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Observations of the Adaptation of the Leaves of Kalmia latifolia to Environment

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In making observations of the leaves of Kalmia latifolia it seemed desirable to collect from two entirely different localities. One set of specimens was obtained from plants growing on high dry land, where they would recieve the full benefit of the sun, and where the moisture amounted to very little. For the other specimens the dark and dismal Cedar Swamp was selected, where each and every plant is struggling for existence. The tall cedars reach upward, each striving to distance others in order to secure all the sunlight possible, and crowd out and leave behind those unable to keep up in this struggle for existance. Beneath these tall trees growing from pools of water and great quantities of moss, which carpet the whole surface of the ground, are many small trees and shrubs each seeking the same end. In this place, where the sun's rays seldom penetrate, were collected the second specimens of Kalmia latifolia.

The shrub growing on the highland, getting the full benefit of the sun's light and heat presents a decidedly differ-

ent appearance from that in the Cedar Swamp. The bush on the highland is more upright than that found in the Cedar Swamp, and has shorter internodes. But the most striking phenomenon is exhibited by the leaves. On examination the leaves of the highland specimen proved to be smaller than those of the low land specimen. This may be due not only to the amount of light that the plant receives but to the moisture as well. (Fig.1 a.b.) Duchartre[1] found on making some experiments with a number of different plants, that moisture played an important part in the development of leaves, and that they were smaller if plants were deprived of water. So he concluded that smallness of leaves may be due to lack of moisture as well as lack of light. However the most interesting thing about the leaves of the highland specimen is in order to screen as much surface of the leaf as possible from the rays of the sun, the leaves bend at the midrib and grow in an upright position, making the amount of surface exposed to sun much smaller than that of the lowland specimen, when the leaves grow in a horizontal position and do not bend at the

1. Annales des Naturelles. Vol.5.p334 1887.

midrib.(Fig.1.a.b.) Johow[2] experimented along this line with a number of different plants and concluded that the position of the leaves depended upon the intensity of the light. In the shade the leaves were flat, and in the sunlight they were folded at the midrib.

On measuring sections cut with a microtome the leaves of the highland specimens proved to be from 5 to 6 m.m. thicker than those of the lowland specimens. (Fig.2.a.b.)

Below are given the results obtained in examination of five leaves from different plants.

specimens.	m.m. thick highland.	lowland
1	3	2.3
2	3.8	2.2
3	2.9	2.4
4	3	2.4
5	2.9	2.3
	—	—
average	2.92	2.32

Similar results were obtained by Stahl[3] who found on examination of the leaves of a large number of different

2.Annales des Sciences Naturelles Vol.5. p 319.

species of plants that those in the bright sunshine developed a greater thickness than those in the shade.

An interesting experiment was performed to test their relative thickness. I collected about twenty-five specimens from both highland and lowland bushes and these were given to me after I had been blindfolded to decide which was which Without any difficulty I was able to distinguish almost instantly the thick hard leaves of the highland specimens from the thin soft leaves of the lowland specimens.

The question will now arise, whether the thickness of the leaf is due to an increase in the number of cells or to the enlargement of them. In the case of the laurel it appeared on examination that the thickness in the highland specimen is due to an increase in the number of cells, which is contrary to the results obtained by Groom[4] of Oxford, who experimented along this line on an orchid which naturally , runs over plants growing on hot sandy heaths. The specimen had been transferred to a place where it was growing under

3. Annales des Sciences Naturelles Vol.5. p 350. 1887.
4. Annals of Botany Vol.7. p 152.

the shade of a well foliaged tree. The most interesting result was that the leaves developed on the sandy soil were small and thick, while those grown in the botanical garden were larger and much thinner. The decrease in the thickness of the leaves in the garden was due to a change in the form of the cells, not to a diminuation of their number.

In studying the structure of the leaf the cuticle of the highland specimen was found to be about twice as thick as the lowland specimen. This additional thickness of cuticle in the highland specimen helps lessen evaporation. (Fig.3.a.b.) The epidermal cells have thicker walls in the highland specimens than in the lowland ones and so assist the plant to retain moisture.

In the lowland specimen the loose parenchyma tissue beneath the palliside cells had larger and more numerous intercellular spaces than the highland specimen, thus exposing to the air a greater area of cell wall from which evaporation might take place. (Fig.3.a.b.)

On examining the upper and lower surface of the leaves of the two specimens some interesting results in regard to the stomata were reached. On the upper surface no stomata

appeared, while on the lower they were quite numerous. By taking a given area, 2 m.m. sq, and counting the stomata, the highland specimen was found to have on an average only four to every eight of the lowland, showing plainly that the decrease in the number of stomata in the highland specimen is to lessen evaporation, for a great amount of the moisture of a plant escapes through the stomata. (Fig.4.a.b.)

The following results were obtained by an examination of the leaves from five different plants.

specimens.	no of stomata in 2 m.m. sq.	
	lowland.	highland.
1	7	4
2	8	3
3	8	4
4	7	5
5	9	4
	—	—
average	7-8	4

The stomata were distributed evenly over the lower surface of the leaf, contrary to some results obtained by Serakofski[5], who found on examining the leaves of the several different species of plants that the stomata varied in number in different parts of the leaf and that they were more numerous in the sunlight than in the shade.

5. Annales des Sciences Naturalles. Vol. 5. p.357.

Summary.

1. In Kalmia latifolia light and dryness diminish the size of the leaf, give it an upright position and cause it to bend at the midrib, develope a very thick cuticle, decrease the size of the intercellular spaces and the number of the stomata.

2. In Kalmia latifolia shade and moisture increase the surface of the leaf and give it a horizontal position, diminish the thickness of the leaf and cuticle, enlarge the intercellular spaces and number of stomata.

3. The morphological differences in the leaves of the Kalmia latifolia are due to an attempt on the part of the plant to adapt itself to environment.

Explanation of Figures.

Fig.1. was photographed from nature, and the other figures are drawings made from nature with the aid of the Abbe camera.

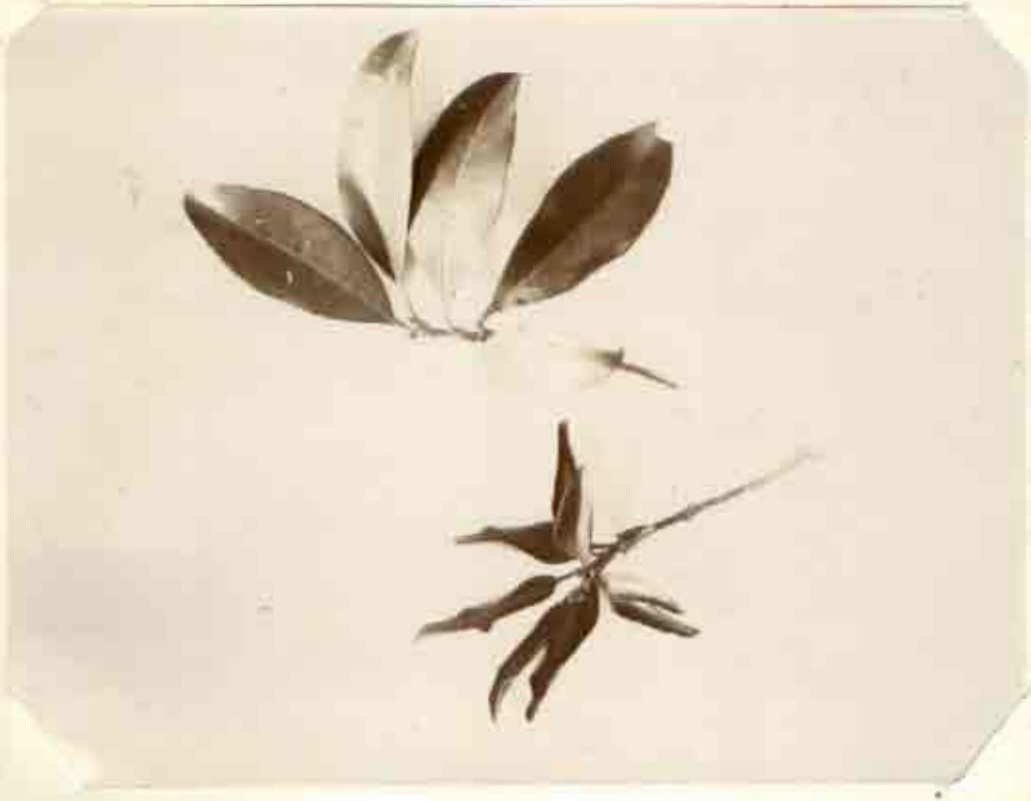
Fig. 1. The difference in the size of the two specimens a. Highland b. Lowland. X 400.

Fig. 2. Structure of the leaves. a. Highland b. lowland. X 400.

Fig. 3. Cuticle. a.Highland b. Lowland. X 400.

Fig.4. Stomata. a. Highland b. Lowland. X 400.

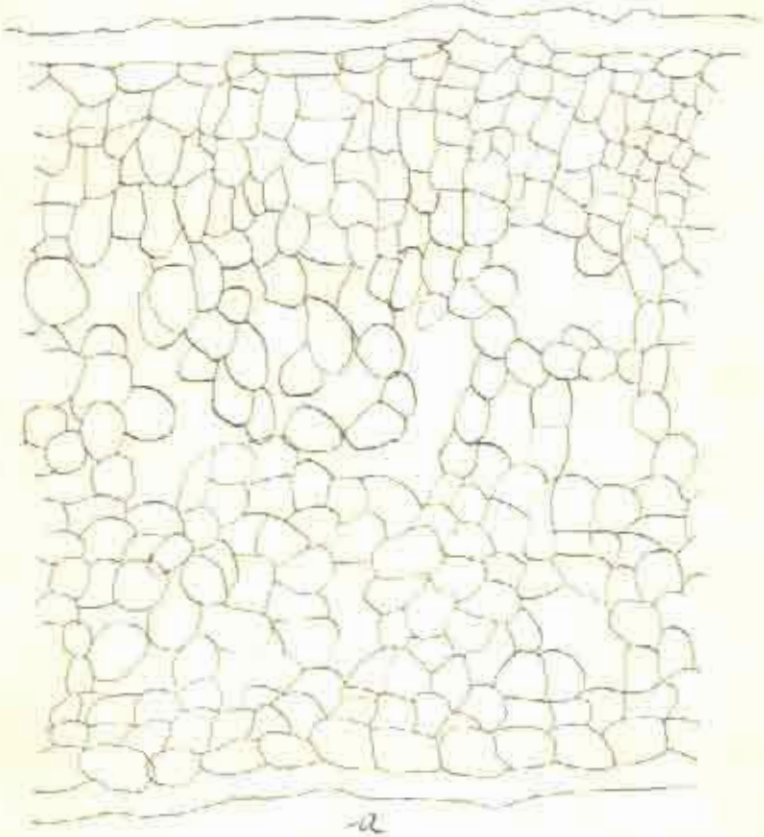
Fig I.



-- b.

--- a.

Fig 1



a

Fig 2

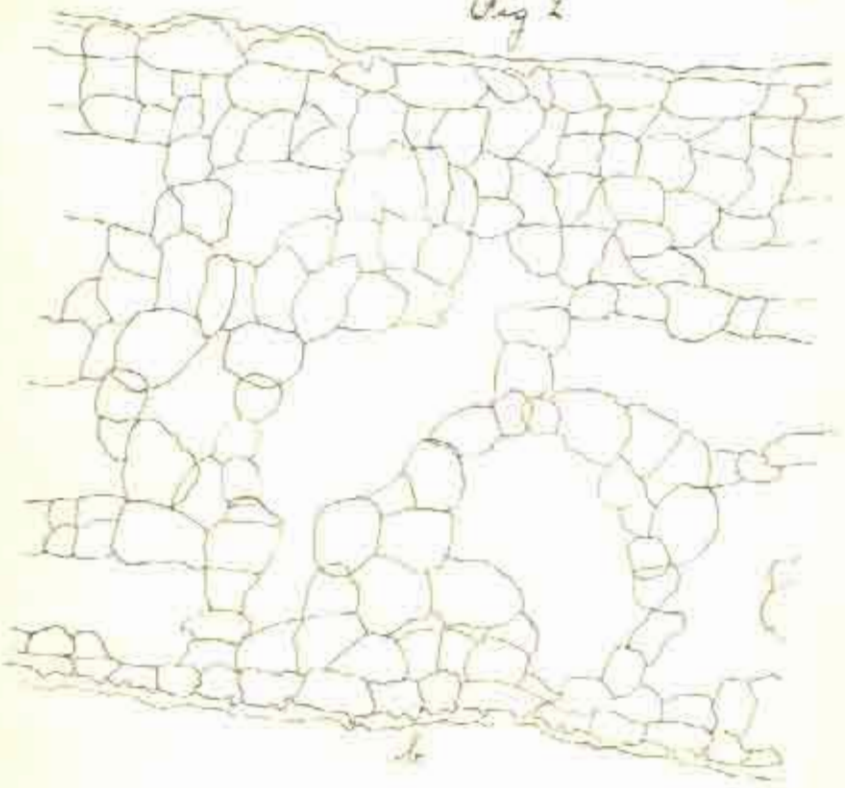
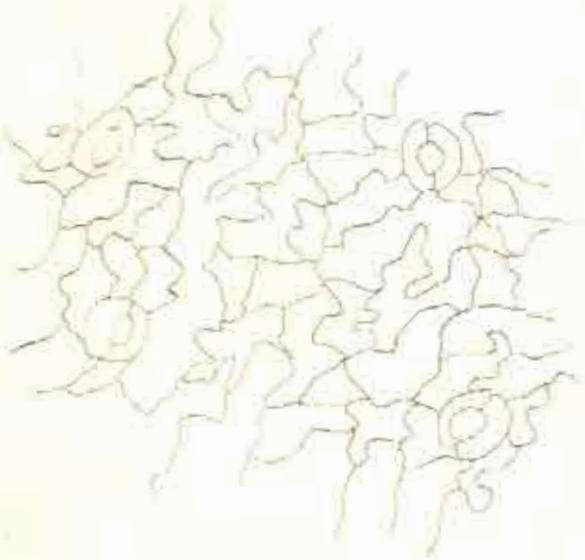


Fig. 8

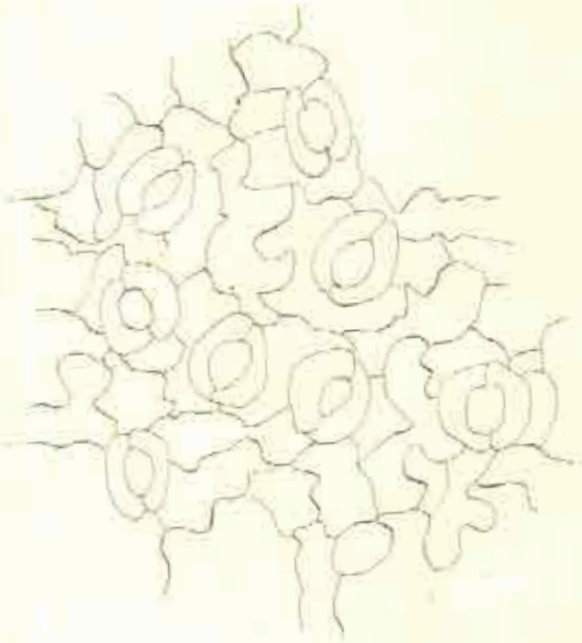
a

b

Fig. 4.



a.



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