crushed parenchyma. This structure continued unchanged for a distance of more than an inch down the root, and there was no sign within that distance of the isolated ring fusing with the ring of endodermis enclosing the vascular cylinder. The root in which this structure occurred was abruptly twisted and bent, and this fact may possibly be in some way correlated with the appearance of the endodermis.

The chief points of interest to be noted in this anomalous structure are :—

First, the occurrence of such an anomaly in roots, which generally show great uniformity in their structure.

And secondly, the absence of all vascular tissue inside the abnormal endodermis, just as Pfitzer found to be the case occasionally in *Equisetum hyemale*¹.

In view of the great stress which has been laid by Van Tieghem and others, in connexion with the stelar theory, on the endodermis as a layer of tissue of great morphological value, the first point is of especial interest, for the structure which is of critical importance in the stelar theory is thus proved to be capable of considerable variation even in the same plant.

The second point is of interest as illustrating an additional instance of the possible existence of a complete independence between the endodermis and all vascular tissue ; i. e. the endodermis can be fully developed without any reference to the vascular tissue with which it is so generally associated.

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THE ANATOMICAL STRUCTURE OF BOWENIA SPEC-TABILIS, Hook.—Having through the kindness of the authorities of the Royal Gardens, Kew, obtained some seedlings of *Bowenia*, and having proceeded to examine their anatomical structure, I discovered the following characters in the vegetative axis.

In the extremely short young *stem* the central cylinder contains about three stout bundles consisting of a great deal of secondary tissue, and a large amount of parenchyma. Leaf-trace bundles occur

¹ Pfitzer, Ueber die Schutzscheide der deutschen Equisetaceen, Pringsh. Jahrb. f. wiss. Bot. vi, 1867, p. 320.

in the cortex. Lower down, just *beyond* the transitional region between stem and root, and where root-structure already prevails, the central stele is of considerable width, and the constituent bundles farther apart, owing to the expansion of the parenchymatous tissues. The large bundles composing the secondary tissues of the stele are now in places connected by delicate, few-layered bands of secondary vascular tissue, whose course is rather difficult to follow.

So far the structure is normal enough. But outside the central normal stele are seen, in transverse section, other strands which, there can be no doubt, represent the extrafascicular vascular tissue of *Cycas*, *Macrozamia*, and *Encephalartos*. Now this extrafascicular vascular tissue, which, at this youthful stage, only occurs outside a small part of the circumference of the central stele, has this peculiarity: that it consists of two distinct parts, viz. an outermost normally orientated and an *innermost band whose parts are abnormally, i. e. inversely orientated*, with the xylem directed outwards and the phloem inwards. Of these two well-marked portions of the extrafascicular tissue, the inner—or that with inverted orientation—is, at this stage of the plant's life-history, the best developed of the two. Both portions, in accordance with the youthful age of the plant, are as yet in a very rudimentary stage of development, the xylem and phloem being in fact but just sufficiently advanced in differentiation for the determination of the above salient characters.

The above structure I regard as homologous with, although a slight modification of, that described by Gregg in the root of *Cycas Seemannii*, Al. Br., and by myself in the root of *Cycas revoluta*, Thunb., and the stem of *Macrozamia Fraseri*, Miq.

It appears to me, moreover, to distinctly support the view put forward in the paper dealing with the latter plant, that the vascular tissues (at least, the extrafascicular zones) are derived by modification from those of plants like the Medulloseae, which normally possess vascular strands, each of which exhibits the mutually-inverted portions above described.

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A NEW CARDIOCARPON-BEARING STROBILUS.—The writers have latterly each met with specimens of *Cardiocarpon*, as figured by the late Professor Williamson and other authors, but attached to a central axis in a strobiloid form (resembling a *Lepido-*

Worsdell, Wilson Crosfield. 1900. "The anatomical structure of *Bowenia spectabilis*." *Annals of botany* 14, 159–160.

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