The structure of the 'stele,' as seen in transverse section, is singularly uniform in essential histological details throughout the group. It may be said to be of the Fern type, but there is no endodermis (i.e. in the case of well-grown plants), and the pericycle is not characteristically present.

The protoxylem is usually endarch—at any rate in the frond—but it may be mesarch.

The protophloem is internal. This was first demonstrated in the steles of the stem by Miss Shove¹. It has since been found to be internal in the steles of the frond of two species of *Danaea* and of *Marattia alata*. There can be little doubt that the internal position of the protophloem is general for the steles of both stem and frond in this group of Ferns.

3. Apical growth.

All the fresh evidence obtained while studying the seedlings of *Danaea simplicifolia* is in favour of an initial group, consisting of a few cells, both in stem and root.

4. Roots.

Nothing new has been observed in the roots of the Marattiaceae. In the roots of *Danaea simplicifolia* there is what might be called a fibrous pith, which is early differentiated, even before the main mass of the xylem has begun to be lignified.

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THE ANATOMY AND DEVELOPMENT OF THE STEM IN THE PTERIDOPHYTA AND GYMNOSPERMS².—Comparatively little attention has been directed to the subject of the development of the stem. This research concerns itself chiefly with the development of the cauline fibro-vascular skeleton, since this appears to be most interesting from the phylogenetic and morphological standpoints. A study of numerous examples drawn from the main groups of the Pteridophyta and Gymnosperms has led to the conclusion that the polystelic type of Van Tieghem does not originate, as he states, by the repeated bifurcation of the epicotyledonary central

¹ Annals of Botany, vol. xiv, 1900, p. 497.

² Abstract, republished from the Proceedings of the Royal Society, vol. lxi, 1901.

cylinder; but that the latter becomes at first a concentric fibro-vascular tube (*Bündelrohr* of De Bary), with gaps for the branches alone, or with gaps for both leaves and branches.

The tubular nature of the central cylinder in the polystelic type may become subsequently disguised by the overlapping of the gaps and by the appearance of medullary strands, derived in all the cases investigated by the writer from the inner wall of the stelar tube. It seems better to describe these conditions as adelosiphonic instead of polystelic, since the latter term implies a misconception.

In the Osmundaceae the writer believes he has found evidence of the derivation of the medullated monostelic and astelic types from the siphonostelic condition with internal phloem by the degeneration of the latter.

Osmunda cinnamomea shows all stages between the polystelic and astelic conditions; *O. regalis* still retains occasionally a brown sclerenchymatous pith, while in *O. claytoniana* this phenomenon is quite absent. Similar examples of degeneracy are found among the Polypodiaceae. Potonié further believes that the so-called medullated monostelic central cylinder of the Gymnosperms is derived by degeneracy of the internal phloem from such types as *Medullosa*. The writer considers that there is good evidence for regarding the so-called medullated monostelic type of central cylinder as derived by specialization, accompanied by degeneracy, from the so-called polystelic type of Van Tieghem, and thus returns to the conception of the morphology of fibro-vascular strands set forth in De Bary's 'Comparative Anatomy.'

The study of the development of the fibro-vascular skeleton of the higher plants seems to lead to the conclusion that this is hardly less important phylogenetically than the osseous skeleton has proved to be in the case of vertebrated animals. Where the tubular central cylinder exists there are two main types, the phyllosiphonic, where foliar gaps are constantly present, and the cladosiphonic, where foliar gaps are equally constantly absent. The central cylinder of the Filicales, Gymnosperms, and Angiosperms belongs to the former type, and that of the Lycopodiales and Equisetales to the latter. These distinctions appear to be of special importance, on account of the absence of constant and far-reaching criteria of taxonomy among the vascular plants. They moreover agree closely with evidence drawn from other available sources.

The writer is of opinion that there are two great primitive stocks of vascular plants, the Lycopsidea and Pteropsida. The Lycopsidea include the Lycopodiales and Equisetales, and are palingenetically microphyllous and cladosiphonic. The Pteropsida include the Filicales and Phaenogams, which are primitively megaphyllous and phyllosiphonic.

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