carbohydrates (polysaccharides) which are levorotatory, and which, on treatment with an acid, hydrolyse to fructose solely or at any rate in the main.

Leclerc du Sablon does not mention submitting the solution of the carbohydrate he extracted from the bulb to the polarimeter, which is the simplest and most satisfactory method of distinguishing between dextrin and inulin.

As far as investigations have gone, the inulins of plants can be arranged in three classes:

- (1) That found in the Compositae and allied orders, which is precipitated in the tissues by alcohol in the form of the well-known spherocrystals, and which is practically insoluble in cold water, requiring a temperature of 50° to 55° for its solution.
- (2) That characteristic of many Monocotyledons, e. g. *Scilla*, *Yucca*, *Phleum*, and the plant now before us; it is precipitated in an amorphous form, in the tissues, as a thick lining to the inside of the cell-wall and is readily soluble in cold water.
- (3) That found in the bulb-scales of species of *Galanthus* and *Leucojum*, which is precipitated in the tissues in an amorphous form, and which requires a temperature as high as 80° for its solution¹.

On the other reserve-organs mentioned by Leclerc du Sablon as containing dextrin, I have not much to say. Only one of them, *Asphodel*, have I asserted to contain inulin, as does likewise *Chevastelon*, and in all probability it does store an inulin similar in kind to that of the *Hyacinth*. In my paper the bulbs of *Lilium* and *Tulipa* are mentioned, among others, as not responding to the inulin tests, and so it is quite possible that the carbohydrate obtained from these by Leclerc du Sablon is dextrin in nature.

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December, 1899.

FORMATION OF AN IRREGULAR ENDODERMIS IN THE ROOTS OF RUSCUS sp.—The root in which this irregular structure occurred was quite young, only a few xylem-elements in each group being lignified. As the sketch shows, there were fourteen

¹ Fischer, H., Cohn's Beiträge zur Biologie der Pflanzen, 1898, Bd. viii, Heft 1, pp. 89, 101, 102. Ehrhardt, Abstract Bot. Centralb., 1894, Bd. lx, p. 207. Parkin, loc. cit., pp. 59 and 64.

protoxylem- and phloem-groups. The vascular cylinder was entirely enclosed by the endodermis in the normal way, but in one place a cell of the endodermis was joined by its uncuticularised tangential wall to a complete ring of endodermis external to the central cylinder. No

Fig. 8.

Fig. 9.

Fig. 8. Diagram illustrating the general arrangements of tissues in the transverse section of the root of *Ruscus* sp. Fig. 9. Part of the above more magnified to show the endodermis.

End., endodermis; *end. ext.*, isolated ring of (abnormal) endodermis; *cr. par.*, crushed parenchyma; *ph.*, phloem; *p. xy.*, protoxylem.

vascular tissue of any kind was present within this ring, the elements consisting entirely of crushed parenchyma.

Further out in the cortex and on the opposite side of the root, a small isolated ring of endodermis was present, and this also enclosed

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.

Lewis, F. J. 1900. "Formation of the irregular endodermis in the roots of *Ruscus*, sp." *Annals of botany* 14, 157–159.

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