

ART. XXXIII.—*Studies in the Cyperaceæ*; by THEO. HOLM.

VI. *Dichromena leucocephala* Vahl, and *D. latifolia* Baldw.

THE genus *Dichromena* was established by Michaux (l. c. xiii) upon the plant which he named *D. leucocephala*, on account of the snow-white inflorescence, while the generic name, derived from $\delta\acute{\iota}\varsigma$ and $\chi\rho\acute{\omega}\mu\alpha$, should merely refer to the partly discolored involucre. No other name could be more suitable for this singular species, but our plant has, nevertheless, met with the same fate as so many of the other North American plants, viz: to get its name changed and to become confounded with totally different species. Professor N. L. Britton, for instance, changed its name to *Dichromena cephalotes*, while Professor A. S. Hitchcock (l. c. ii) suggested the name *D. colorata*, since he thought that Linnæus had this plant before him when he described his *Schænus coloratus* (l. c. vii). It is not, however, likely that this last change of name will hold good either, for two reasons: first, that Linnæus would hardly have called our discolored *Dichromena* "colored;" and second, because the Linnean diagnosis does not prove that these two plants are really the same.

In regard to the specific name "coloratus," Linnæus did not use this term for discolored organs, but he used "*variegatus*," for instance (l. c. v) "*Arundo indica variegata*," "*Gramen paniculatum aqu. phalaridis sem. folio variegato*," and "*Agri-folium foliis ex albo variegatis*," which plants exhibit the same discoloration as our *Dichromena*. Furthermore, in his *Philosophia botanica* (l. c. ix) Linnæus employed the terms "albicans" and "palescens" for such organs as are whitish or pale green, viz: "*Abrotanum cauliculis albicantibus*," etc., besides that he named a species of *Schænus* "*niveus*" (l. c. x) in contrast to his *Schænus* "*coloratus*"! These two species are now generally recognized as *Kyllinga triceps* and *K. monocephala*, of which the first one is described by Kunth (l. c. iv) with "*squamis hyalino-albidis*" (*niveus*), while the other species, *K. monocephala*, has the same organs "*purpureo-punctulatis*" (*coloratus*).

There are, furthermore, if we examine the diagnosis of *Schænus coloratus*, some points which seem to show that Linnæus did not intend to describe our *Dichromena*; he says, as follows: "*Schænus coloratus*, culmo triquetro, capitulo subrotundo, involuero longissimo plano variegato." This last character may suit very well for a *Dichromena*, although the involucre of some species of *Kyllinga* is known, also, to show a

similar discoloration. But the very long involucre ("involucro longissimo") does not fit as well for a *Dichromena* as for a *Kyllinga*, and our *K. monocephala* has, as we remember, the involucreal leaves very long, much longer than in any species of *Dichromena*. The character "capitulum subrotundum" is, also, without doubt meant for the *Kyllinga*, since Linnæus would surely not have overlooked the several spikes in *Dichromena* with the flowers and bracts almost "biseriate." We really feel assured that if Linnæus had seen our *Dichromena*, he would rather have referred it to *Cyperus*, on account of its biseriate bracts, etc. It is, furthermore, difficult to detect any organ in *Dichromena* which Linnæus observed to be so conspicuous in order to name the species "*coloratus*." The inflorescence of *Dichromena leucocephala* is, as its name indicates, snow-white, while that of *Kyllinga* is purplish-dotted.

The later editors of Linnæus' works, for instance Murray (l. c. xii), refer *Schænus coloratus* and *S. niveus* respectively to *K. monocephala* and *K. triceps*, and Giseke (l. c. x), in accordance with Rottbøll (l. c. xiv), makes the following statement: "*Kyllinga* Rottbølli adeo similis est *Schæno*, ut duæ ejus species a Linnæo patre sub illo comprehensæ fuerint, nomine '*colorati et nivei*' quæ jam *Kyllinga monocephala* et *triceps* vocantur." Finally, Willdenow (l. c. xi) reached to the same conclusion as Giseke and Rottbøll, and it must be noted that this author, Willdenow, states that he had seen specimens of *Kyllinga monocephala*, a fact that perhaps will be sufficient to decide the identity of the *Schænus* with the *Kyllinga*, instead of with our *Dichromena*.

In considering now our plants, they are of a very singular aspect with their partly discolored involucre and white spikes, but an examination of the details will soon show that our plants are not different in any essential particular from most of the other genera of the *Scirpeæ*. The genus *Dichromena*, for instance, has three characters in common with *Cyperus*, viz: the almost biseriately arranged bracts and flowers, the lack of bristles, and finally the development of one of the internodes of the stem into a long scape with the bracts and inflorescences crowded at the apex. But it is at the same time readily distinguished from *Cyperus* by the achene, which in *Dichromena* is crowned with the persistent base of the style.

Let us pass to examine the internal structure of our plants, beginning with the species *leucocephala*. This species shows the general features, which are known to be characteristic of the *Cyperaceæ*, besides that there are a few points in which it seems to differ from all the others which, so far, have been examined. The stem-leaf has a long flat blade, which is perfectly smooth like the other parts of the plant, and green

in contrast to the partly discolored involueral leaves. The epidermis of the upper face consists of very large cells, which cover the entire surface, excepting near the margins, where a relatively large group of stereome is located, above which the epidermis-cells have become very small. The upper face of

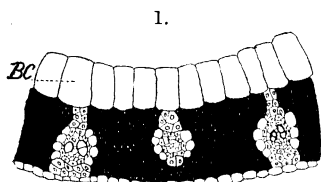


FIG. 1. Transverse section of the leaf of *D. leucocephala*.
B. C. the bulliform-cells. 75 × natural size.

the blade is thus covered with bulliform-cells, in which respect our plant reminds us somewhat of *Cyperus fuscus*, which has been described and figured by Duval-Jouve (l. c. i). The cells of the epidermis of the lower surface are much smaller, and their walls are slightly undulate; we find, also, here the internal cones, which seem to be constantly developed in the epidermis, which covers the stereome. Stomata are to be observed on this, the lower surface; they are not very prominent, and they form longitudinal bands underneath the mesophyll. This last tissue occupies a very large part of the blade and consists of rather closely packed palisade-cells on the lower surface, while it shows a more open tissue on the upper face, just underneath the bulliform-cells. We notice, therefore, that the palisade-tissue and the stomata are exclusively restricted to the lower face of the leaf-blade, a fact which seems due to the extraordinary development of the upper epidermis. The palisade-cells are mostly arranged vertically upon the leaf-surface, but we have, also, observed an approximately radial arrangement around the mestome-bundles. The cells of the mesophyll near the upper surface are polyhedric and leave room for numerous, but small, intercellular spaces. While only a few cells of the lower epidermis contained tannin, the mesophyll was observed to possess quite a number of such reservoirs. Very distinct and well differentiated from the mesophyll is the colorless parenchyma-sheath, which borders on the mestome-bundles and partly surrounds these. We have seen from previous studies that this parenchyma-sheath is generally interrupted by the stereome in the large mestome-bundles, while it forms a closed ring around the smallest ones, which as a rule are not in contact with the hypodermal groups of stereome. *Dichromena* forms, however, an exception to this rule, since, as we shall see later, the colorless parenchyma-sheath does not surround even the smallest mestome-bundles, but is, also, here interrupted by small stereome-elements, widely separated from the epidermis of both faces of the leaf-blade. Inside the colorless parenchyma-sheath is the usual mestome-sheath, which is here

composed of equally thickened cells, those on the leptome-side being smaller and with narrower lumen than the others. The mestome-bundles seem to represent three different forms in the leaf of *Dichromena*, but not so much in regard to the

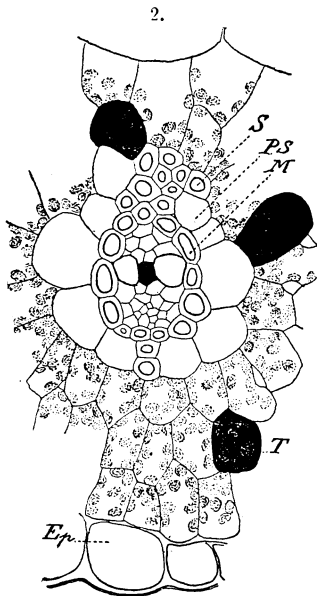


FIG. 2. Transverse section of a mestome-bundle from the leaf-blade. *Ep*, the lower epidermis; *S*, stereome; *PS*, parenchyma-sheath; *M*, mestome-sheath; *T*, tannin reservoir, indicated with black in four cells of the section. 400 × natural size.

development of the leptome and the hadrome as in regard to the difference in their mechanical support. The largest bundles have the leptome and hadrome well developed and not separated from each other by thick-walled mestome-parenchyma; these bundles are supported by large groups of stereome on both faces, both groups extending from the corresponding epidermis. The mestome-bundles, which may be designated as those of second degree, have, also, a well differentiated leptome and hadrome, besides two groups of stereome, but this tissue does not here extend to the epidermis of the lower face. The smallest bundles contain mostly leptome, and their mechanical support consists only of a few stereome-cells on both faces of the bundle, thus interrupting the parenchyma-sheath, but without coming in contact with the epidermis. The general distribution of the stereome has, thus, already been indicated, and it may

be added that no isolated groups

of this tissue were observed in the leaf of our plant, not even in the margin, where, although present, the stereome was in connection with a small mestome-bundle. The leaf of *Dichromena* shows, therefore, a rather firm structure in regard to the dense mass of mesophyll, which is entirely destitute of any openings large enough to be designated as lacunes. It has, also, been stated that tannin was observed in the epidermis, and quite abundantly in the mesophyll, besides that it was, also, traced in the hadrome of most of the mestome-bundles.

If we now examine the leaves of the involucre, we find a very singular structure, corresponding to that which Lagerheim (l. c. iv) has observed in *D. ciliata* Vahl from Ecuador. The discolored part, the base of the involucre, has the epidermis of the upper face developed as a stratum of large papillose

cells, while the lower epidermis consists of somewhat smaller cells. The mesophyll is in this part of the involucre composed of rather long, loosely connected cells, all destitute of chlorophyll, giving the leaf the peculiar white aspect in contrast to the upper part, in which the mesophyll is of usual structure and well provided with chlorophyll. The mestome-bundles are small, but represent, nevertheless, the same forms as we have described as characteristic of the proper leaves; cells containing tannin were observed in the mesophyll and in the hadrome. Stomata were observed, but confined to the lower surface of the green part of the involucre.

As to the aerial stem: this is perfectly smooth, terete, slightly furrowed and hollow. It contains a bark rich in chlorophyll and composed of about eight layers of very regularly arranged palisade-cells, which are closely packed, except underneath the stomata, which are well represented in the epidermis. The palisade-tissue does not form closed rings in the

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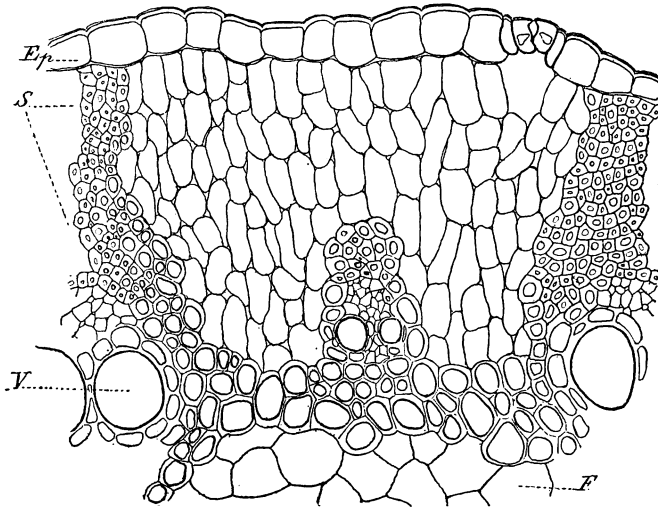


FIG. 3. Transverse section of the stem of *D. leucocephala*. *Ep*, Epidermis; *S*, Stereome; *V*, vessels; *F*, fundamental tissue. 320 × natural size.

stem, but is interrupted by the stereome which support the mestome-bundles. There are three concentric bands of mestome-bundles in the stem, and they are very regularly arranged and represent three degrees of development. Those of the outer- and inner-most band show exactly the same development in regard to the mestome; the leptome and hadrome are very

highly developed, but there is a difference in regard to their mechanical support. Those of the outer band have a large group of stereome all around the bundle, and especially on the leptome side from where the stereome extends outwards to the epidermis. The mestome-bundles of the innermost band are but a few in number and their mechanical support is very insignificant, there being only a few stereomatic cells on the leptome- and the hadrome-side of these bundles. The third form of mestome-bundles are in regular alternation with those of the outer band; they are very small, round and are merely supported by a small group of mechanical tissue on the leptome-side, which group is widely separated from the epidermis by the bark-parenchyma. The leptome and hadrome are, however, well differentiated in these small bundles. (Compare figure 3.)

In considering now the stereome, this forms, as already stated, groups of various strength for the support of the mestome-bundles, and it forms besides an uninterrupted ring inside the two outer bands of mestome-bundles, thus encircling those of the inner band. The innermost part of the stem is occupied by a fundamental tissue, which is composed of large, thin-walled cells, bordering on the rather wide central cavity. Tannin-reservoirs were only observed very scarce in the stem, and they seemed to be confined to the bark, besides that one cell of the hadrome between the two large vessels in all the mestome-bundles was observed to contain this matter.

The rhizome of our species is well developed, creeping and of a comparatively firm structure. It contains a huge bark-parenchyma of roundish cells, which forms a circle all around the central-cylinder. Very conspicuous are the numerous tannin-reservoirs, which abound in the bark, increasing in size towards the epidermis. While no typical endodermis is differentiated, there is, however, a closed ring of stereomatic tissue, just inside the bark, but the cells of this stereome are rather open and with thin walls. It surrounds the entire system of mestome-bundles irregularly scattered in the fundamental tissue, and it is, also, represented as supporting groups on both faces of the mestome-bundles, especially on the innermost face of these. There are two distinct forms of mestome-bundles observable, viz: the ordinary collateral and the so-called concentric, the last of which occur here as perihadromatic; these two forms do not, however, show any special arrangement, but are to be observed scattered among each other. We stated above, that tannin-reservoirs were abundant in the bark; they are again to be observed in the fundamental tissue, where they are quite numerous, besides in the stereome and the

hadrome of nearly all the mestome-bundles. The rhizome shows thus a dense and solid structure with no trace of lacunes or even ducts, the cells of the bark-parenchyma leaving only very narrow intercellular-spaces.

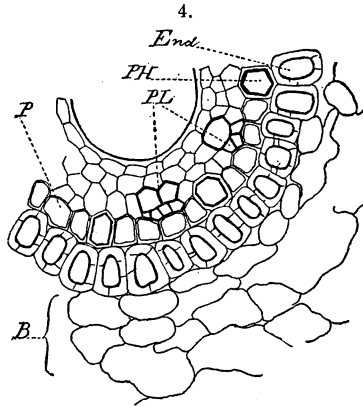


FIG. 4. Transverse section of a root. B, the bark-parenchyma. End, Endodermis; P, Pericambium; PL, Protoliptome; PH, Protohadrome. 400 × natural size.

The root shows a very simple structure, which agrees in all respects with that of the *Cyperaceæ* in general. The epidermis becomes thrown off by age, but is then substituted by a thick-walled hypoderm, which surrounds the very open bark - parenchyma, showing numerous lacunes, which have arisen by the tangential collapsing of the bark-cells. The innermost bark is differentiated as a very thick-walled and porous endodermis (End in figure 4) which surrounds the pericambium; this last is as usual in the *Cyperaceæ* (with the only exception of *Carex Fraseri*, so far as is known) interrupted by elements of protohadrome, which therefore lie close

up towards the endodermis. In alternation with the protohadrome are to be observed small groups of protoliptome, while the center of the root is occupied by a huge vessel, surrounded by a few layers of conjunctive tissue.

This is the general structure of *Dichromena leucocephala*, and if we now institute a comparison of these structures with the corresponding organs of *D. latifolia*, we may be somewhat surprised to find exact uniformity rather than any differences. Both plants have long been unanimously recognized as distinct species, although the differentiation seems to have been based on so slight a character as "the tubercle of the achene being decurrent down the margins." This character did not, however, seem sufficient to Kunth for separating them as two species, and he therefore did not accept the species *latifolia* without a certain reservation and doubt: "*Dichromenæ leucocephalæ* affinis, sed major. Mihi adhuc dubia."

A comparison of their structural characters may simply be expressed in this way, that the mechanical tissue is somewhat more strongly developed in *D. latifolia*, but otherwise no difference was to be detected. That this uniformity in anatomical structure, as observed in the most important organs of the

plants, should be considered sufficient to unite these supposed species is more than probable. There seems always, even in closely related species, to be at least a few distinct anatomical characters to be observed, which in connection with similar morphological ones may prove the species to be valid; but we have, so far, been unable to trace any such divergences as warrant the separation of *Dichromena latifolia* Baldw. from *D. leucocephala* Vahl.

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