

This Week's Citation Classic

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Talmadge K W, Keegstra K, Bauer W D & Albersheim P. The structure of plant cell walls. I. The macromolecular components of the walls of suspension-cultured sycamore cells with a detailed analysis of the pectic polysaccharides. *Plant Physiol.* 51:158-73, 1973.
[Dept. Chemistry, Univ. Colorado, Boulder, CO]

This was the first in a series of papers^{1,2} dealing with the structure of cell walls isolated from suspension-cultured sycamore cells (*Acer pseudo-platanus*). These studies were made possible by the availability of purified hydrolytic enzymes and by improvements in the techniques of methylation analysis, which permitted partial characterization of the more abundant macromolecular components of sycamore cell walls. [The SCI® indicates that this paper has been cited in over 205 publications since 1973.]

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"Cell walls are important in plant biology. The work cited was a first attempt to describe the structure of the primary cell wall as an entity. Researchers had looked at fractions and individual components of primary cell walls but had not considered the aggregate of those components. The formation of a team of three graduate students—Talmadge, Keegstra, and Bauer—and myself generated sufficient manpower and courage to try to look at the walls of growing plant cells as a whole. Our experiments led to a hypothetical model of the structure of the primary cell walls of plants. The model was sketchy but useful, and the chemical data presented have, for the most part, stood the test of time. It is the model and the underlying chemistry that led to such frequent citation of this paper.

"Our modeling was naive because plant cell wall polysaccharides are far more structurally complex than we realized. We looked at the polysaccharides only as structural polymers. We have since learned that these polymers contain oligosaccharides within their exceedingly complex structures that, when released from covalent attachment within the polysaccharides, act as regulatory molecules.

"The study of the plant cell wall was so challenging that we seriously considered

abandoning the project. This was partly true because we were trying, at first, to study the mixture of primary and secondary cell walls present in intact seedlings. Progress came when we focused our research on undifferentiated cells grown in suspension culture that possess only primary cell walls. The methods that we were using in the early-1970s were still not sophisticated enough to unravel the complete primary structure of plant cell wall polysaccharides. In 1977, our laboratory came close, for a second time, to ending all work on plant cell wall structural analysis. Again, the development of new methods enabled us to make real progress in unraveling the complex structures of these polymers. But this work is still very challenging, and the number of laboratories trying to determine the polysaccharides of plant cell walls is too few. Even Talmadge, Keegstra, and Bauer chose other areas of science in which to use their talents. Talmadge moved first into animal hormone research and then into industry. Keegstra, too, went into animal research, working on animal viruses, but after about five years he returned to plant science and is now associate professor of botany at the University of Wisconsin. Bauer has remained in plant science research throughout his career. He works on the symbiotic association between *Rhizobium* and legumes at the Charles Kettering Institute in Yellow Springs, Ohio.

"The 1973 model of the primary cell wall of plants that evolved from the work of this *Citation Classic* has been reprinted many times in books and reviews, and it was the subject of an article in *Scientific American*.³ The model proved of value in focusing interest and directing experimentation on plant cell walls, but it is now time to move forward. Our most recent reviews^{4,5} no longer present a model of the primary cell wall because we realize that the wall is far more complex than we had anticipated. The discovery that regulatory molecules are stored within the structures of the wall polymers will, I believe, greatly increase research into cell wall structure and function."

1. Bauer W D, Talmadge K, Keegstra K & Albersheim P. The structure of plant cell walls. II. The hemicellulose of the walls of suspension-cultured sycamore cells. *Plant Physiol.* 51:174-87, 1973.
2. Keegstra K, Talmadge K W, Bauer W D & Albersheim P. The structure of plant cell walls. III. A model of the walls of suspension-cultured sycamore cells based on the interconnections of the macromolecular components. *Plant Physiol.* 51:188-96, 1973. [Citation Classic. *Current Contents/Agriculture, Biology & Environmental Sciences* 12(7):16, 16 February 1981.]
3. Albersheim P. The primary cell wall of plants. *Sci. Amer.* 232:80-95, 1975.
4. McNeil M, Darvill A G & Albersheim P. The structural polymers of the primary cell walls of dicots. (Herr W, Grisebach H & Kirby G W, eds.) *Progress in the chemistry of organic natural products.* Vienna: Springer-Verlag, 1979. Vol. 37. p. 191-249.
5. Darvill A, McNeil M, Albersheim P & Delmer D P. The primary cell walls of flowering plants. (Tolbert N E, ed.) *The biochemistry of plants.* New York: Academic Press, 1980. Vol. 1. p. 91-162.