Preface

Wood Cell Wall Ultrastructure

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This special edition of the IAWA Journal contains 8 original papers and 3 review articles, all of which share a focus on the ultrastructure of wood cell walls. At the end of 2019, we are celebrating 100 years of wood cell wall science which began more or less in the early 1920s with Ritter's investigation of lignin distribution and other concurrent studies of cellulose. In the first quarter of the 21st century, researchers have a wide range of techniques available for investigations of the nanostructure and properties of wood cell walls in softwoods, hardwoods, reaction wood, decayed or aged wood, bamboo, and ancient artefacts as well as modern wood-based products.

Donaldson (2019) reviews wood cell wall ultrastructure with a historical summary of methods and key applications, a description of the main components of wood cell walls and their distribution across the cell wall, and a discussion of how ultrastructural features are related to wood properties. Many of the investigations reviewed focus on wall layers, cellulose microfibril orientation, and lignin distribution because these features determine the longitudinal stiffness and pulping properties of wood. With the development of antibodies against hemicelluloses and pectins, our knowledge of the topochemistry of cell walls has advanced beyond just cellulose and lignin in the last 20 years or so. Modern fluorescence techniques are now allowing studies of cell wall porosity in native wood and many other applications with resolution approaching that of electron microscopy, without the need to dry samples thus preserving the native state.

Kaack *et al.* (2019) review the three-dimensional structure of intervacular pit membranes in hardwood vessels and their role in water conduction. They explore the hypothesis that “pit membranes enable water transport under negative pressure by producing stable, surfactant coated nanobubbles while preventing the entry of large bubbles that would cause embolism”. Also, on the topic of pitting but from the perspective of the cytoskeleton and pit formation, Begum *et al.* (2019) explore the role of actin filaments and cortical microtubules during wood formation in conifers.

This is followed by three papers, 1) on the localisation of extractives and their relationship to cell wall microporosity in Douglas fir (Donaldson *et al.* 2019), 2) on the distribution of pectins and hemicelluloses in tension wood of European ash (Kim & Daniel 2019), and 3) on tension wood in a large sample of tropical hardwoods (Ghislain *et al.* 2019). The latter covers a large number of non-traditional species and demonstrates considerable variability in tension wood characteristics and thus represents a major advance in our knowledge of reaction wood. These three investigations share the use of fluorescence as a technique for fine level characterisation.

Haag *et al.* (2019) describe the characteristics of juvenile and mature wood in a collection of minor hardwood timber species from Mexico using SilviScan and UV absorbance microscopy to measure anatomical characteristics as well as lignin and extractive distribution. This improved knowledge of wood properties will contribute to the more effective utilisation of these minor species.

In the third review, Singh *et al.* (2019) describe investigations of the bacterial decay of wood. Most wood decay is caused by fungal activity but the discovery of bacterial decay in the 1980s revealed a whole new array of decay types including tunneling and erosion bacteria. It seems likely that this type of decay may lead to future biotechnology applications which are currently limited by the difficulty in culturing the causal organisms. Investigations by Wang *et al.* (2019) and Guo *et al.* (2019) describe features of ancient Chinese wooden artefacts including chemical-based wood identification and aspects of wood aging in 8000-year-old *Phoebe* wood while the investigation by Zhang *et al.* (2019) describes the intercellular pathways in bamboo metaxylem heralding new ultrastructural research in woody monocots.

As with previous special issues on select topics, IAWA is publishing a limited trade edition of this special issue in addition to the normal print run of IAWA Journal 40 (4). The editors wish to thank contributing authors, referees, and, on the occasion of her retirement, especially layout editor Emma van Nieuwkoop for her expert desk editing.

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