solenostele, causing it to project somewhat towards the centre of the stem.

A similar marginal enlargement also occurs in *D. adiantoides*; and here it is continued past the leaf-gap, forming a ridge on the internal surface of the solenostele, running from one leaf-gap margin to another. In the internode this projecting portion of the xylem becomes separated off from the rest and surrounded by a phloem of its own; however, it remains always included within the same endodermis.

In *Dicksonia rubiginosa* the typical vascular ring is interrupted by gaps other than those due to the leaf-traces, and it may therefore be termed polystelic. In addition there are two or three small accessory steles lying within the vascular ring. Throughout the internode the course of these internal steles is quite free from the vascular ring, but at each node one of them approaches the free margin of the leaf-gap, and completely fuses with it, separating off again after the leaf-gap has become filled up.

Pteris elata, var. *Karsteniana*, has a typically solenostelic vascular ring, and also possesses internal accessory steles, which behave in a manner quite similar to those of *Dicksonia rubiginosa*; but they are relatively larger, and frequently they all fuse up together so as to form a second, inner, completely closed vascular ring.

It is suggested that the several internal steles and vascular rings that occur in the *Saccolomas* and in *Matonia pectinata* are also of the same origin and nature as those described above.

The relation of the internal accessory steles in certain *Cyatheas* to those of the above-mentioned Ferns is also discussed.

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ON THE ANATOMY OF DANAEA AND OTHER MARATTIACEAE¹.—Various species of the Marattiaceae were studied for the comparative anatomy of the adult structure, and *Danaea simplicifolia*, Rudge, for the development of the vascular system.

1. Development of the vascular system of *Danaea simplicifolia*.

The primary vascular axis is a simple concentric stele. The xylem

¹ Abstract of paper read before the Botanical Section of the British Association, Glasgow, September, 1901.

consists of a central mass of small scalariform tracheids, without any conjunctive parenchyma. The phloem consists of a layer of small sieve-tubes separated from the xylem by a layer of parenchyma. The pericycle may be absent or only imperfectly represented. There is a definite endodermis, but the constituent cells are not clearly always the innermost ones of the extrastelar parenchyma.

When the cotyledon-trace is about to be given off, the xylem of this vascular axis, or 'protostele,' is separated into more or less unequal portions by a layer of parenchyma. The parenchyma increases in amount, and ultimately the cotyledon-trace is separated from the central stele. The cotyledon-trace is collateral. The next few leaf-traces are given off in the same manner, and are likewise collateral. The stele resumes its simple 'protostelic' appearance. Cauline roots occur, but not regularly.

As further leaf-traces depart from, and root-traces join the vascular axis, the primitive structure is gradually modified, and it may become more or less crescentic, forming an incomplete, or even complete, gamostelic ring. The spaces left by the departure of the leaf-traces now constitute leaf-gaps. The vascular tissue of this stage may be described as a 'siphonostele with leaf-gaps.'

The time of appearance of the first mucilage-canal varies. The earliest occurrence noted was after the third leaf-trace had been differentiated.

In one seedling a curious ligament of phloem was observed, which pursued an oblique course upwards and connected the two horns of a crescentic vascular mass. This strand of phloem interrupted the course of the central mucilage-canal.

At first the leaf-traces are simple and collateral; later they are simple and concentric; still later each trace divides into a pair of strands as it recedes from the axis. At a higher level the leaf-trace consists of a pair of strands, each of which takes its departure separately.

A remarkable deviation in the early stages of development was shown by one seedling. A mass of parenchyma early made its appearance in the centre of the xylem, simulating a pith. Careful examination showed that this was due to abortion of the cotyledon and its trace, and exceptionally early preparation for the departure of the three succeeding leaf-traces.

2. Stele of the Marattiaceae.

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.

Brebner, George. 1901. "On the anatomy of Danaea and other Marattiaceae." *Annals of botany* 15, 777-779.

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