but from the study and comparison of organisms which are believed to be nearer to the border line between Bryophyta and Vascular plants, viz. the *Homosporous Pteridophyta*.

F. O. BOWER, Glasgow.

PRELIMINARY STATEMENT ON THE SORUS OF DANAEA¹. The sorus of *Danaea*, though its structure in the mature state has been repeatedly described, has not yet been studied as regards its development.

The oblong, cake-like sori lie parallel to one another on the lower surface of the leaf, their longer axes following the course of the vascular bundles. Each sorus consists of two rows of loculi, of approximately equal size, completely sunk in the rather massive tissue of the wall. Dehiscence is described as being by a pore at the apex of each loculus.

The sporogenous tissue of each loculus is usually referable to the segmentation of a single superficial cell, which gives rise to it, and to the portion of the sporangial wall above it. There is, however, great variety of bulk, number of cells, and mode of segmentation in adjoining sporangia; though the sporangia of the same sorus develop simultaneously, such extreme differences of number as between four and sixteen cells may be seen in the same section. Moreover, the whole sporogenous group is not always referable to a single parent cell. These facts stand in marked contrast to the uniformity of size and segmentation so characteristic of the Leptosporangiate Ferns.

The dehiscence is by slits, which appear in the sporangial wall above the loculus. By the drying and contraction of the adjoining cells the slit gapes widely, and appears as a pore; but the details are very like those of other Marattiaceae, excepting that there is no 'annulus' of indurated cells. This, which is absent in *Danaea*, where the loculi are deeply sunk, is present in those Marattiaceae in which the sporangia project as separate papillae. In the latter case the annulus is mechanically effective in widening the slit; in the former, the sporangia being closely united, such mechanical effect would be impossible.

Though the loculi of a sorus are frequently of nearly uniform size,

¹ Read before the Royal Society, Dec. 5, 1895: reprinted by permission from Proc. Roy. Soc., No. 354, Vol. lix.

examples may often be found where they vary to an extreme degree; and these have an important bearing upon the theory of septation; for cases of incomplete septation are often to be recognized in the mature sorus, while the study of earlier stages has revealed almost all imaginable steps between the single loculus and two loculi lying side by side as an obvious pair. Such pairs of loculi are common; sometimes the septum between them is of the average thickness; sometimes thin, but still complete, with firm, permanent tissue continuous across it; sometimes the permanent tissue is incomplete, and the septum composed in its middle part only of tapetum, which disappears at maturity; sometimes a large loculus will be seen with only slight encroachments of tapetum upon the sporogenous group, thus indicating the position, though not realizing the complete development of a possible septum; the last step of the series would be simply a loculus larger than the average, and these are common.

An analytical study of the tissues shows that the tissue of these partial septa may have either of two sources of origin: (1) single cells of the sporogenous group are liable to development as sterile cells; this has been seen in sporangia which even approach the normal; (2) the surrounding tissue may encroach on the sporogenous group, in the form of tapetal cells, which, when their development is considerable, is followed by cells of permanent tissue of the wall; in these cases the partial septa will be clearly seen in the mature state.

The similarity between these results and what is known in the case of septate anthers of Angiosperms is of peculiar interest; in these anthers partial septa are common, and a detailed comparison of them with those of *Danaea* suggests that the phenomena are closely alike. But, in the case of the Angiospermic anthers, we conclude, on comparative grounds, that progressive septation has taken place; this would indirectly support the view that the sorus of *Danaea* is also a result of progressive septation.

Obviously such a series of stages as that presented by *Danaea* may be read either way, and it would be possible to urge that in them we have evidence, not of progressive septation, but of fusion of loculi. This question must be considered on grounds of general probability. Without at the moment declaring a final opinion (though I think the probability is largely in favour of a view of progressive septation), this point, at least, seems clear: *that in Danaea the identity of the sporangium or loculus is not strictly defined.* To arrive at this point is,

in my opinion, a matter of some importance; the study of the sporangium in Pteridophyta has long been based upon the examination of the highly specialized and strictly constructed sporangium of the Leptosporangiateae. The conclusion is, however, becoming obvious that such strictness of construction and regularity of segmentation is exceptional, and that in the Eusporangiateae such strictness is not the rule.

Other Marattiaceae, and especially *Kaulfussia*, have also been examined, and they are all found to conform to one fundamental type, though differing in detail; it appears that, as regards the sorus, *Danaea* is the least specialized, and *Angiopteris* the most specialized, of the living genera, and that they form a very natural series. Such a series in plants of so antique a stock deserves the most careful comparative study, and the results should carry unusual weight.

F. O. BOWER, Glasgow.

DIRECT NUCLEAR DIVISION IN THE EMBRYO-SAC OF LILIUM MARTAGON.—In the course of some work on the nuclear divisions immediately preceding the formation of the ovum in *Lilium Martagon*, I have observed the interesting fact that the two lower antipodal nuclei appear to be regularly formed by a process of direct division.

The primary nucleus of the embryo-sac divides by the indirect method, and the daughter-nuclei divide again after a very short period of rest. These divisions have been frequently figured as typical examples of karyokinesis. The four nuclei thus formed remain in the resting condition for some time, during which the embryo-sac increases greatly in length. At first the resting nuclei are all alike, in spite of the curious difference in the number of chromosomes which go to build up the micropylar and chalazal pair respectively (Guignard, *Nouvelles Études sur la Fécondation*, p. 187). But towards the end of this resting period the nuclei are differentiated in pairs. At the micropylar end the two nuclei have increased little in size since their formation. They are usually rather egg-shaped, and are separated from the chalazal nuclei by a vacuole which occupies the centre of the embryo-sac. The two chalazal nuclei have grown a good deal: the upper one is usually somewhat flattened, and the lower one of rather irregular outline, fitting neatly into the pointed chalazal end of the embryo-sac.

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