

Perspectives on the Biophysics of Xylem Transport

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*"I'm sorry to say that the subject I most disliked
was mathematics. I have thought about it. I think the reason
was that mathematics leaves no room for argument.
If you made a mistake, that was all there was to it."
(X, 1992, p. 35)*

The fundamentals of the cohesion-tension theory of sap ascent are now well covered in textbooks (Taiz and Zeiger, 2002; Fisher, 2000) with which most in our potential readership are familiar. Moreover, many deeper questions of xylem biophysics were covered in now hoary reviews (Pickard, 1981; Zimmermann, 1983) and have been updated by Tyree in a substantial monograph (Tyree and Zimmermann, 2002); there is no need to be encyclopedic. Nevertheless, any review of xylem biophysics must include at least some discussion of the cohesion-tension theory. This will be followed by a rather more extensive discussion of how embolisms within the transpiration stream might be formed and, more important, resorbed. Since cohesion-tension theory has only recently survived a significant assault on its hegemony, we present a brief discussion of this controversy, including what has been learned. Finally, we focus on factors that affect hydraulic resistance in plants. In each of these endeavors, some effort will be expended to define each concept with clarity and to frame each explanation rigorously.⁵

⁵Martin Zimmermann's observation that discussions of "*sap ascent have become so mathematical that they are not read by many plant anatomists*" (1983, p. 1) may be no less apt today than it was twenty years ago. But it misses the take-home lesson of Malcolm X's dictum quoted at the beginning of this paper that mathematical rigor does tend to squelch wrangling. And if it can't quite do that, it may at least pinpoint the root causes of the dispute.