

An observation on the effectiveness of root pressure

Ray C. Friesner
Butler University

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Butler University Botanical Studies

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Edited by

Ray C. Friesner

The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner, included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daudenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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AN OBSERVATION OF THE EFFECTIVENESS OF ROOT PRESSURE IN THE ASCENT OF SAP

By RAY C. FRIESNER

While making some field observations on stump-sprout reproduction in several species of *Quercus*, a striking exudation of sap from uninjured stems of *Acer rubrum* was noted. After seeing this on a number of specimens, more pointed observations were made with the result that it became apparent that all of the stems showing this exudation through unbroken bark were sprouts from stumps made by logging operations about four years ago. The exudate was coming through the bark of stems ranging from one to two inches in diameter and appeared from six to eight feet above the soil. The volume of sap exuding was sufficient to wet most of the stem below the points of emergence.

These observations called to mind the question of the forces involved in the ascent of sap. Root pressure has always been looked upon as one of these forces but has seldom been assigned a role of any considerable significance. White (*Am. Jour. Bot.* 25:223-227, 1938) has recently pointed out that the importance of root pressure is probably often underestimated. He found that in the tomato the pressure was in excess of 6 atmospheres and that it may have been as high as 10 atmospheres. It is to be noted that in the present observation on *Acer rubrum* the root system was in every case probably much in excess of that for a normal tree of the same size since the observations were on sprouts from stumps of trees larger than the present stems. While the stumps were not measured, it is estimated that they ranged from 3 to 5 inches in diameter.

Of course, these observations do not mean that the osmotic activity of parenchyma cells along the path of ascent of sap was not involved. These living cells will always exert an osmotic "pull" and this pull may be added to the other forces tending to lift water, but it is difficult to understand how they can exert a "push" as well as a "pull" since a "push" would be necessary for water to leave the ascending path and be "forced" to the outside of the stem through otherwise uninjured and impervious bark.

It is a matter of common observation that sap will exude from broken or otherwise injured points on twigs and stems of *Acer spp.* but these observations differ in that the "bleeding" is through bark unbroken except by the force of the exudate itself. These observations point to the conclusion that root pressure is a factor of greater significance than we are prone to allow for it. The fact that we are not able to explain "osmotic push" on any physico-chemical basis does not lessen its importance as a factor in the ascent of sap.