SUCCESSIVE CAMBIA

By Marcelo R. Pace

Successive cambia is the condition where multiple cambia are developed in an orderly, sequential way (Fig. 1). Each cambial layer or ring develops xylem towards the inside and phloem towards the outside producing alternate bands or rings of xylem and phloem.

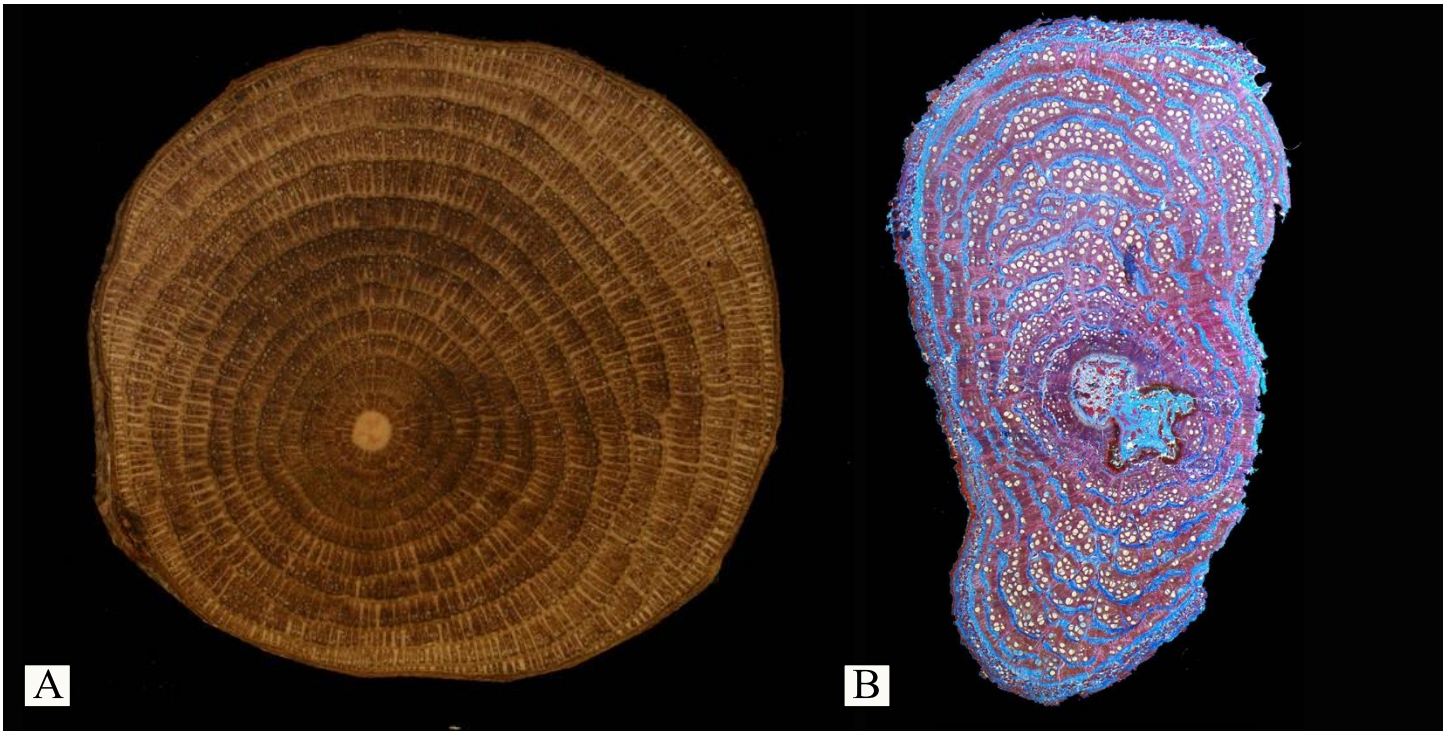

Fig. 1. Stem cross-sections in Menispermaceae showing successive bands or rings of xylem and phloem. A. *Abuta sp.*, macroscopy. B. *Telitoxicum rodriguesii*, microscopy.

Successive cambia is the most widespread type of cambial variant, being present in 37 families of seed plants including *Gnetum*, a Gymnosperm (Fig. 3B), and two major clades (Rosids & Asterids) of Angiosperms (Carlquist, 2001, Angyalossy et al., 2012, 2015). Although this cambial variant is common in lianas, it is also present in herbs, shrubs, and trees.

Ontogenetically, successive cambia is derived either from the pericycle, cortex or primary and secondary phloem (Nair & Mohan Ram, 1990; Carlquist, 2007, Tamaio et al. 2009; Terrazas et al. 2011; Rajput & Marcati 2013; Cunha Neto et al. 2018; Pace et al. 2018). Successive cambia can be concentric, resulting in cylindrical (Fig. 1A) or flattened stems (Fig. 1B); unilateral; discontinuous (Fig. 2A-B); or coalescent, where cambia merge with one another into a reticulate structure (Carlquist 2007). Examples of the latter are found in *Gnetum* and *Maripa* (Convolvulaceae).

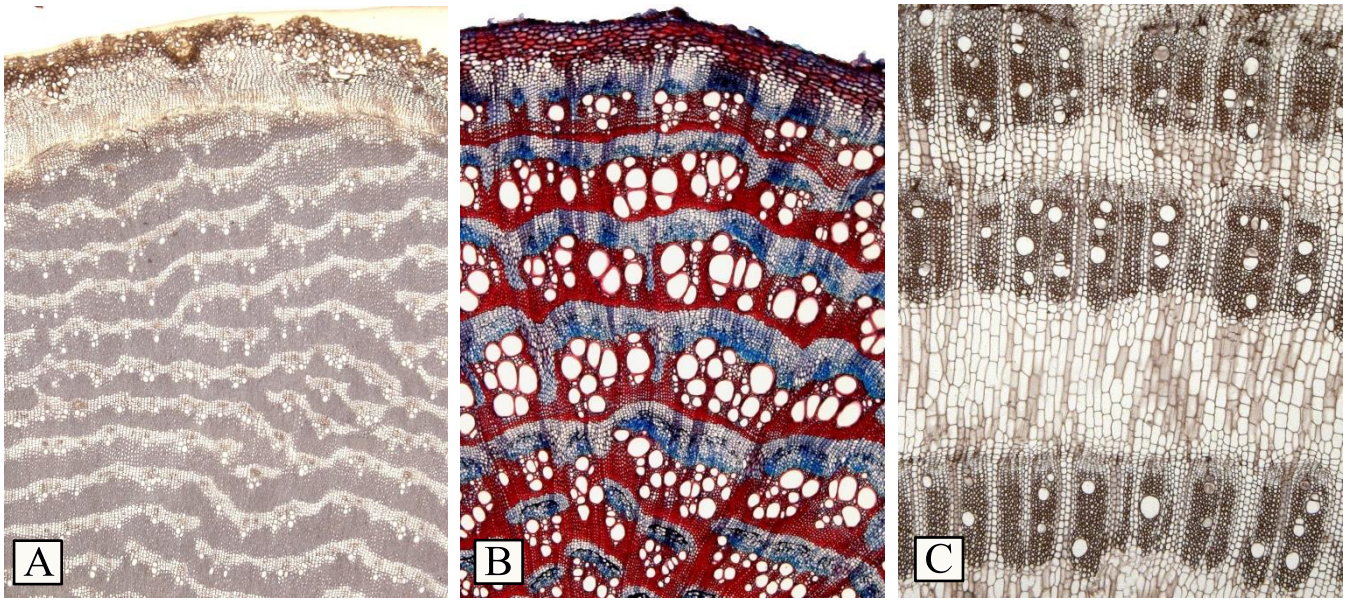

Fig. 2. Successive cambia. A. *Arthrocnemum arbuscula*, a shrub in the Amaranthaceae. B. *Hebanthe eriantha*, a liana in the Amaranthaceae. C. *Phytolacca dioica*, an herb in the Phytolaccaceae.

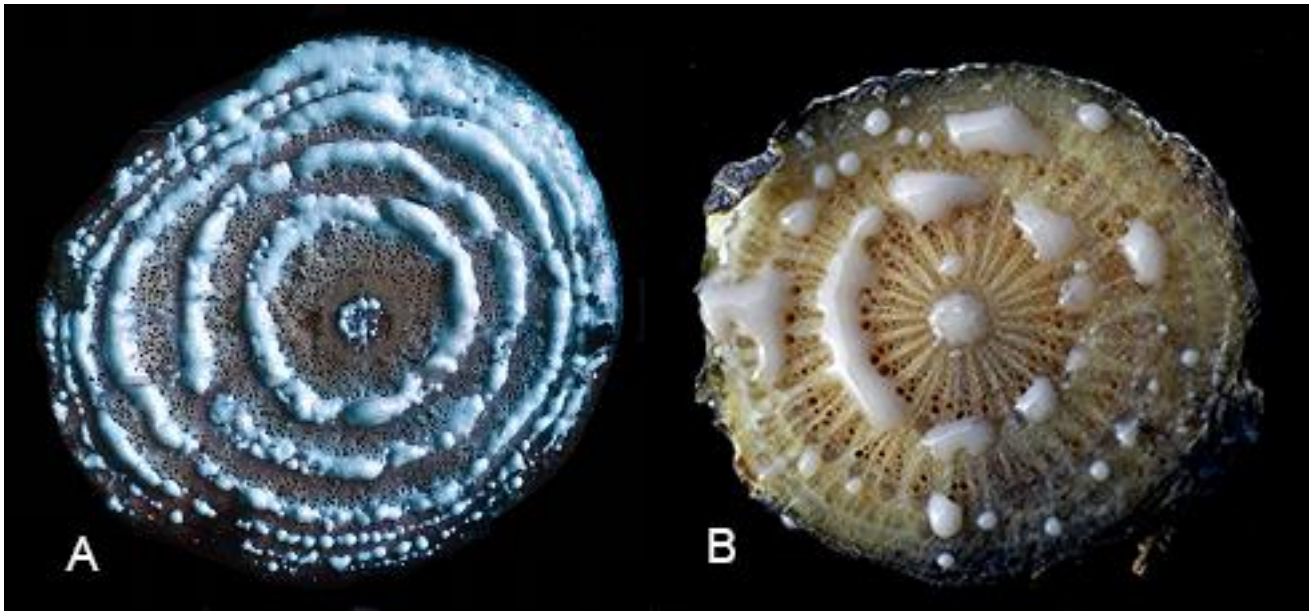

Fig. 3. Stems with successive cambia with additional diagnostic characters. A. *Odontadenia sp.* (Apocynaceae), with abundant latex from the secondary phloem, pith and cortex. B. *Gnetum leyboldii* (Gnetaceae), with cream exudate and wide rays.

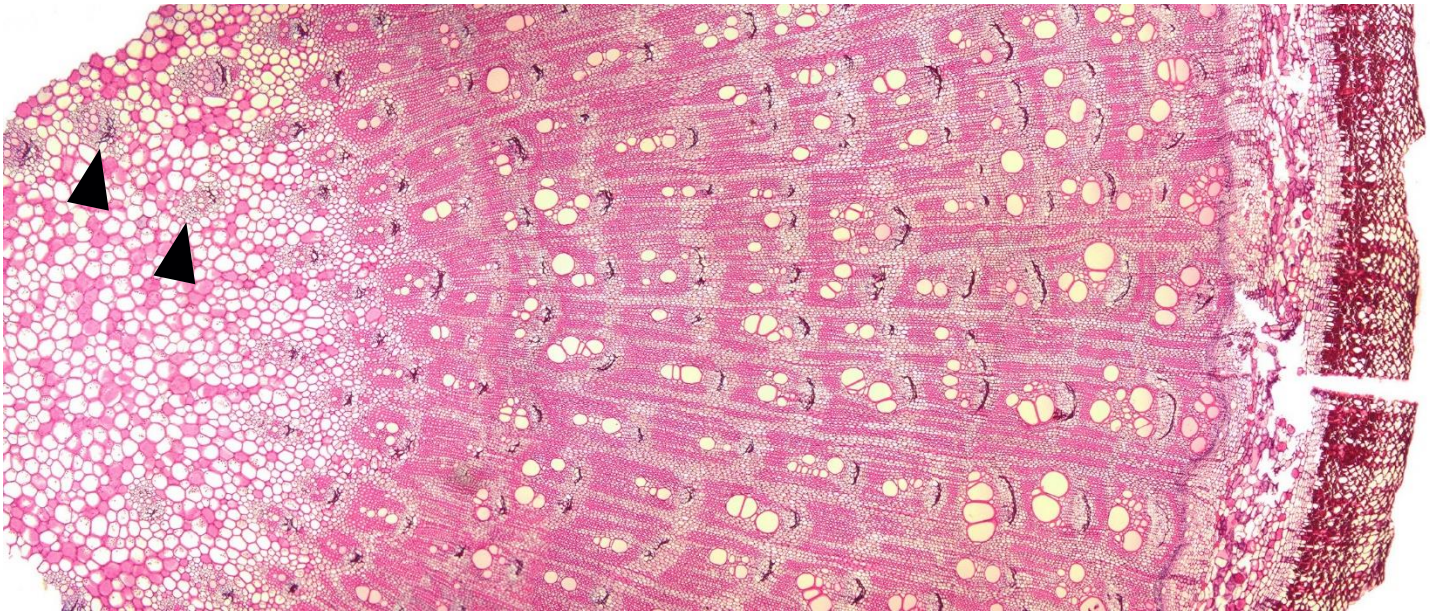

Fig. 4. Stems of *Bougainvillea laterita* (Nyctaginaceae) with successive cambia and medullary bundles (arrowheads).

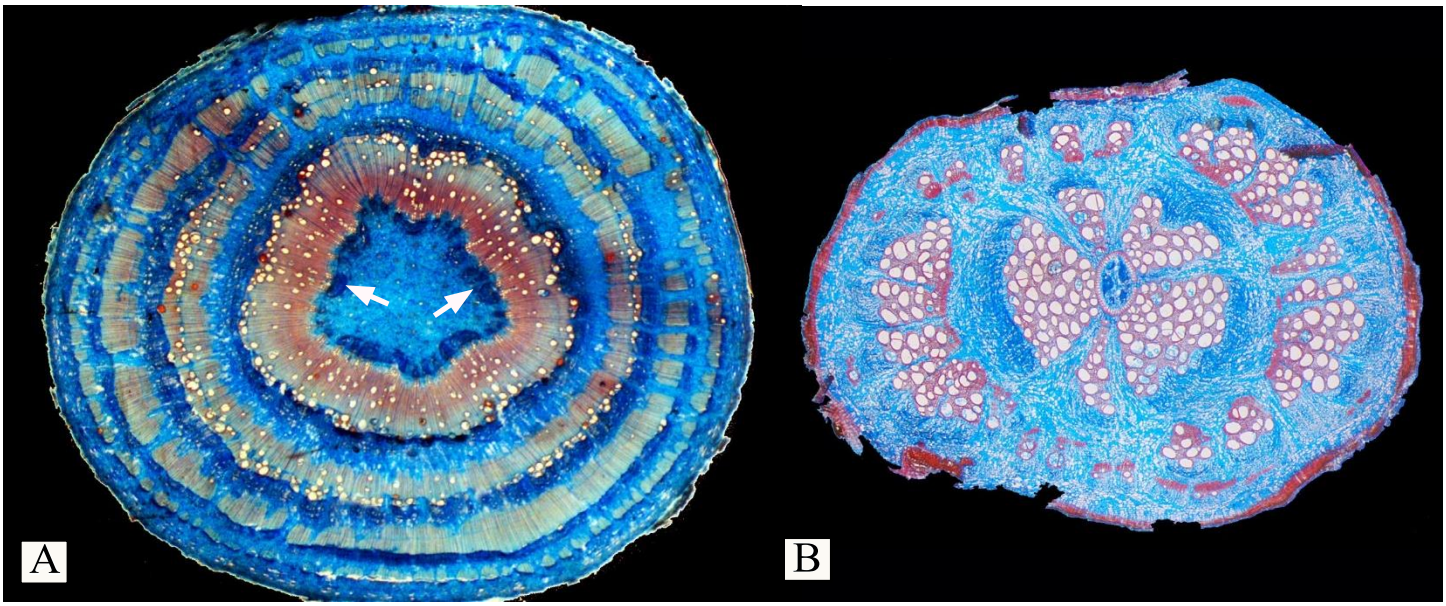

Fig. 5. Cross sections of stems with successive cambia and intraxylary phloem (perimedullar phloem; arrows) in Convolvulaceae. A. *Ipomoea arborea*. B. *Ipomoea cairica*.

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