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Note on Radial Tree Growth

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Most radial growth curves obtained by the use of the dendrometer or dendrograph are typically logistic or S-shaped. After the peak of the curve has been reached and growth has ceased, there is almost invariably a decrease. It is generally agreed that this decrease is associated with tissue dehydration in late summer and fall due to inadequate soil moisture and continued transpiration. If the curve is extended through the winter months there may be further decline. This decline is probably associated with dehydration, a process important in frost hardiness (Levitt, 1941). During winter there may also be some increase in the curve but only rarely does this exceed the fall maximum. It is generally not until the initial spring incline that the fall maximum is reached.

Brown (1915), working on histological growth studies in *Pinus strobus* L., recognized two types of growth in spring: (1) growth without cell division—usually occurring in phloem and related to water uptake or rehydration of tissue replacing that lost in fall and winter, and (2) growth by cell division—a result of cambial activity. These phenomena have been recognized by most researchers of radial tree growth. However, there is no record until 1952 of concurrent histological and dendrometer studies to determine the relationship between these two types of growth (Fraser, 1952). From these and later studies conducted in early spring Fraser (1956) concluded that "a swelling is invariably found before any wood cells have been laid down."

When the literature on radial growth is surveyed, one finds three criteria for determining the date that growth begins: (1) date of the initial increase of the curve in spring, (2) the date when the spring curve reaches the fall maximum, and (3) the date by which 5 percent of the annual increment has been reached. The first of these may include growth with and without cell division. The second criterion assumes that cells have a maximum expansion. This expansion represents the fall peak and any deviation below this peak involves dehydration and rehydration. It should be realized, however, that the fall maximum does not necessarily represent the maximum potential expansion, particularly during years of low rainfall. The third criterion is frequently used when comparisons between species are made. This enables the investigator to place each species on a common basis and thereby rid the data of differences in growth rates.

For studies concerned only with net annual increment and interspecific comparisons, there is no need to separate the dates of growth with and without cell division. On the other hand, if one is interested in determining the external factors causing the initiation of growth, it may then be necessary to separate the two phenomena. Whether the swelling due to rehydration is to be considered as growth is an academic question, but nevertheless, there may be certain temperature requirements necessary for this phenomenon to occur. Also, if the cells have been dehydrated, rehydration may be a prerequisite for cell division. Temperature requirements for cell division may differ from the temperature requirement for rehydration. In other words, growth in spring involves two distinct processes, each of which may have different requirements.

A preliminary study was conducted during the spring of 1958. Two species were chosen for histological studies (sugar maple, *Acer saccharophorum* K. Koch, and beech, *Fagus grandifolia* Ehrh.). The trees, located in Hutcheson Memorial Forest in New Jersey, used for histological sampling were not the ones used for dendrometer studies; however, they were close together, on similar sites, and of similar size. During the period of study, observable phenological events coincided in those trees from which cambial samples were taken and the dendrometer trees.

Dendrometer readings were taken weekly at the same time of day. Bark samples were taken semi-weekly. A wood chisel was used to remove a sample of about one-half

square inch. All samples were taken between 4 and 6 feet from the ground. This seemed justifiable in view of the rapidity at which the march of cambial activity occurs downward in deciduous trees (Fraser, 1956). Each sample was carried back to the laboratory immediately, and permanent slides were made that day. If the cambial zone was damaged too much a new sample was taken that day. The staining technique is included below. With this technique, permanent slides can be had 20 to 30 minutes after reaching the laboratory with the samples. This is particularly important if the samples are damaged, for enough time is left to take a new sample.

Cut on sliding microtome in 50% alcohol and place sections on microscope slide.
Fix in FAA (2 to 5 minutes).
Rinse once in 50% alcohol.
Safranin O after Johansen (1940) (2 to 6 minutes).
Rinse in 50%, 70%, 95%, and 100% alcohol.
Fast green (10 seconds) (0.5gm. fast green, 125cc xylene, 125cc methyl salicylate, and 250cc 100% alcohol).
Rinse out excess fast green with mixture of ½ methyl salicylate and ½ 100% alcohol.
Rinse in xylene.
Mount.

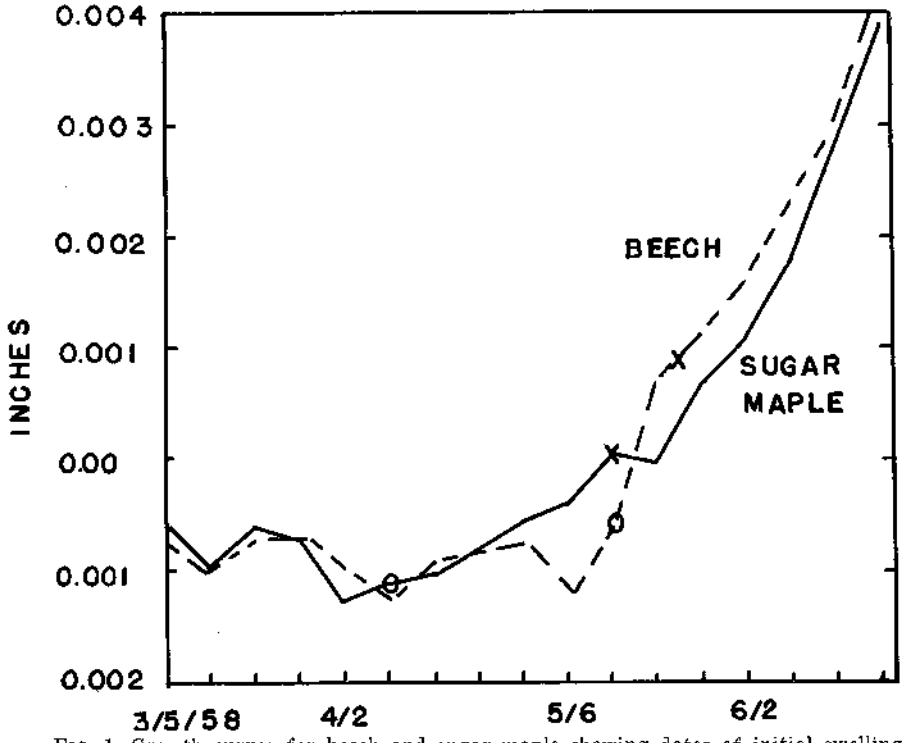

FIG. 1. Growth curves for beech and sugar maple showing dates of initial swelling (circles) and dates of actual cambial inception (crosses). Inches refer to change in radius.

All steps from fixation to mounting are easily done with the sections on the microscope slide to be used for the permanent slide.

The results of the preliminary survey are summarized in Figure 1. The time difference between the date of initial swelling and the date of cambial inception is 35 days in

sugar maple and 10 days in beech. Fraser (1956) found a difference of 14 days between initial swelling and cell division in sugar maple and 13 days in beech.

If the date of radial enlargement in sugar maple is considered with respect to the fall or winter maximum (3/19), then the date of radial increase would change from 4/9 to 4/30 (Figure 1). If 4/30 is considered the true date of radial enlargement then 14 days elapse between radial enlargement and cambial inception. This is in accord with Fraser.

These differences between date of swelling and date of actual cell division are of a large magnitude. If specific environmental conditions controlling growth initiation are being sought, the time of initial swelling and the time of cambial inception must be investigated more closely.

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Supplementary Notes on Cynanchum, Elscholtzia and Other Local Plants

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A question sometimes occurs as to what happens to an adventive plant after it has been first duly recorded for a locality. Does it persist? Is it discovered elsewhere? Is there a sequel to the published report? Is anyone, besides the author, really interested? The following notes are on several weeds that were reported recently from New York.

Cynanchum medium (6). The species was reported by me from Westchester and the Bronx in New York and York County in Pennsylvania; I suggested that, although confused with *C. nigrum*, it is nearest related with *C. Vincetoxicum* (*C. officinale*). I received a letter dated July 15, 1957, from Dr. R. J. Moore, Botanst, Cytogenetics, Dept. Agr. Sci. Serv., Bot. & Plant Pathology Lab., Ottawa, Canada:

"I was interested in your recent paper 'Cynanchum in The New York Area'. A species of *Cynanchum* has been growing as an escape about the Dominion Arboretum and adjacent areas for at least the past 25 years. We have been calling it *C. nigrum*, although we are aware that it does not fit this species well.

"I am sending you a specimen and would appreciate your opinion as to whether this is the *C. medium* which you have found in your area. There is, of course, no need to return the specimen.

"I have found that the chromosome number of our plant is $2n = 22$. This count differs from the counts reported by Pardi—*C. nigrum* $2n = 44$, *C. officinale* $2n = 22$. This disagreement has strengthened our doubts regarding the identity of the plant."

The species proved to be identical with the one I had reported. Dr. Moore wrote further (July 29, 1957):

"The oldest specimen of this *Cynanchum* that we have was collected in 1899 at 'Toronto Junction' (Mrs. A. G. White—Sept. 21, 1899). This collection is probably on the