

## THE PERICYCLE IN THE ROOT OF EQUISETUM.

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The researches of Van Tieghem (1) on the root of *Equisetum* led him to conclude that a pericycle is entirely absent. Campbell (2) is of the same opinion. Both of these investigators state that the endodermis is two cells in thickness but that the outer cell develops characteristic Casparian thickenings. But the so-called inner endodermis resembles a pericycle in appearance and position, gives rise to secondary roots and is continuous with the pericycle of the stem. Its origin is definitely cortical as Van Tieghem and Campbell have shown and this appears to be the only reason for not giving it the name of pericycle. Their interpretation satisfies the definition that the endodermis is the innermost layer of the cortex but is inconsistent in that the pericycle of the stem is then continuous with the endodermis of the root. Just where the stem pericycle ends and the inner endodermis of the root begins becomes a purely arbitrary statement.

Recent investigations on the origin of tissues have shown that in some cases it is impossible to consider the endodermis as the innermost layer of the cortex and the pericycle as the outer boundary of the stele. Chang (3) working on *Pteris aquillina* and Conard (4) on *Dicksonia punctilobus* have found that the endodermis is stelar. Schoute (5) and Barratt (6) on *Hippuris* and Johnson (7) on *Equisetum scirpoides* have shown that not only the endodermis but from one to several layers of the cortex as well is of stelar origin. The morphologist now may take one of two courses, either recognize the tissues in question solely on their morphological and physiological differentiation or entirely on their origin. It is the latter criterion which has largely been used in the past.

If, in the root of *Equisetum*, the pericycle is to be eliminated on the grounds that it is cortical in origin, then, the endodermis is most certainly lacking in the rhizome of *Pteris aquilina* and *Dicksonia punctilobus*. In fact one is not only obliged to consider the endodermis as absent but must also regard the outer layer of the pericycle as developing Casparian thickenings. In the stem of *Hippuris* and *Equisetum* the situation is even more confusing because there the stele is terminated by a layer of cells usually regarded as cortex but which may now be called pericycle. The presence of a layer of cells with Casparian thickenings just inside the pericycle (should it be given that name) is difficult to explain.

Thus, it seems unwise to classify tissues solely on their origin, especially when so many variations are coming to light in recent research. The other alternative is to consider morphological and physiological differentiation as the criterion for classifying tissues regard-

less of their origin. If this is done the difficulties which arise when the endodermis is considered as the innermost layer of the cortex and the pericycle as the outer boundary of the stele are avoided. Therefore, it seems wise to apply the term pericycle to the so-called inner endodermis in the root of *Equisetum*. By so doing the terminology of the tissues of the root is harmonized with that of the stem.

#### LITERATURE CITED.

1. Van Tieghem, Ph., Sur la limit du cylinder central et de l'ecore dans le Cryptogames Vasculaires. Jour. de Bot. II:369. 1888.
2. Campbell, D. H., Mosses and Ferns. 3rd. ed. N. Y. 1918.
3. Chang, C. Y., Origin and development of tissues in rhizome of *Pteris aquilina*. Bot. Gaz. 83:288-306.
4. Conard, H. S., The structure and history of the hayscented fern. Carnegie Inst. Washington, 1908.
5. Barratt, Kate, The origin of the endodermis in the stem of *Hippuris*. Ann. Bot. 30:91-99. 1916.
6. Schoute, J. C., Die Stelär Theorie. Groningen, 1902.
7. Johnson, M. A., Unpublished work.