351). A few stumps of eastern white pine have been observed to callus over and increase in diameter (George S. Perry. Personal correspondence, 1939). Hemlock stumps will increase in diameter due to root graft unions with standing trees (O'Neil, *op. cit.*). A report cited by Priestley (*op. cit.*) states that a larch stump in a beech forest grew in diameter though no other larches were present. Stumps of many dicotyledons but few conifers produce shoots, and these appear at different levels on the stump. Most of the shoots from a stump are considered to have traces that extend to the pith. This view seems untenable to me, however, since (*Science*, October 4, 1946, p. 329) many shoots arise below the root collar, and error is possible with regard to the first few annual rings. Many factors of the environment are able to induce the formation of adventitious buds.

The reasons for the differences in behavior between stumps are obscure. Such factors as water supply, temperature, food reserves, responses to wounding, and the activation of buds of standing trees have been studied. Similar work is necessary with respect to activities in stumps.

A number of facts are known. Some of the stumps that increase in diameter have root graft unions with standing trees. Buds remain viable in stumps for varying periods of time. Diameter growth of the stump and the emergence of shoots from it indicate that the conditions favorable for meristem maintenance (and probably initiation as well) are present. It is obvious, therefore, that enough food and moisture are available and that a stimulus to bud and cambial activity appears.

The cambial stimulus is a process, not yet understood, that results in the initiation of cambial activity. In a standing tree the impulse to renewed cambial activity begins in the swelling foliar initials and then proceeds in a downward course to and into the roots, where such activity is sluggish and perhaps continuous (J. H. Priestley and Lorna I. Scott. *An introduction to botany.* New York: Longmans, Green, 1938; J. H. Priestley. *New Phytol.*, 1930, 29, 316–351). It probably does not enter the stumps across the root graft unions because the normal course in the tree is downward. Nutrient solutes available in the spring may be the cambial stimulus (Priestley and Scott's *An introduction to botany*; J. H. Priestley. *Forestry*, 1935, 9, 84–95). Contrary to the belief of many investigators that hormone action is the stimulus, it is suggested (*Forestry*, 1935, 9, 84–95) that solutes released in sieve tube differentiation during the spring are the cambial stimulus. There is also a suggestion (O. F. Curtis. *The translocation of solutes in plants.* New York: McGraw-Hill, 1935) that food solute movement and an electrical gradient are parts of the complex. It seems to me that there might be a condition that is something like after-ripening of seeds, with fluctuating temperatures, simulating seed stratification, entering into the situation.

Such fluctuation may lead to enzyme activity and make food reserves soluble in the swelling foliar initials, differentiating dividing tissue beneath quiescent growing points, and (in secondary tissue) in the phloem parenchyma and xylem ray parenchyma. This situation appears first in the buds because the diameter there is small. The process would follow a downward course through the shoots and the bole in the direction of increasing diameter. Such changes would lead to sieve tube differentiation in the phloem parenchyma, followed by cell division in the growing points and cambium, and the production and differentiation of primary tissue beneath the shoot apices. Solutes from the parenchyma elements, and finally from differentiating vascular elements, would lead to the nourishment of buds and an increasing expanse of cambium until all the elements in all the meristems are engaged in cell division. This basipetal progression of solute availability, begun by fluctuating temperature and governed by diameter, is the cambial stimulus.

Given a stimulus that begins and behaves in this manner, such an appearance should be equally possible in both standing trees and stumps. Only moisture, stored foods, and fluctuating temperature would be needed. A multiple of buds would not be necessary. The speed of the stimulus in ring-porous trees would seem to be too great for a downward movement of hormones. It is, more likely, a downward development of transverse availability of solutes, perhaps influenced by delaying action effects of bark of increasing thickness in a proximal direction. The effect of disbudding in delaying the downward spread of cambial activity would in consequence have to be within the realm of some other condition than hormone action—and what that is I do not know. Perhaps it may be interference with hydrostatic units that have to begin somewhere in a meristem terminal. The fact remains that stumps are known to increase in diameter. It is also certainly reasonable to believe that solute formation that is incidental to temperature would take place in regions of small diameter sooner, but would nourish cambium equally well anywhere.

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Courses on the Biochemistry of Cancer

In a recent announcement of a course on the Biochemistry of Cancer to be given this summer at the University of California (*Science*, February 6, p. 137) it was stated that it would be the first of its kind offered in a U. S. university. J. Murray Luck, professor of biochemistry at Stanford University, in a Letter to the Editor, comments that ". . . Stanford University already offers a course of lectures on the 'Biochemistry of Cancer.' Dr. Clark Griffin is the instructor, the present enrollment is 40, at has been in progress since January 7, and will be repeated annually." H. P. Rusch, director of the McArdle Memorial Laboratory for Cancer Research, University of Wisconsin, writes: "A course in Experimental Oncology emphasizing biochemical aspects is now a part of the official curriculum. . . . It is being given during the present semester by the faculty of the McArdle Memorial Laboratory for Cancer Research. Twenty-one graduate students are enrolled."