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Notes on the North American species of *Plagiochila*.

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WITH PLATES XV AND XVI.

Only two species of *Plagiochila* are attributed to our limits in the first part of the *Synopsis Hepaticarum*, published in 1844, and the first of these two, *P. porelloides*, must be considered a form of the second, *P. asplenoides*. Three years afterwards, in the supplement to the same work, five additional species are given: one of these, *P. interrupta*, is here reported from Greenland alone; three of the others are species which Sullivant had described the year before and one of these, *P. macrostoma*, must be regarded as a synonym of *P. interrupta*; while the fifth species, *P. nodosa* Tayl., likewise published in 1846, is one of the many forms of *P. asplenoides*. Only four valid species, therefore, are left to our credit:—*P. asplenoides*, *P. interrupta*, and Sullivant's two species, *P. undata* and *P. Ludoviciana*.

A fifth species, *P. spinulosa*, is described in Sullivant's "*Musci and Hepaticæ of the United States*," published in 1856, but the specimens from which the description is drawn are very different from the true *P. spinulosa* (Dicks.) Dum. and form the type of a new species. In Dr. Millspaugh's recent "*Flora of West Virginia*," a sixth species is added, and this, together with the two described in the present paper, increases the total number of our species to eight. It is probable that others remain undetected, particularly in our southern and western states.

The *Plagiochilæ* so rarely produce organs of fructification that it is usually necessary to depend upon purely vegetative characters in distinguishing the species. The method of branching, the shape and arrangement of the leaves, the peculiarities of their margins and of their cells are all of

extreme importance in this respect. The underleaves, on the contrary, are of less value than in most hepatic genera. They are present, occasionally at least, in all our species, but they are, in most cases, minute structures deeply split into slender hair-like divisions and at first sight bear much resemblance to clusters of rhizoids. A closer inspection, however, will show that their laciniae are multicellular and that they proceed from a basilar membrane one or more cells in height. The cells of which these underleaves are composed are not like ordinary leaf-cells; they are smaller and have much more delicate walls; but, in two of our species, peculiar, more distinctive underleaves with leaf-like texture are sometimes produced, and these will be especially noted. In the following key, none except vegetative characters are considered.

Key to the species.

- Stems creeping and radiculose; leaves not decurrent. 1. *P. interrupta*.
 Stems ascending from a rooting caudex, normally non-radiculose; leaves more or less decurrent.
 Leaves rarely reflexed at the postical base, not forming crest-like lines parallel to the stem.
 Margins of leaves either entire or denticulate, the teeth exceeding ten in number. 2. *P. asplenioides*.
 Margins of leaves dentate, the teeth not exceeding ten in number.
 Length of leaves averaging less than twice their width.
 Teeth arising from a broad base; leaf-cells large. 3. *P. Columbiana*.
 Teeth arising from a narrow base; leaf-cells small. 4. *P. Virginica*.
 Length of leaves averaging more than twice their width.
 Leaves obliquely spreading, forming an angle of 40° - 45° with the stem, scarcely narrowed at the base. 5. *P. Floridana*.
 Leaves widely spreading, forming an angle of 55° - 70° with the stem, distinctly narrowed at the base. 6. *P. Sullivantii*.
 Leaves reflexed at the postical base, forming two crest-like lines parallel to the stem.
 Postical margin of leaves plane and dentate beyond the reflexed base. 7. *P. Ludoviciana*.
 Postical margin of leaves repand-undulate beyond the reflexed base. 8. *P. undata*.

1. *PLAGIOCHILA INTERRUPTA* (Nees) Dum. Rev. Jung. 15. 1835.

P. macrostoma Sull. Musci Alleg. n. 221.

P. interrupta differs from all our other species in several important respects. As a result of its prostrate habit, its leaves spread horizontally and are almost flat, so that the plant has much the appearance of a *Chiloscyphus*, while in its inflorescence it is autoicous and not dioicous as in typical *Plagiochilæ*. Lindberg considered these differences sufficient to separate it from the rest of the genus, at first as a subgenus,¹ but afterwards as a distinct genus to which he gave the name of *Pedinophyllum*.² This genus is maintained by Schiffner,³ but, as Spruce⁴ points out, the characters assigned to it are scarcely of generic value, though it might be well to consider them of subgeneric. Lindberg himself had little faith in its validity; four years after its publication, he placed *P. interrupta* in Mitten's genus *Leptoscyphus*.⁵

Plagiochila macrostoma was first definitely referred to *P. interrupta* by Austin,⁶ though even Sullivant had doubted the permanence of his species. His specimens were found on old logs and on shaded banks instead of on calcareous rocks where *P. interrupta* usually grows in Europe, but they agree pretty closely with European specimens. The principal difference which he gives, the presence of underleaves, does not hold, as these bodies may also be found on European plants. The species has not been collected recently in the United States.

2. *PLAGIOCHILA ASPLENIOIDES* (L.) Dum. Rev. Jung. 14. 1835.

P. porelloides (Torr.) Lindenb. Spec. Hepat. 61. pl. 12.

P. nodosa Tayl. Lond. Journ. Bot. 5: 268. 1846.

P. asplenoides is very widely distributed in northern latitudes, being found in Europe, Asia and America; it grows on stones in brooks, on rocks dampened by the spray of waterfalls, on the ground in woods, on shaded rocks and banks, and at the base of trees; and its stems are either loosely massed together or scattered among other bryophytes. Specimens vary greatly in size, in the position of their leaves, and

¹Not. Soc. pro F. et Fl. Fenn. 13: 366. 1874.

²Cf. Acta Soc. Sci. Fenn. 10: 504. 1875.

³Engler-Prantl, Die natürlichen Pflanzenfamilien 91: 89. 1893.

⁴Hep. Amaz. et And. 452. 1885.

⁵Musci Scand. 4. 1879.

⁶Bull. Torr. Bot. Club 6: 85. 1876.

in the character of their leaf-margins; but the various forms may be at once distinguished from *P. interrupta* by their ascending habit, and from all our other species by their rotund or broadly ovate leaves with rounded apex. The leaves may be distant or imbricated, nearly plane or strikingly convex, obliquely spreading or deflexed, and their margins are entire, subentire or denticulate; in fact, several of these variations are often found on a single stem, the tendency in such a case being for the leaves to become more crowded and more toothed as the apex of the stem is approached.

The American forms with entire or subentire leaves were long ago separated from typical denticulate-leaved forms as a distinct species, *P. porelloides*. We find the first description of this plant (as *Fungermannia porelloides* Torrey) in the classical "Naturgeschichte der europäischen Lebermoose" of Nees von Esenbeck, who had examined sterile specimens collected in New York. After comparing it with his *Fungermannia interrupta*, he states that it is more nearly related to *F. asplenioides*, differing in its "constantly entire, obovate-cuneate leaves with less reflexed dorsal margin." Dumortier does not enumerate it among his species of *Plagiochila*,⁹ but Lindenberg both describes and figures it under this genus; it is also admitted into the Synopsis Hepaticarum, where, although it is placed next to *P. interrupta*, it is said to differ from entire-leaved forms of *P. asplenioides* in the gibbosity of its leaves, no other difference being stated. In all recent works on American hepaticology, *P. porelloides* finds a place and it has also been distributed in several exsiccatae.

As early as 1849, however, Spruce doubted the validity of this species. In his valuable notes on the "Musci and Hepaticæ of the Pyrenees," he writes, "I have seen no specimens of *P. porelloides* which I can safely separate from *P. asplenioides*."¹⁰ Forty years afterwards Lindberg¹¹ reduced *P. porelloides* to a subspecies of *P. asplenioides* giving one European and two Asian stations for the plant, which had heretofore been regarded as peculiarly American. The most important point of distinction which he gives is in the shape of the perianth; in *P. porelloides* this is stated to be "ovate-rectangular, well rounded at the base," while in *P. asplenioides*, it is said

⁹ l: 169. 1833.

¹⁰ Rev. Jung. 14. 1835.

¹¹ Ann. and Mag. Nat. Hist. II. 4: 105. 1849.

¹² Kongl. Sv. Vet. Ak. Hand. 23: 34. 1889.

to be "obconic." I have found that the shape of the perianth depends to a large extent upon the presence or absence of fertilization. In Swedish specimens of *P. asplenoides* collected by Dr. Arnell, some of the perianths with unfertilized archegonia are distinctly rounded at the base, while in specimens of *P. porelloides* collected by Professor Underwood near Syracuse, New York, perianths with mature capsules are narrowed and subterete at the base. It is apparent, therefore, that Lindberg's point of distinction is of little real value. Dr. Schiffner¹² has already reduced *P. porelloides* to a simple synonym of *P. asplenoides*, and there seems to be no reason why we should not follow his example, particularly as forms of this species with entire or subentire leaves have long been recognized in Europe.

3. **Plagiochila Columbiana**, n. sp.—Plate XV. figs. 1–10.

Sterile, brownish or yellowish green, loosely caespitose; stems ascending, simple or pinnately branched, rarely dichotomous, often sparingly radiculose; leaves contiguous or imbricated, widely spreading, broadly orbicular-ovate, antical margin decurrent, revolute, entire or occasionally bearing an acute lobe-like tooth, postical margin rounded at the base, plane or rarely reflexed, entire or irregularly 1- to 3-toothed, apex broadly truncate, usually bearing a few scattered teeth; underleaves either minute and subulate or larger, lanceolate to ovate, acute, entire or irregularly toothed or lobed; leaf-cells polygonal, with thickened walls and prominent trigones.

Stems 1.5 to 3^{cm} long, 0.4^{mm} in diameter; leaves 1.6^{mm} long, 1.1^{mm} wide; leaf-cells from middle of leaf averaging 0.041^{mm} in diameter.

On boulders subject to inundation; Rock Creek, near Washington, D. C., J. M. Holzinger.

In general appearance *P. Columbiana* bears some resemblance to *P. asplenoides*; but, under the microscope, it may be at once distinguished from that species by the ragged outlines of its leaves and by the irregularity in the number and position of their teeth. The latter are frequently wanting in the lower leaves and they are always few in number; as a rule they are short and blunt but they are sometimes longer and become lobe-like in character. The leaf-cells of this species are much larger than those of *P. asplenoides* or of any other of our *Plagiochilæ*. The large underleaves described above

¹² Engler-Prantl, Die natürlichen Pflanzenfamilien 91: 89. 1893.

are quite unlike those commonly found in the genus. In some cases they attain a third the size of the leaves and their cells are very like the ordinary leaf-cells of the species. They are by no means frequent, occurring on about one out of every five stems examined, and it is rare to find more than one or two of them on a stem. When they do occur, however, they are persistent and may be found by the older, as well as by the younger leaves. It is to be hoped that fruiting specimens of *P. Columbiana* may soon be collected, as it would be of interest to learn whether or not these peculiar underleaves take part in the formation of the involucre.

4. *PLAGIOCHILA VIRGINICA* Evans in Millspaugh: Flora of West Virginia 497. *pl.* —. 1892.

Since the publication of this species, I have received from Professor Underwood specimens of the same plant, collected by himself near Washington, D. C., in 1891. They are a little more robust than those collected by Dr. Millspaugh and some of the stems show minute underleaves; otherwise the specimens agree closely.

5. *Plagiochila Floridana*, n. sp.—*Plate XV. figs. 11-17.*

Dioicous; loosely caespitose, yellowish or brownish green; stems simple or dichotomously branched; leaves imbricated, rectangular or ovate-rectangular, slightly convex, obliquely spreading, antical margin decurrent, straight or nearly so, entire, plane or subreflexed at the base, postical margin narrowly and abruptly long-decurrent, straight and parallel to the antical margin, or slightly curved, entire or usually irregularly dentate, apex broad and truncate, either irregularly and deeply spinose-dentate or bifid with a shallow sinus and distant acuminate lobes; leaf-cells polygonal with thickened walls and evident trigones; underleaves minute, subulate; ♀ inflorescence terminal, subtended by one or two innovations; bracts two, oblong, antical margin reflexed, entire in lower part, margins otherwise irregularly spinose; perianth (young) shorter than the bracts, broadly obovate, bilabiate with ciliate lips, wingless or narrowly winged; ♂ inflorescence not seen.

Stems 0.5 to 1.5^{cm} long, 0.12 to 0.25^{mm} in diameter; leaves 1.1^{mm} long, 0.4^{mm} wide; leaf-cells in middle of leaves, averaging 0.023^{mm} in diameter.

Mixed with *Lejeuneæ* on decaying logs; Ocala, Florida, L. M. Underwood. Distributed in Hep. Amer. n. 109 as *P. Ludoviciana*.

This species differs from *P. Ludoviciana* in its smaller size, in its manner of branching, and in the shape of its leaves, which are not widened out and reflexed at the postical base and whose antical margins are not strongly arched. It is near *P. dubia* Lindenb. & Gottsche as figured by Gottsche,¹³ but the leaves are more imbricated and more deeply toothed than he represents and the perianth has longer cilia.

6: *Plagiochila Sullivantii* Gottsche MS.—*Plate XV. figs. 18-21* and *XVI. figs. 1-3*.

P. spinulosa Sull. Musci Alleg. n. 219 [not (Dicks.) Dum.].

Dioicous; growing in depressed tufts, glossy, bright green varying to yellowish green and becoming brownish with age; stems simple or sparingly branched; leaves distant or subimbricated, widely spreading, slightly convex, varying in shape from narrowly ovate to obovate, antical margin slightly decurrent, straight or a little curved, entire, subreflexed towards the base, postical margin short-decurrent, arched, usually entire at the base but soon becoming incised-dentate, apex broad, either coarsely dentate or bifid with pointed, entire or denticulate lobes; leaf-cells polygonal, thin-walled and scarcely thickened at the angles; underleaves minute, split to the base into several capillary lobes.

Stems 0.5 to 1.5^{cm} long, 0.2^{mm} in diameter; leaves 1.2^{mm} long, 0.5^{mm} wide; leaf-cells in middle of leaf 0.019^{mm} in diameter.

Banks of rivulets, Alleghany mountains, Sullivant. On shaded rocks; New Hampshire: White mountains, James; Connecticut: Beacon Falls, Evans; Branford, Eaton; Pennsylvania: Canadensis, Mrs. Britton; North Carolina, in Lindenb. herbarium. Distributed as *P. spinulosa* in Musci Alleg. n. 219, in Hep. Bor.-Amer. n. 9, and in Hep. Amer. n. III.

Some years ago Mr. W. H. Pearson of Manchester, England, expressed the opinion that this species was distinct from the true *P. spinulosa*, and a comparison of the two soon convinced me that such was indeed the case. I had hoped to name the plant in Mr. Pearson's honor, but upon consulting the Gottsche herbarium, I found that it had already been named in manuscript by that author. In addition to the material distributed by Sullivant, Gottsche had examined a specimen from the Lindenberg herbarium (labeled *Fungermannia*

¹³ Mex. Levermosser pl. 2. 1863.

sertularioides Michx.), upon which he had discovered perianths. I have failed to find these organs in any of the material at my disposal, so I add the following description from Gottsche's notes: "perianthio ovato-cylindrico semi exserto non alato, ore rotundo compresso, labiis dentatis; foliis involueralibus conformibus, appressis." Some of our forms differ considerably from Sullivant's specimens, which we must regard as the type of the species; but no good lines of distinction can be drawn between them, as intermediate forms also occur.

The true *P. spinulosa* is a European species occurring in Great Britain and, more sparingly, in the western parts of the continent. It is extremely variable, but its numerous forms all agree in the characters of their leaf-cells, which have thick walls and strongly developed trigones, in marked contrast to the thin-walled cells of *P. Sullivantii*. It also differs from our species in its larger size and in its broadly ovate or obovate leaves, which are strongly arched over the stem at the postical base. Among our own Plagiochilæ, *P. Virginica* and *P. Floridana* bear some resemblance to *P. Sullivantii*. The former differs in its pale, dull color, in its broader leaves with shorter and more inconspicuous teeth and its slightly larger leaf-cells; the latter in the shape of its more obliquely spreading leaves and in its leaf-cells which have thicker walls and better developed trigones.

7. PLAGIOCHILA LUDOVICIANA Sull. Musci Alleg. n. 223. 1845: Amer. Journ. Sci. and Arts II. 1: 73. 1846.—Plate XVI. figs. 4-12.

Stems 2 to 4^{cm} long, 0.2 to 0.3^{mm} in diameter; leaves 2.5^{mm} long, 1.2^{mm} wide; leaf-cells with slightly thickened walls and well developed trigones, in the middle of the leaf averaging 0.029^{mm} in length by 0.021^{mm} in width.

In this species the underleaves are of two forms: in the one, they are of delicate texture and are deeply split into slender laciniae; in the other, they are leaf-like in texture and are either bifid or irregularly cleft with entire or toothed margins. The latter form is apparently confined to robust plants. Sullivant says that the ♀ inflorescence is terminal, but does not describe the floral organs. In the examination of a large number of specimens, I failed to find either kind of inflorescence. Many of the plants examined reproduced themselves vegetatively by means of the propagula, which have been

well described for the genus in general by Spruce.¹⁴ They are minute stems springing from the leaf-cells and bearing distant bifid leaves; in some cases they are very numerous and almost cover the surfaces of the leaves from which they spring. Similar propagula are sometimes found in *P. Florida* and possibly in our other species.

8. *PLAGIOCHILA UNDATA* Sull. Musci Alleg. *n* 222. 1845: Amer. Jour. Sci. and Arts II. 1: 73. 1846.—*Plate XVI. figs. 13-19.*

P. crispata Gottsche? Mex. Levermosser 71. *pl.* 15. 1863.

Stems 2 to 3^{cm} long, 0.2 to 0.3^{mm} in diameter; leaves 1.9^{mm} long, 0.8^{mm} wide; leaf cells with thickened walls and well developed trigones, in the middle of the leaf averaging 0.020^{mm} in diameter.

Like the preceding species, *P. undata* is usually sterile. I have examined a single imperfect perianth from specimens collected by Professor Underwood at Toccoa Falls, Georgia, and append a description of it and its bracts: perianth terminal, subtended by 2 innovations, 2^{mm} long by 2^{mm} wide, flattened, campanulate, bilabiate with ciliate lips; bracts two, 1.7^{mm} long and 2.6^{mm} wide, broadly cuneate, antical margin reflexed, denticulate, postical margin and apex irregularly dentate.

The Mexican *P. crispata* is with some doubt referred to this species. If Gottsche's figures are compared with those of *P. undata*, it will be seen that, although at first sight they are apparently unlike, the differences are of degree, rather than of kind. In *P. crispata*, the leaves are more strongly repand-undulate along the postical margin than in our species. The specimens of *P. undata*, however, which were collected by Rev. A. B. Langlois at Chinchuba, Louisiana, and distributed as no. 152 of "Hepaticæ Americanæ," show both extremes in this regard and seem to break down the distinction between the two species. Both *P. Ludoviciana* and *P. undata* are rather widely distributed in our Gulf states.

In conclusion I would express my thanks to Professor Underwood, who has loaned me his valuable collection of *Plagiochilæ*; to Mr. Pearson, who has given me permission to use his drawing of *P. Sullivantii*; and to Professor Schumann, who has allowed me access to the Gottsche herbarium, now preserved in the Botanical Museum at Berlin.

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¹⁴Hep. Amaz. et And. 452. 1885.

EXPLANATION OF PLATES XV AND XVI.

Plate XV.

Plagiochila Columbiana Evans.—Fig. 1. Plants, natural size.—Fig. 2. Part of stem, antical view ($\times 6$).—Fig. 3. Part of stem, postical view ($\times 6$).—Fig. 4. Underleaf, small, normal form ($\times 32$).—Figs. 5–9. Underleaves, larger form ($\times 12$).—Fig. 10. Cells from middle of leaf ($\times 200$).

Plagiochila Floridana Evans.—Fig. 11. Plant, natural size.—Fig. 12. Part of stem, antical view ($\times 12$).—Fig. 13. Part of stem, postical view ($\times 12$).—Figs. 14, 15. ♀ bracts ($\times 12$).—Fig. 16. Young perianth ($\times 12$).—Fig. 17. Cells from middle of leaf ($\times 200$).

Plagiochila Sullivantii Gottsche.—Fig. 18. Plants, natural size.—Fig. 19. Part of stem, postical view ($\times 12$).—Fig. 20. Part of stem, antical view.—Fig. 21. Cells from middle of leaf ($\times 200$).

Fig. 19, from Musci Alleg. *n.* 219; fig. 20, from Hep. Bor. Amer. *n.* 9, after a drawing by W. H. Pearson; figs. 18 and 21, from Connecticut specimens, collected by the author.

Plate XVI.

Plagiochila Sullivantii Gottsche (cont.).—Figs. 1, 2. Parts of stems, postical view ($\times 12$).—Fig. 3. Underleaf ($\times 32$).

Figs. 1 and 3, from Connecticut specimens, collected by the author; Fig. 2, from Pennsylvania specimens collected by Mrs. Britton.

Plagiochila Ludoviciana Sull.—Fig. 4. Plant, natural size.—Fig. 5. Part of stem, antical view ($\times 12$).—Fig. 6. Part of stem, postical view ($\times 12$).—Fig. 7. Underleaf, small, normal form ($\times 32$).—Figs. 8–10. Underleaves, larger form ($\times 32$).—Fig. 11. Cells from middle of leaf ($\times 200$).—Fig. 12. Part of leaf, showing propagula ($\times 32$).

Figs. 4, 8–11, from Louisiana specimens, collected by Langlois; figs. 5–7, 12, from Florida specimens, collected by Lighthipe.

Plagiochila undata Sull.—Fig. 13. Plant, natural size.—Fig. 14. Part of stem, antical view ($\times 12$).—Fig. 15. Part of stem, postical view ($\times 12$).—Fig. 16. Leaf, postical view ($\times 32$).—Fig. 17. Leaf, lateral view ($\times 32$).—Fig. 18. Underleaf, lateral view ($\times 32$).—Fig. 19. Cells from middle of leaf ($\times 200$). All figures from Hep. Amer. *n.* 108.



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