

corneum, Lam., or *G. cartilagineum*, Gaill. Semper thinks that the sponge in this case 'may with some probability be included in the family of the Chalinae.'

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PRELIMINARY NOTE ON THE MORPHOLOGY AND DEVELOPMENT OF ISOËTES LACUSTRIS, LINN.—The genus *Isoëtes* has always been an object of interest to botanists ever since Hofmeister's brilliant researches on the vascular cryptogams, but the accounts given by the different observers on the development and organogeny of the sporophyte are so conflicting, and moreover our knowledge of the sexual generation is so limited, that a renewed investigation of the whole subject seems desirable. In the present communication I propose to summarise, as briefly as possible, the more important of my own observations on one species, *I. lacustris*, to which my attention has been directed for some time past. I intend to deal here only with the germination of the macrospore, and to reserve details of minor significance, as well as all account of the sporophyte, for treatment in a future paper, as this part of the subject requires critical discussion.

The shape of each macrospore is, as is well known, that of a tetrahedron with somewhat rounded sides, and the protoplasmic contents are enclosed in a number of coats which in mature specimens are differentiated into six layers. Peripherally is the episporium, a colourless, glassy, and brittle layer, whose surface is beset with numerous irregular prominences. The episporium which is derived from the epiplasm of the sporangium stains with haematoxylin, though only to a slight extent. Within this outer layer is the exosporium, consisting of three brown cuticularised layers, but of which the two outer ones are frequently not easily distinguishable as separate coats. The two innermost membranes are cellulosic in character and form the endosporium.

The protoplasm which is contained in the spore includes a large quantity of reserve-material consisting of starch and oil, the latter being, however, eliminated during the process of soaking in turpentine to which the spores are subjected previously to their being embedded in paraffin. A number of sections through each spore were obtained by means of the Cambridge rocking microtome, and were arranged in series, thus permitting of an examination of the internal structure of

the spores. The protoplasm, which is remarkably granular, is of a spongy texture (probably due to the extraction of the oil), and contains a nucleus of very large size in which bodies resembling nucleoli were in some cases detected. The nucleus is sharply marked off from the cytoplasm by a membrane, but it must be borne in mind that this feature may be due in part to the methods used in embedding. When spores are examined in this stage the protoplasm stains but slightly with haematoxylin, and the tint is inclined to red, even the nucleus not being deeply coloured. In somewhat older spores, at the period immediately preceding germination, the whole protoplasm stains far more readily and deeply, but a nucleus is no longer differentiated by staining, and the colour now produced is of a deep blue. As I have frequently had spores of different ages on the same slide, all of which were subjected to exactly similar treatment, this difference probably indicates an actual diffusion of the substance of the nucleus through the cytoplasm, since the change is always so prominent in spores in the condition referred to.

This view receives some confirmation from the circumstances attending the formation of the prothallium, now to be described. The first indication of cell-division occurs in a somewhat peculiar manner, but its significance is rendered clear by what takes place subsequently. Before entering upon a description of what actually happens, it may be well, in order to avoid misconstruction, to state expressly the opinion that the characters presented are rendered visible only by the action of the means necessarily employed in embedding. This does not, however, vitiate the conclusion that they may be taken as indications of internal changes which actually occur in the protoplasm. In spores, in which cell-formation is about to commence, the deeply stained protoplasm is seen to be traversed by a few 'cracks' which divide the contents of the spore into a few large isolated masses. Although the surfaces of the protoplasmic masses which abut on the 'cracks' possess a granular structure, there is nothing as yet which points to the definite existence of a cell-wall separating them from each other; at a subsequent period, however, the spaces ('cracks') are seen to be traversed here and there by membranes of extreme tenuity, which are also in contact with the protoplasm in numerous places. These membranes are formed in the spore between originally confluent masses of protoplasm, and the splitting is produced artificially as above referred to. The young cell-wall, very soon after its appearance, grows

in thickness, and is very easily recognised; but from the mode of its formation it can hardly arise otherwise than by the conversion of a layer, already present in the protoplasm, directly into cellulose, and it appears to be the presence of this substance, arranged in a definite plate-like manner, which determines the splitting referred to. The first membrane cuts the spore into an apical and a basal portion, and while the latter for some time undergoes no further change, the apical cell is divided almost simultaneously into a number of cells whose arrangement can still be followed even in quite old prothallia. When the first primary cells are formed, the nuclei are again distinguishable by haematoxylin, but they are of exceedingly small dimensions; and with this change the staining properties of the protoplasm become less marked. Divisions in all planes proceed very rapidly in the upper portion of the prothallium, and the rudiments of the archegonia are laid down much as in the *Marattiaceae*. Periclinal division of single superficial cells into two takes place, the upper of which gives rise to the neck, and by repeated division forms four stories, each story being divided into four cells arranged like quadrants of a cylinder. The lower cell gives rise to the central series, in which a neck canal-cell is cut off, and then a ventral canal-cell, from the oosphere. It can now be seen that the canal-cells thrust themselves between the neck-cells, and produce a distortion in the two lower stories so great that in some cases these are not easily recognisable in later stages.

While these changes have been taking place in the upper of the two primary cells, the basal one is dividing, but comparatively slowly, and it is easily distinguishable in that the cells which arise from it remain of a large size as compared with those formed in the upper part of the prothallium.

In spite of repeated search through a great number of preparations, it has not been found hitherto possible to arrive at a definite conclusion as to the mode of cell-division which prevails in the secondary stage, for no karyokinetic figures could be detected; nevertheless it is highly probable that the process does not differ in any important respect from that prevailing in other plants, and the arrangement of the nuclei about the walls of recently formed cells makes this supposition almost a certainty.

I have purposely omitted any reference to the researches of other observers in the present note, and it was not my object to attempt

a complete account of my own work, which is still in progress, but the results given above appear of sufficient interest to justify the appearance of this note.

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ON A NEW FORM OF TRAPELLA SINENSIS.—Since the account of the new Chinese genus *Trapella* appeared (ANNALS OF BOTANY, Vol. II (1888), p. 75) further specimens have been forwarded by Dr. Henry from Ichang. The specimens in question, which are dried, show an apparently unbranched, erect-growing, dwarf plant, which there is no reason to suppose is other than a terrestrial form of *T. sinensis*. The plant grows in amongst the rice-stalks in the locality where the aquatic form was taken. Its general configuration would point to the plant being a reduced form of the aquatic species, adapted to land habit. The leaves are smaller and of one shape, and the fruits are borne in the leaf-axils. The plant does not exceed 10 cm. in height. Dr. Henry was never able to find it in flower, and an examination of this material points to a cleistogamic production of all the fruits. It will be remembered that, in the aquatic form, all the fruits developing in the axils of *submerged* leaves are so produced. It is possible some difficulty attends the pollination by insects of normally expanded flowers, growing, as the plant does, crowded in between the bases of the rice-stalks. As to histological differentiation, such examination, as was possible, of the dried specimens, shows a retention of the aquatic type of central bundle-cylinder, with however a more powerfully developed xylem—there being several rings of vessels—than in the described form. For the present this form may be regarded as being derived from the normal aquatic type, recalling a comparable state of things in the genus *Myriophyllum*. Should Dr. Henry be able to send spirit-material of this plant it should furnish the basis of a supplementary paper on this singular genus. During the past summer, however (1888), no specimens of *Trapella* were observed, either in the rice-fields or in the ponds. The season was a very dry one, and the pond in which *Trapella* previously occurred was dried up.

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