

MORPHOGENESIS OF THE STOMATA IN *HOLBOELLIA LATIFOLIA* WALL. WITH REMARKS ON THE TAXONOMY OF THE AFORENAMED GENUS*

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ABSTRACT

The stomata of *Holboellia latifolia* Wall. have been studied. Ontogenetically the stomata in the group are of the haplocheilic type. No subsidiary cells are present and the guard cells bear around them only ordinary epidermal cells. This work is the first of its kind on *Holboellia* and supports placement of this genus in Lardizabalaceae but not in the Berberidaceae.

INTRODUCTION

The genus *Holboellia* is confined to the Himalayas, China and Japan. It has five species of which only one, *Holboellia latifolia* Wall., occurs in India. The foliage of the species are intrinsically so broad that the plant itself is called as latifolia.

Only limited information is available on the organization of the *Holboellia latifolia*. BHATNAGAR (1965) investigated the gametophytes and endosperm. The phloem is reported to be having no fibres (METCALFE & CHALK, 1950). The formation of the stomata is yet unknown. The species is considered to be berberidaceous by many including BENTHAM AND HOOKER (1862-1867). This study on *Holboellia latifolia* Wall. was, therefore, undertaken to (i) put the origin and development of the stomata on record, (ii) combine the data thus obtained with the ones as available, and (iii) inquire into the systematics of *Holboellia*.

MATERIAL AND METHODS

The primordial, unripe and full grown leaves of *Holboellia latifolia* Wall. were collected during September, 1964, from plants growing in the Lloyed Botanic Garden of Darjeeling by the author. They were fixed in F.A.A. and preserved in 70% alcohol.

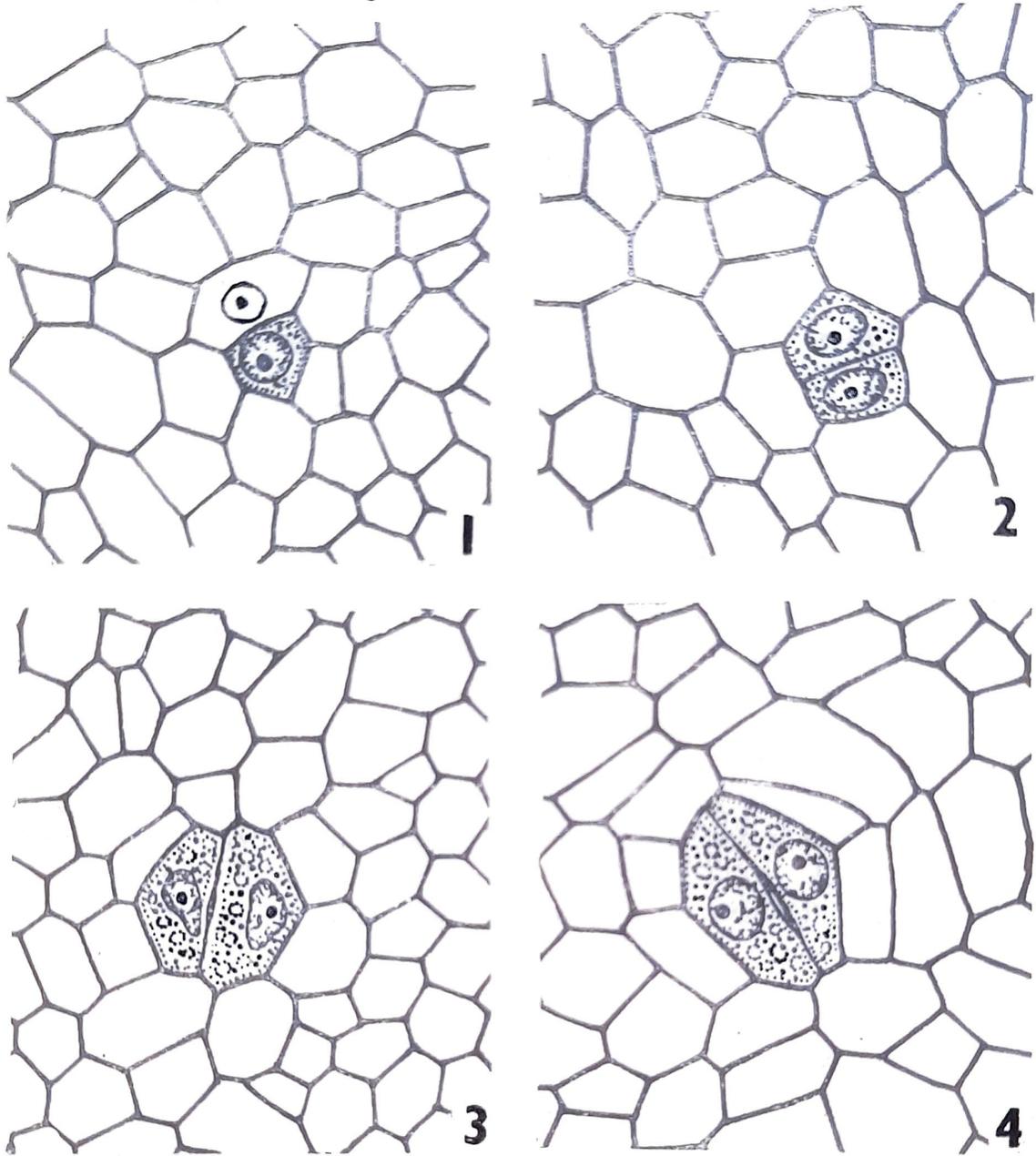
Both whole-mounts and peels of the leaflets were made. In regard to first the primordia were stained in acetocarmine and Delafield's haematoxylin, dehydrated gradually through alcohol-xylol series, and mounted in canada balsam. The cuticular strips with attached epidermal cells were obtained by macerating pieces of leaflets in a mixture of equal volumes of 5% chromic acid and 5% nitric acid at a temperature of about 56°C. These were stained in Sudan IV and mounted in glycerine jelly.

OBSERVATIONS

Holboellia latifolia is a dioecious woody climber. Its leaves are evergreen, coriaceous, petiolate and digitately compound with 3-7 stalked and entire leaflets. The latter may be upto 6 inches in length and as much as 2 inches in width. The venation is reticulate.

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The stomata are present on the lower epidermis of the leaflets. They occur all over the surface except near the margins and above the veins. The epidermal cells in the stomatiferous areas are polygonal and possess sinuous walls while in the non-stomatiferous areas such as the veins and the edges of the leaflets they are elongated and rectangular.



Text-figs. 1-4. Development of stomata in *Holboellia latifolia* Wall. $\times 850$.

The stomatal apparatus is oval (Text-fig. 4) being made up of two kidney-shaped, differentially walled and uninucleate guard cells. The pore is small. No subsidiary cells, stomatal or epidermal, are present around the guard cells. The stomatal ontogeny begins with the differentiation of a protodermal meristemoid. This is markedly larger and protoplasmic. It divides so as to produce two unequal cells (Text-fig. 1). Of these the smaller one functions as the guard mother cell. It has dense cytoplasm and a nucleus occupying almost the entire cell lumen. In its turn the guard mother cell bisects itself into two isomorphic cells which become the guard cells (Text-figs. 2-4). The area destined to be the opening first swells but eventually naturalises into the stomatal pore (Text-figs. 3,4). The other protodermal cells adjacent to the guard mother cells mature as epidermal cells. The development of the stomata thus conforms to the haplocheilic type of FLORIN (1931) or aperigenous type of FRYNS-CLAESSENS AND VAN COTTHEM (1973) and PALIWAL (1969).

The stomata of *Holboellia latifolia* as borne out by their origin and mature organization observed during this work are haplocheilic or aperigenous. They lack subsidiary cells altogether and bear around their guard cells ordinary epidermal cells. In the allied species *Holboellia coriacea* Diels also the stomata, although uninvestigated as regards their ontogeny, are stated to be made up of just two guard cells by METACALFE AND CHALK (1950). This study on *H. latifolia* is in this way the first on the development of the stomata in *Holboellia*. It is likewise to be remarked that just as noticed in *H. latifolia* the stomata in *H. coriacea* are also known to be found only on the lower surfaces of the leaves and in this species too they are distributed in a purely solitary manner.

It is thus obvious that there are no deviations in the stomatal features in *Holboellia latifolia*. In other words, the distribution, morphology, ontogenesis, occurrence and typification of the stomata are all quite invariable and constant in this lianous species. BAILEY AND NAST'S (1948) report holding an climbing plant to be instable in regard to its characters is, therefore, of no avail.

The taxonomy of the genus *Holboellia* is still controversial. In the texts of BENTHAM AND HOOKER (1862-1867), and recently of PLOWDEN (1970) *Holboellia latifolia* as well as other holboellias are included in the family Berberidaceae. On comparing the stomatal features of *Holboellia* with the Berberidaceae (Table 1) it is seen that stomatally the former genus is

Table 1—Comparison of Stomata of *Holboellia* and Berberidaceae

Serial No.	Stomatal Features	<i>Holboellia</i> (After Metcalfe & Chalk, 1950; Singh <i>et al.</i> , 1974; Jalan, present work)	Berberidaceae (After Metcalfe & Chalk, 1950; Singh <i>et al.</i> , 1974)
1.	Occurrence	Lower surface of the leaves	Lower surface of the leaves
2.	Distribution	Singly	Singly or in pairs
3.	Subsidiary cells	Absent	Absent
4.	Form	Oval	Elliptical
5.	Size	Small	Large
6.	Guard cells	Two with outer walls thin and unligified	Two with outer walls thin, or thick and ligified
7.	Ontogeny	Aperigenous	Unknown

different from the latter. In other words *Holboellia* does not have any of the structures such as the paired stomata, large sized stomata, and stomata having thick and lignified outer walls of their guard cells which are visible in the berberidaceous plants. In its phytogeography, habit, vegetative body, morpho-histology of the leaves, phloem, floral morphology, megasporangium, female gametophyte, endosperm and phytochemistry, the group *Holboellia* is also wholly unlike the Berberidaceae (Table 2). To this author thus there seems to be no tribal relationship between *Holboellia* and the Berberidaceae. It is on the whole argued that *Holboellia* should be considered as non-berberidaceous. The genus fits well in the proposed Lardizabalaceae Decne. and should find itself in it.

Table 2—Comparison of morphology of *Holboellia* and Berberidaceae

Serial No.	Characteristics	<i>Holboellia</i> (After Metcalfe & Chalk, 1950; Eames, 1961; Bhatnagar, 1965; Jalan, present work)	Berberidaceae (After Metcalfe & Chalk, 1950; Eames 1961; Davis, 1966)
1.	Geographical distribution	East Asia	North-temperate regions
2.	Habit	Climbers	Erect herbs and shrubs
3.	Vegetative body	Non-spinous	Spiny
4.	Morpho-histology of leaves	Leaves digitately compound, epidermal hairs absent, hypodermis present, mesophyll differentiated into multi-layered palisade and spongy tissues, veins vertically transcurrent	Leaves simple or pinnately compound, epidermal hairs present, hypodermis absent, mesophyll may or may not be differentiated into palisade and spongy regions, veins vertically not transcurrent
5.	Phloem	Fibreless	Fiber-bearing
6.	Flowers	Unisexual	Bisexual
7.	Stamens	Laminar, connective massive with elongated apices, anthers dehisce longitudinally	Non-laminar, connective non-massive, anthers open by valves
8.	Gynoecium	Multipistillate	Unipistillate
9.	Megasporangium	Orthotropous, micropyle formed by inner integument	Anatropous, micropyle formed by both the integuments
10.	Female gametophyte	Monosporic 8-nucleate, antipodals small and ephemeral	Monosporic 8-nucleate or tetrasporic, antipodals large and persistent
11.	Endosperm	Cellular	Nuclear
12.	Alkaloid	Berberine absent	Berberine present

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