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POLLINATION OF THE ERICACEAE: IV. LEDUM AND PYROLA

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LEDUM GROENLANDICUM Oeder

LEDUM GROENLANDICUM Oeder, Labrador tea, is occasionally abundant over small areas in damp acid soils in southern Maine. It is an upright evergreen shrub, from 3 to 10 dm. tall, with thick, oblong leaves, strongly revolute at the margins, which are densely rusty-woolly beneath, a provision, according to Kerner, against too rapid transpiration.

The small white flowers, which are slightly aromatic, are in terminal umbel-like clusters of ten to twenty-five flowers each, with two or three clusters at the end of each branch. The flowers are from 1.2 to 1.5 cm. broad. The stamens are usually five alternating with the petals, but frequently there are six, and in one instance there were eight. As *L. palustre* has normally ten stamens, the occurrence of extra stamens opposite the petals in *L. groenlandicum* may be a case of reversion.

The filaments are white, hairy at base, with yellowish anthers which open by terminal pores. The pollen is yellow and in tetrads. In mature buds 5 mm. long (FIG. 1, A) the stamens are 7 to 8 mm. long, their filaments bowed under tension, and spring or move upward when the petals are separated. The anther-pores open in the bud and pollen grains may be observed around these openings and on the stigma with which the anthers are in contact at this stage. It is probable that self-pollination occurs frequently in the bud. The flowers are nearly homogamous though showing a slight tendency to become protandrous.

The green capitate stigma, which bears five very small tubercles, remains persistent after the pollen has been shed. The ovary is likewise green and covered densely with short glandular hairs. Nectar is secreted sparingly by a green disc at the base of the ovary, where it is partially protected by the hairs on the filaments and ovary. It

slowly escapes between the filaments to the base of the petals. In fully expanded flowers (FIG. 1, B) the widely diverging stamens are 7 to 8 mm. long, while the erect style is one to two millimeters shorter. Self-pollination might still occur in lateral flowers, the pedicels of which were not erect.

The nectar is readily accessible to a wide variety of insects. Bumblebees alight directly on the center of the flowers, where their legs and

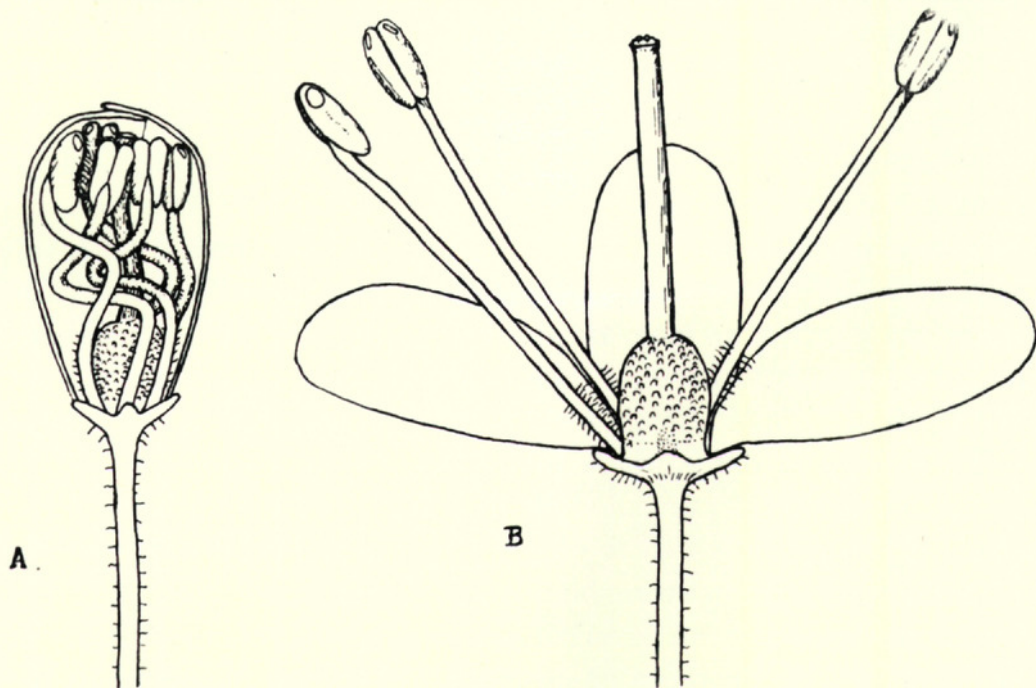


FIG. 1. *LEDUM GROENLANDICUM*: A, section of a mature bud, $\times 8$; B, flower with 2 petals and 2 stamens removed, $\times 8$.

the ventral side of the abdomen come in contact with the anthers, and effect pollination when they visit another flower. A few butterflies, the day-flying moth *Thysbe*, flies and beetles are occasional or rare visitors, but are of little importance as pollinators. We have been unable to verify Warming's statement that the flowers are occasionally anemophilous.¹

The following insects were collected on the flowers from June 14th to July 1st at Waldoboro.

APOIDEA: *BOMBUS TERNARIUS* Say ♀; *B. TERRICOLA* Kirby ♀ ♂; *ANDRENA HIPPOTES* Rob. ♀; *A. VICINA* Sm. ♀; *A. sp.* ♀; *OSMIA ATRIVENTRIS* Cr. ♀.

LEPIDOPTERA: *PYRAMEIS ATALANTA* L; *HEMARIS THYSBE* Fab.

DIPTERA: *CHILOSIA LEUCOPAREA* Loew; *LUCILIA CORNICINA* Fab.

COLEOPTERA: *AGRIOTES STABILIS* Lec.

¹ Knuth, *Blütenbiologie*, Band II, Teil II, S. 47.

PYROLA ELLIPTICA Nutt.

Numerous observations have been made in Europe on the pollination of *Pyrola* and closely allied genera by Warming, Müller, Knuth,¹ and others; but there are no records for the American species, *P. elliptica* Nutt. and *P. americana* Sweet, which at Waldoboro, in southern Maine, are common in open sandy woodlands.

Shinleaf (*Pyrola elliptica*) is a perennial herb with basal elliptical leaves, from which rise an upright scape $1\frac{1}{2}$ to 2 dm. tall, bearing from 5 to 14 nodding white flowers. The corolla has a breadth of 12 to 14 mm., and the petals are nearly or wholly separate. It is slightly irregular, the two upper petals standing close together during anthesis to protect the anthers, while the three lower are widely extended.

There are ten stamens, which are glabrous and awnless with the filaments attached to the anthers about 1 mm. below the pores. The anther is about 3 mm. long, two-beaked, with short tubes opening at the apex by an oval pore on each lobe. The pore-tubes are at first bright yellow becoming with age a reddish brown.

The ecology of the flower is divided into three distinct stages: in the first autogamy is prevented by the position of the anthers, in the second it becomes adapted to crossing, and in the third to automatic self-pollination. In mature buds the anthers stand close together around the stigma in an inverted position, resting on the outside of the filaments with the tubes pointing upward toward the ovary, as the flowers are nodding (FIG. 2⁷). The pores open in the bud, this upside down position preventing the escape of the pollen and self-pollination.

As the flower expands it becomes adapted to cross-pollination. As the result of the unequal growth of the upper end of the filament, the anther slowly capsizes, or is turned right side up, that is, it rotates over the end of the filament (FIG. 2¹, 2², 3³) and downward on its inner side so that the pores point away from the ovary, the anthers coming into a nearly horizontal position beneath the two upper petals.

The flower having expanded, the style lengthens downward until it lies nearly in the concave lower petal. The stigma is nearly flat, its five lobes only slightly developed, but the tip is moist and in a receptive condition (FIG. 2⁴). If it is visited by insects at this stage crossing may readily be effected. But long-continued collecting has yielded only six small Halictine bees, visiting the anthers only for pollen, which were not seen to touch the stigma, and one specimen of

¹ Knuth, Blütenbiologie. II, Teil 2, S. s. 52.

Augochlora confusa. According to Knuth,¹ no insect visitors have ever been collected on the closely allied European *P. rotundifolia* L. Apparently cross-pollination is of rare occurrence. The flowers have a sweetish odor but are devoid of nectar.

During the final stage of anthesis autogamy may be brought about by a change in the position of the stigma. The five lobes now grow until they extend a millimeter beyond the ring at their base, and be-

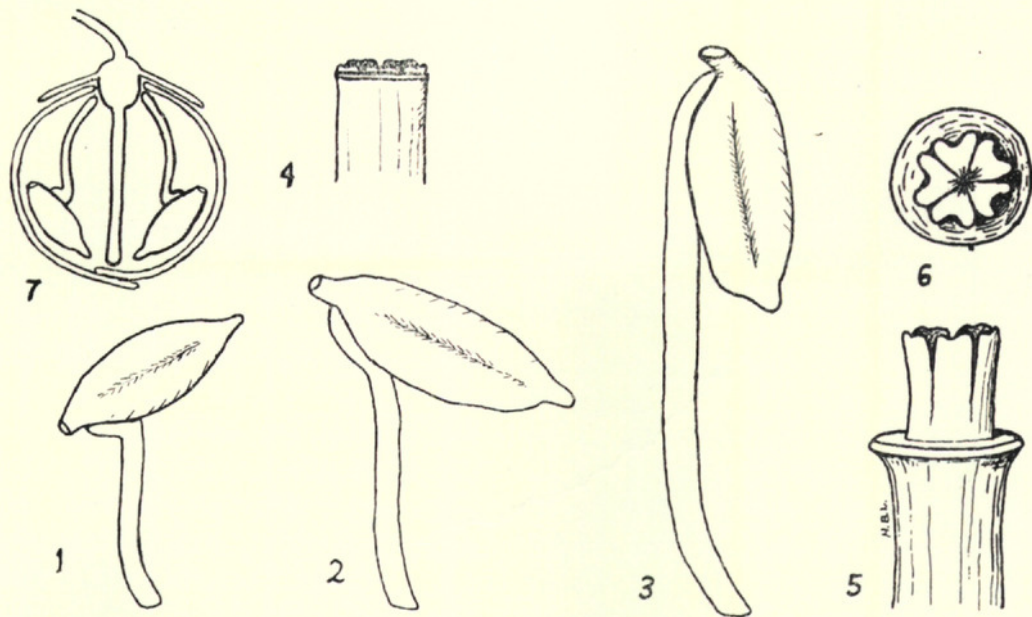


FIG. 2. *PYROLA ELLIPTICA*: 2¹, position of anther in bud, $\times 10$; 2², position of anther in flower soon after opening, $\times 10$; 2³, position of anther in mature flower, $\times 10$; 2⁴, stigma in flower soon after opening, $\times 10$; 2⁵, stigma in mature flower, $\times 12$; 2⁶, end view of stigma of mature flower, $\times 12$; 2⁷, section of bud enlarged, showing position of anther.

come bifid at their tips and very viscid (FIG. 2^{5, 6}). The lengthening of the style and a slight curvature forward brings the stigma beneath the pores of the anthers. Then if the flower is shaken by the wind or by insects, the pollen falls freely on this large glutinous surface and self-pollination results.

As the result of long and careful observation the following visitors were captured on the flowers, collecting pollen, from July 17th to 19th.

APOIDEA: *HALICTUS VIRIDATUS* Lovell ♀, c. p.; *H. PLANATUS* Lov. ♀, c. p.; *H. PILOSUS* Sm. ♀, c. p.; *AUGOCHLORA CONFUSA* Rob. ♀, c. p.

Bombus ternarius Say, ♀, was twice seen to fly within an inch of a flower-cluster, but failed to alight.

¹ Knuth, Blütenbiologie, II, Teil 2, S. 53.

PYROLA AMERICANA Sweet

This species is closely allied to *P. elliptica*, but may be readily distinguished by its thick round leaves and longer sepals. Its flower ecology is essentially the same, but the stigmatic lobes are less elongated and do not show the bifid divisions found in the shinleaf. Although the flowers were under observation on several occasions for a long time both at Waldoboro and at the Knox Arboretum, Thomaston, where it is very common, no insect visitors were recorded.

WALDOBORO, MAINE.

NOTES FROM THE HERBARIUM OF THE UNIVERSITY
OF WISCONSIN—XIII

NORMAN C. FASSETT

ASTRAGALUS CANADENSIS L., var. **longilobus**, n. var., calycis dentibus 2.5–5.5 mm. longis, tubo 4–5 mm. longo; calycibus et foliolis infra strigosis var. typicum simulantibus.—MINNESOTA: Willmar, July, 1892, *W. D. Frost* (Wis.¹); Jefferson, July 20, 1889, *H. L. Lyons*, no. 257 (Minn.). IOWA: Decorah, July 13, 1881, *L. H. Pammel* (Ia.); common in thickets, along roadsides, etc., Chickasaw Co., July 11, 1926, *W. D. Spiker* (Ia.); Decatur Co., July 24, 1903, *J. P. Anderson* (Ia.). WISCONSIN: railroad cut, New Richmond, August 5, 1934, *N. C. Fassett*, no. 17104 (Wis.); Pine Bluff, August 6, 1889, *L. S. Cheney* (Wis.); Madison [about 1861], *T. J. Hale* (Wis.); Little Sturgeon, July, 1884, *J. H. Schuette* (Wis.; Field); sandy roadside, Binghampton, July 8, 1930, *W. E. Rogers*, no. 278 (TYPE in Herb. University of Wisconsin); roadside, low ground, Winchester, August 12, 1929, *N. C. Fassett & W. T. McLaughlin*, no. 9336 (Wis.). INDIANA: bank of Wabash River 1½ mi. south of East Mt. Carmel, rare here, June 18, 1918, *C. C. Deam*, no. 25469 (Deam); on wooded hillside east of Newburg, July 2, 1915, *Deam*, no. 16785 (Deam); wooded hills east of Winona Lake, Kosciusko Co., July 29, 1897, *Deam* (Deam; Field); 5 mi. northeast of Elkhart, July 2, 1921, *Deam*, no. 34424 (Deam).

The widespread typical *A. canadensis* has the calyx-lobes not more than one half the length of the tube (lobes 1–3 mm. long; tube 4.5–6 mm. long). *A. canadensis* var. *carolinianus* (L.) Jones,² of the southern Alleghenies, has the lobes usually more than half the length of the tube (lobes 2–3.7 mm. long; tube 4–5 mm. long). *A. canadensis* var.

¹ Specimens located as follows: Wis., University of Wisconsin; Minn., University of Minnesota; Ia., Iowa State College; Field, Field Museum of Chicago; Deam, Herbarium of C. C. Deam.

² Proc. Calif. Acad. ser. 2: v. 647 (1895).



Lovell, Harvey B. and Lovell, John H. 1936. "POLLINATION OF THE ERICACEAE: IV. LEDUM AND PYROLA." *Rhodora* 38, 90–94.

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