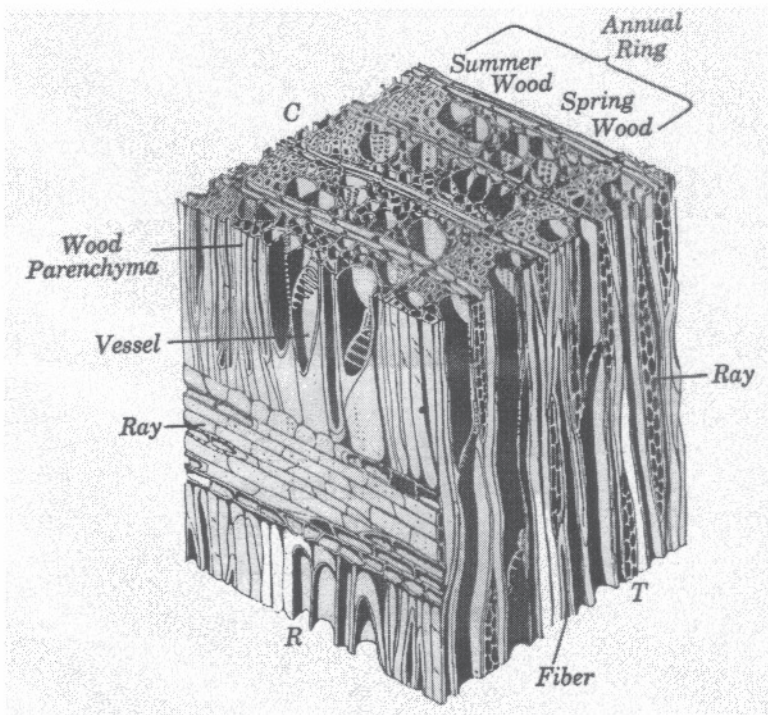
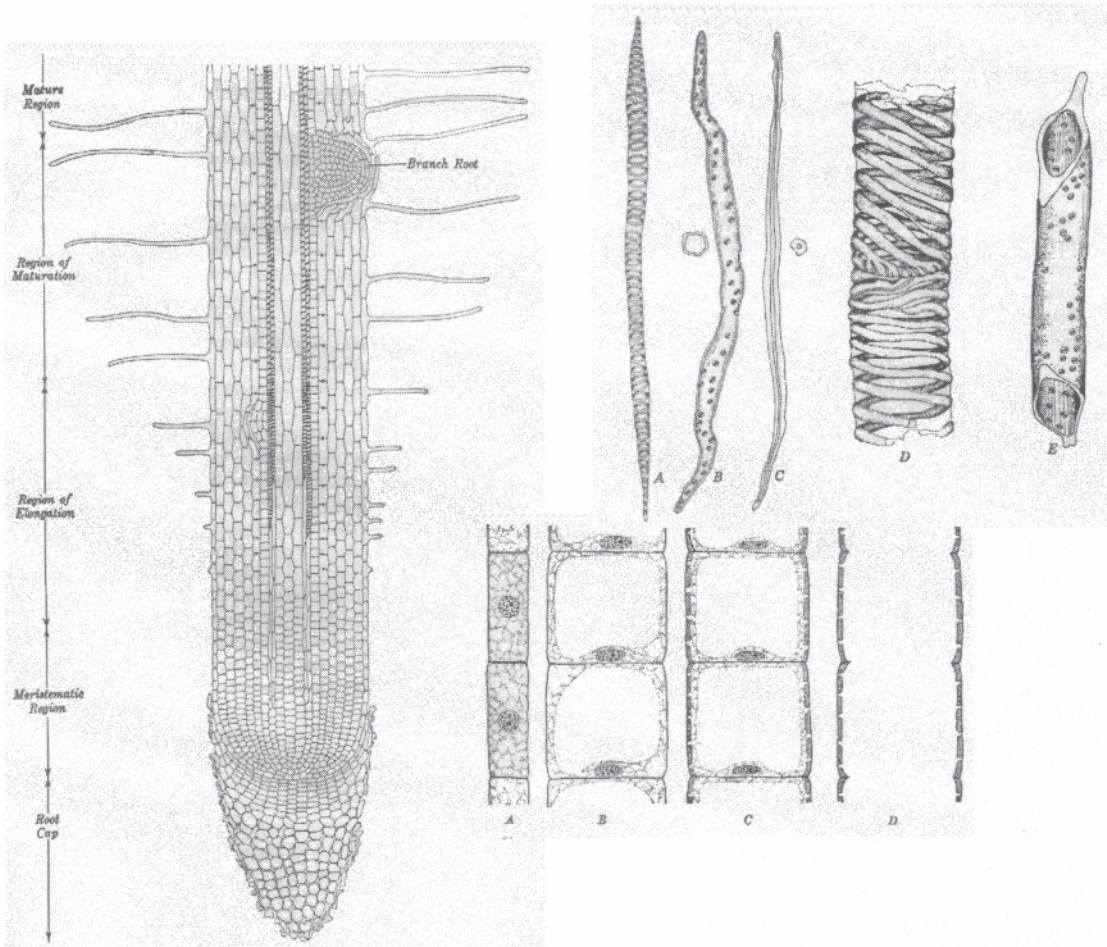


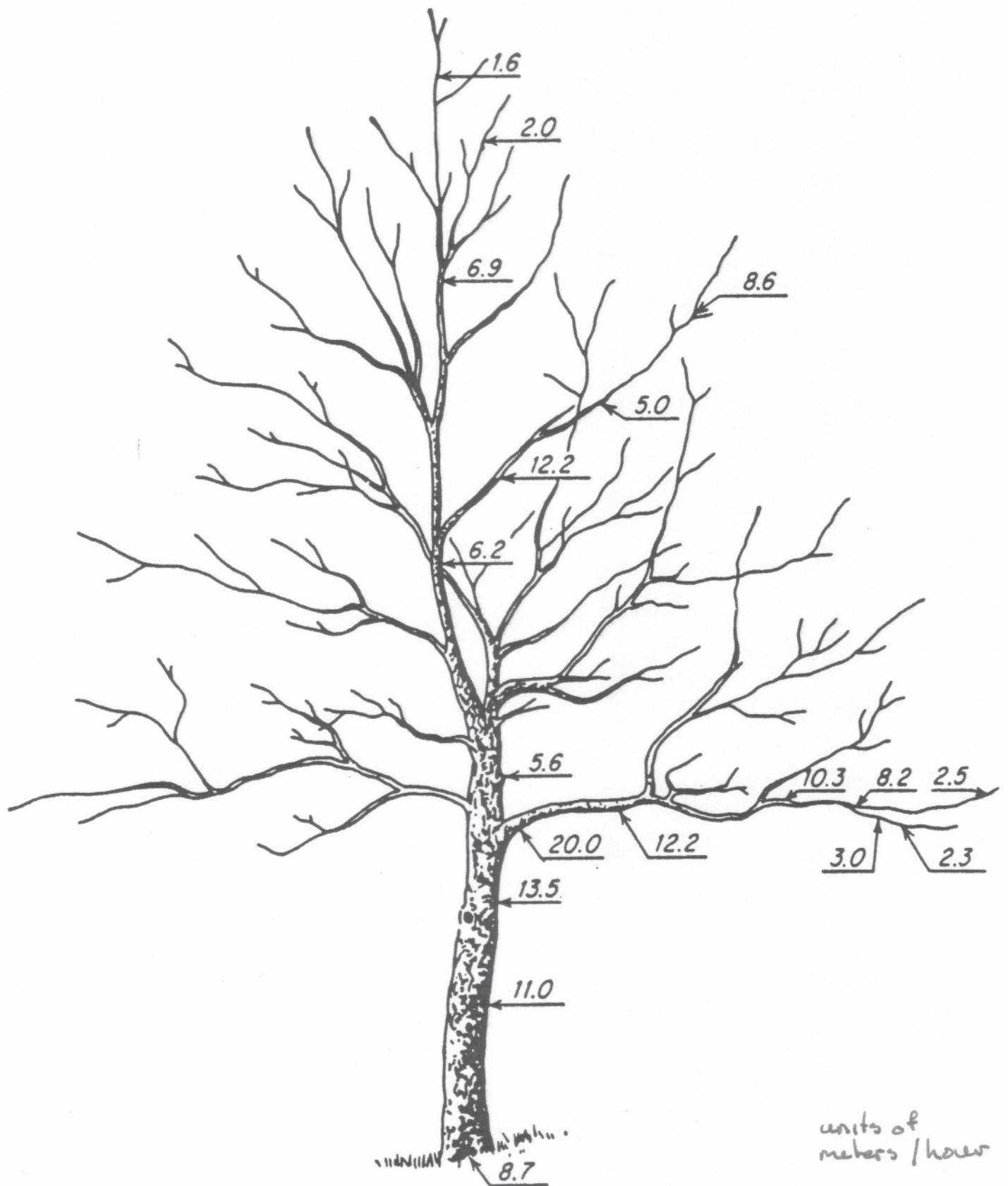
Tsuga canadensis
eastern hemlock

Thuja occidentalis
eastern white cedar









Rates of water movement in meters per hour in various parts of an oak tree at midday, measured by the thermoelectric method. The rate of flow decreases toward the top because the relative conducting surface (ratio of xylem cross section to leaf area) increases toward the top¹.

¹ Kramer, P.J. 1983 Water Relations of Plants. Academic Press. page 275.

Atmosphere / Meter
is equivalent to 0.1 MPa / meter

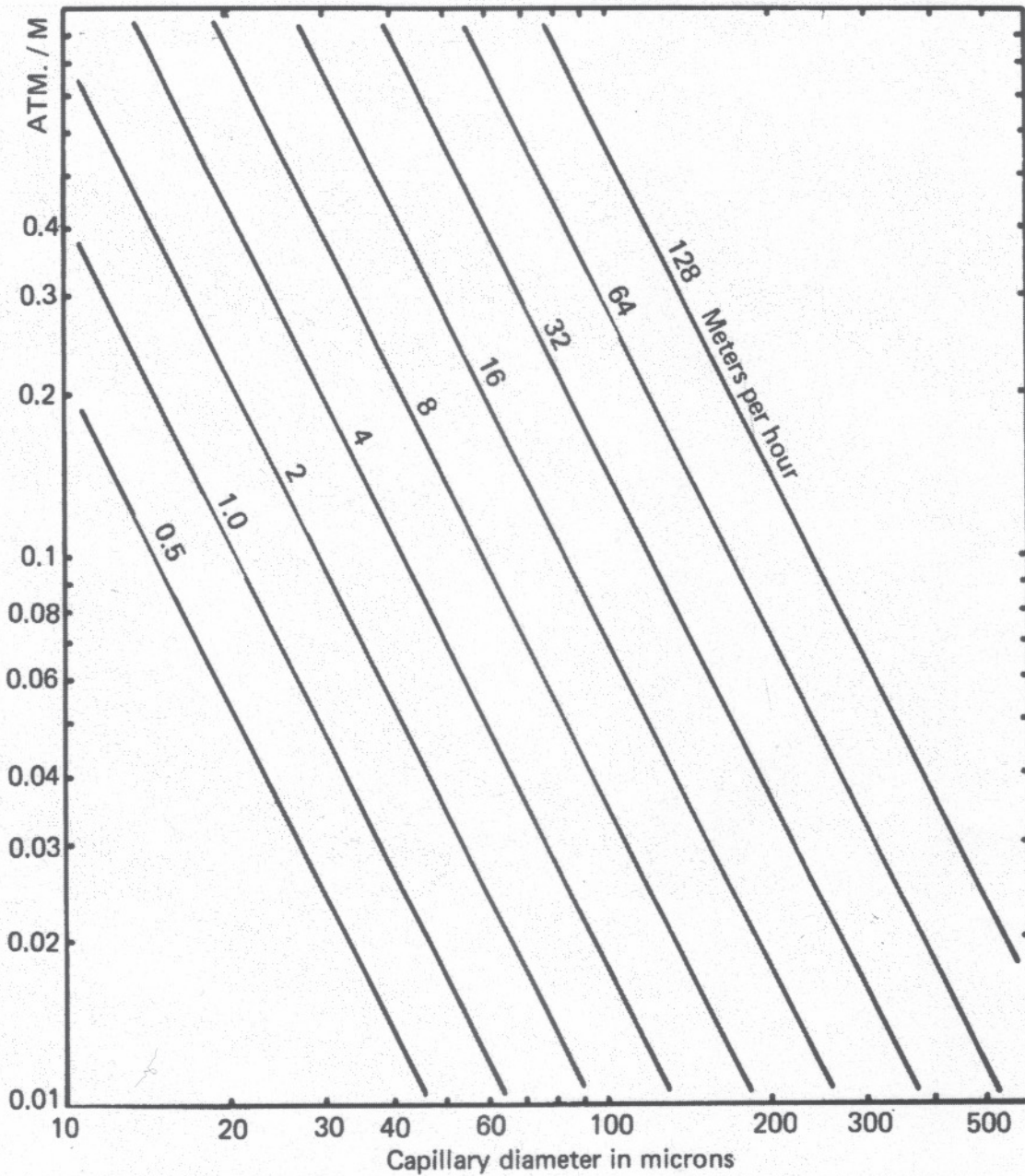


Fig. IV-15. Diagrammatic representation of the Poiseuille equation. Peak velocities are given.