NOTE.

SPORE-FORMATION AND KARYOKINESIS IN HEPATICAÆ.—In pursuing a series of investigations on spore-formation in the Hepaticae, I find the existence of a quadripolar spindle in the early stages of the division of the spore-mother-cell to be a more widely spread occurrence than I had previously supposed when writing on *Pallavicinia*¹.

Two species of *Fossombronina* exhibit this curious spindle in a marked degree. The first sign of the division of the nucleus of the cell in question does not occur until the latter has assumed the lobed character which is common to the *Jungermannia*-series of Liverworts. The initial phase of mitosis is marked by the appearance, on the periphery of the nucleus, of four beautiful centrospheres with their attendant radiations. Thus a four-armed spindle arises. But the division of the nucleus is not a simultaneous partition into four daughter-nuclei; *two* daughter-nuclei are first formed, and each of these again divides once more. Essentially the same process takes place in *Aneura*. In *Pellia* a well-marked cell-wall is formed during the first of the two mitoses, but otherwise there is a substantial agreement between the three forms just mentioned.

In those *foliose* Jungermannieae in which I have succeeded in following out the details of spore-formation, I have seen a quadripolar spindle in a few instances; a normal double division in any case takes place. There exists a considerable range of variation amongst the various forms, as to the degree of rapidity with which the two mitoses follow on each other.

In the alliances of the Marchantieae and Riccieae, the form of division of the spore-mother-cells differs considerably from the corresponding process in those Jungermannieae, both foliose and frondose, which I have examined. The cell never becomes four-lobed, and a rapid

¹ Annals of Botany, Vol. ix, p. 35, 1894.

double division of the nucleus occurs within it, with no attendant formation of cell-walls. The four nuclei which have arisen in this way take up equidistant points near the periphery, and a tetrahedral division of the entire cell then occurs. The original spherical (*Riccia*, *Riella*, *Targionia*, *Marchantia*, *Plagiochasma*) or flattened (*Fegatella*) contour of the spore-mother-cell is retained until the spores separate.

There are two specially important features which are characteristic of the karyokinesis of the spore-mother-cell. First, that the number of chromosomes is in every case reduced to one half, as compared with the antecedent mitoses in the sporophyte; and that this reduced number is thenceforth retained in at any rate all those mitoses in the gametophyte which I have been able to feel confident about. Secondly, that the mitosis resulting in the formation of the spores differs from all the archesporial and vegetative mitoses in its character, and conforms to that type which Flemming distinguished as 'Heterotypic.'

A third feature of some interest, and which in practice is specially noticeable, is that, just at the period of the spore-formation, it becomes exceedingly difficult to fix the cells without contraction. This is the more remarkable, since the nuclei which may happen to be dividing in either earlier or in later stages, present not the slightest difficulty. Moreover the cytoplasm also stains deeply with most nuclear stains, and everything points to the conclusion that there is something going on in the cell during this so-called 'reduction-division,' which is not met with at any other period, whether in resting or dividing cells.

The above points are only intended to indicate the general results at present obtained during these researches. The details, together with a general discussion on them, will shortly be published *in extenso* in this periodical.

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