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LANTZIUS-BENINGA, G. B. S. (1847). Beiträge zur Kenntniss des inneren Baues der ausgewachsenen Mooskapsel, insbesondere des Peristomes. *Botanische Zeitung* 5(2): 17-22, Tab. 1.

[original page 17]

**Contributions to the knowledge of the inner structure  
of the mature moss capsule, especially of the peristome**

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Table I.

The results of a series of examinations of the structure of the mature, not yet disintegrated moss capsule, especially in relation to the structure of the peristome which I had the occasion to execute this summer are presented here as a provisional excerpt; I hope to be able to present a more detailed description soon.

On the construction of the capsule in general I found not much remarkable. Hedwig at first distinguished the columella, and the inner and the outer capsule membrane; between the inner capsule membrane and the columella should be located the spores.

In my dissertation in the year 1844 (*De evolutione sporidiorum in capsulis muscorum*. Göttingae 1844. 4.) I said already, that I cannot take as natural such a separation and the designation of the inner parts of the moss capsule. At that time I made the suggestion that the inner capsule membrane and the two outer cell layers of the columella which, not only enclose the spore space and seem to be important for the support of the mother cells and for the forming of the spores, but also because the cells by their shape and content differ from all the other capsule cells, may be considered as a peculiar inner organ of the moss capsule. I have drawn the attention to the fact that in several species of *Polytrichum* this organ, along its entire length, [original page 18] is separated from the outer capsule membrane as well as of the columella and is connected with it only in the upper and lower parts of the capsule. At present, having examined many more moss capsules, I cannot but repeat this suggestion, in which I will use provisionally the name spore sac, however in a different sense to that of Bruch and Schimper. (The authors Bruch and Schimper inappropriately designate by the name spore sac Hedwig's *membrana capsulae interior*.)

All the mosses which I could examine agree essentially, so far, in that which concerns the construction of the lower and median parts of the capsule. More interesting is the upper part, beginning at the upper border of the spore sac, which after the operculum has detached, reveals the orifice of the capsule with the peristome.

Mosses without peristomes have in this part an absolutely uniform cell tissue showing nothing unusually remarkable. Worthy of mention is *Sphagnum* with the peculiarity that it has no separation of the spore sac from the outer capsule membrane and that the columella (at least from all the examinations I made) does not reach to the point of the operculum but is standing freely in the middle of the capsule like a pillar, being completely surrounded with spores at the sides and above.

Of the mosses with a single peristome the genus *Tetraphis* is already correctly described and depicted by Bruch and Schimper. In this case the outermost cell layer of the epidermis detaches as the operculum, the cell tissue remaining splits into four parts, and thus forms the four peristome teeth. [original page 19] Totally different are the other mosses with a single peristome. The base of it appears, in the upper part of the capsule, at about the same height as the annulus or at the place where the operculum detaches (somewhat below the middle), more or less in the centre of the capsule (one, two, or three cell layers of the epidermis), a circle or a real wall of sixteen or, sometimes by a further cell building, thirty-two relatively big cells, the membranes of them possessing a more or less strong partial thickening (see the given drawings at pp.). In the lower part of the peristome this thickening is from time to time nearly regular, normally, however, already here at the capsule wall, on the inner-side of the capsule, these cells are stronger (see Fig. 3, x); in the cells of the same layer, situated nearer to the capsule point, the thickening is usually already partial and also on the wall facing to the centre of the capsule (see Fig. 3, y. The drawing is made from a section somewhat oblique from below to above). It forms the peristome. On the thickened spots of the lower cells the next layer of upper cells are always arranged so that they form a cord, a pillar of thickenings (see Fig. 1 pp.); if a cell has only one thickened cord then the peristome has sixteen teeth, if each big cell has two thickened cords then the peristome has thirty-two teeth (see Fig. 2. *Anacalypta rubella* with sixteen, Fig. 3, and 4, *Barbula fallax* with thirty-two teeth). In *Dicranum*, at the base of the peristome about half way up, in not yet dehisced capsules, a broad thickened stripe is seen which separates into two cords higher up (the reason for the division of the peristome teeth), thus the transverse section of the uppermost part of the capsule has the same appearance as the section of the point of a capsule of a *Barbula*- or a *Trichostomum*-species.

At the detachment of the operculum its inner cell tissue and also the membranes of the sixteen big cells tear, only the thickened cords remain upright as free pillars, as peristome teeth. [original page 20] I have especially noticed that at the same time as the membranes of the sixteen big cells (I will name them peristome cells), the neighbouring cells (t. t. Fig. 2, 3, 4) bordering the inner-side are thickened at the same place, thus each thickened cord or each peristome tooth consists of two halves, one orientated towards the inner-side, the other one to the outer-side, resulting in the interpretation that the teeth e.g. of *Barbula* would consist of a double layer of cells (in this case the thickened cords would be taken as being complete cells).

The indication of Bruch and Schimper that *Trichostomum* is distinguished from *Barbula* by the fact that the peristome of *Trichostomum* consists of one cell layer only and that of *Barbula* of two layers, is incorrect. The peristome teeth of *Trichostomum* are built as those of *Barbula* but they are more delicate and the both halves separate more easily.

Very similar is the construction of the capsule with a double peristome. It differs from that described above only by the fact that the membrane of the sixteen or thirty-two peristome cells, orientated to the outer side of the capsule, is very strongly thickened (mostly stronger than the wall orientated towards the inner side); the membranes of the outer-side of the cells, as in *Hypnum*, *Bryum* and other mosses with a similar peristome, participate in the thickening process. At the disintegration of the capsule the cell tissue as well as the horizontal and the

lateral membranes of the peristome cells are torn, and therefore the outer and the inner thickened cords remain as the outer and the inner peristome. The longitudinal and horizontal lines are the remains of the separating walls of the neighbouring cells, and the fine lines and spots are the remains of a granular, rough, thickened layer which covers the surface of most of the peristomes. In general these spots are spread out fairly regularly so that they appear as stripy or even as spirals by a weak magnification.

Noticeable is the position of the layer of the peristome cells in relation to the spore sac and the outer capsule wall (inner and outer capsule membrane), namely immediately above the gap, the air space, which is between these two organs. It follows clearly that it is once and for all out of the question whether the peristome arises from [original page 21] "the inner or the outer capsule membrane" (see Fig. 1 and 5, v.p.p.).

Isolated is *Polytrichum*, the peristome teeth of it consist of bundles of horseshoe-like thick-walled fibre cells bent upwards, a structure correctly described also by Bruch and Schimper. In mosses of this section appear a "epiphragma", constructed at the place where the operculum detaches. Immediately at the peristome cells, and partly grown together with them, a layer of cells runs to the centre of the capsule, their lower membranes thickened and roughly granular. After the detaching of the operculum besides the peristome teeth, these thickened membranes remain as a connected skin (epiphragm) whilst the other tissue totally or partly tears off and disappears.

### Explanation of the illustrations

Fig. 1. Depiction of a part of a longitudinal section of a mature capsule of *Anacalypta rubella* Hübn. (*Weissia recurvirostra*) ee. epidermis, a. annulus, v. empty space between outer capsule membrane and spore sac, s. inner space of the spore sac, rr. cell layer bordering the layer of the peristome cells to the outer side, pp. peristome cells, tt. cell layer close to the centre of the capsule, cc. centre of the capsule. The peristome is built here by the partial thickening of the connecting membranes of the cell layers pp. and tt. Magnification approximately 250x.

Fig. 2. Part of a transverse section of a capsule of the same moss. Meaning of the letters and magnification as for the previous figure.

Fig. 3. Part of a transverse section of a capsule of *Barbula tortuosa* not yet completely grown, cut slightly obliquely from below to above. Part x the lower one, part y. the upper one. Here is to be seen, that the thickening of the membranes of the cell layers pp. and tt. becomes entirely partial above. Meaning of the other letters and magnification as above.

Fig. 4. Part of a transverse section of a completely grown capsule of *Barbula reflexa*. In the thickening cords of the membranes situated between pp. and tt., the peristome teeth, which are here relatively very strong, are visible the separating lines of the different thickened layers. Meaning of the letters as above, magnification approximately 500x.

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Fig. 5. Part of a longitudinal section of a capsule of *Hypnum sylvaticum*. At the place where in the previous figures a strong thickening between the cell layers pp. and tt. is visible, is here a weak one, the inner peristome; on the other hand relatively very strong is the thickening of the membranes between pp. and rr., forming the outer peristome. Meaning of the letters as above, magnification 250x.

Fig. 6. Part of a transverse section of a similar capsule; here the reason for the pleats of the inner peristome is visible (between pp. and tt.). Meaning of the letters and magnification as above.

The examinations are executed with an instrument von Schiek with a magnification 700x.



