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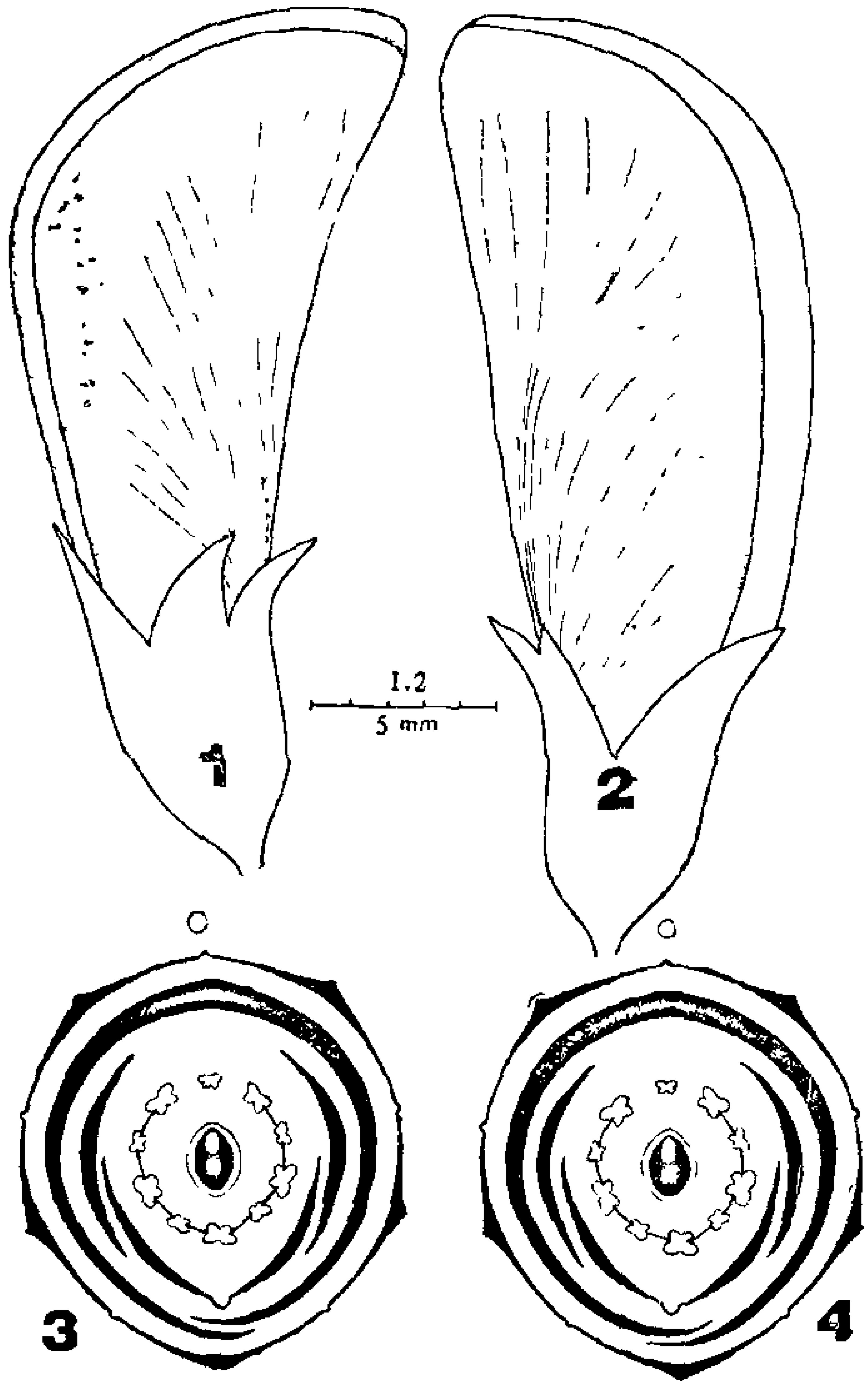
COROLLA HANDEDNESS IN PAPILIONACEAE

COROLLA handedness has been studied in several members of the Malvaceae, Bombacaceae and Palmae by Davis and coworkers[6–9] and in the Caricacaeae and Euphorbiaceae by Bahadur[1–3] and coworkers. So far no such work seems to have been attempted in the Papilionaceae whose members show vexillary aestivation. In this communication we report corolla handedness in Papilionaceae with regard to contortion of vexillum petal either to the left or to the right in a given flower or in flowers borne on the same inflorescence on a particular plant.

A total of 28 genera comprising 54 species belonging to 6 tribes have been examined (Table I) following the method of Bahadur and Venkateshwarlu[2–3]. A A total of 1,290 flowers from 4 species were sampled (Table II), of these 743 were left handed (57·6%) and 547 were right handed (42·4%). In Figs. 1 and 2, right and left handed flowers of *Cajanus cajan* are shown. Figs. 3 and 4 represent their floral diagrams. It is clear from the figures that the vexillum petal shows contortion either to the left, *i.e.*, clockwise or to the right, *i.e.*, counter-clockwise and further the vexillum completely encloses the wing and keel petals in the bud condition. As the flower opens the vexillum unfolds and the contortion is lost. As shown in Figs. 3 and 4 the vexillary aestivation is unusual and clearly distinguishable into levo-vexillary and dextro-vexillary types on one and the same plant.

As shown in Table II, the χ^2 value on the total for 1 d.f. is high and the P value is highly significant. If, however, data on *Heylandia latibrosa* and *Tephrosia hamiltonii* are separately considered both the species show a greater incidence of left handed flowers, 66·55% and 66·03% respectively. *Indigofera tinctoria* also shows an excess of left handed flowers. In *Cajanus cajan*, however, the left and right handed flowers are in equal numbers as compared to the condition in *Bambusa arundinacea* (Bahadur *et al.*[3]). The great inequality observed in other species is comparable to the one noted in several Malvaceous species by Davis and Ramanujacharyulu[6].



FIGS. 1–4. Figs. 1–2. Right and left handed flowers of *Cajanus cajan* showing contortion of vexillum petal. Figs. 3–4. Floral diagrams of right and left handed flowers of *C. cajan*. The contortion of vexillum petal to the right and left is clearly seen.

A tribe-wise examination of corolla handedness in Papilionaceae shows that all the species examined under Genesteae, Galegeae and Hedysarae show this condition, whereas species belonging to Trifoleae lack this. In the tribe Phaseoleae, however, out of the 13 genera examined, only 5 show corolla handedness (Table I). The presence or absence of corolla handedness thus appears to be useful as a taxonomic pointer but more data are required before conclusions can be

TABLE I

Tribe-wise distribution of corolla handedness in Papilionaceae

Sl. No.	Tribe	Number of Genera	Number of Species	Corolla handedness
1.	Genesteae	3	6	+
2.	Trifoleae	4	5	—
3.	Galegeae	3	8	+
4.	Hedysareae	3	4	+
5.	Phaseoleae	15	31	±

+ corolla handedness present, — corolla handedness absent.

handedness is possibly due to the sterioisomerism of the hormone molecules.

Davis and Ghosh[8] have observed that a right handed flower of *Adansonia digitata* bears on an average a greater number of stamens than a left handed flower. In the present work, however, no such difference has been detected. Bahadur and Venkateshwarlu[2,3] observed differences in pollen grain size among the left and right handed flowers in *Jatropha* sp. and *Carica papaya*, but once again no such difference was detected in the present work.

The papilionaceous corolla and the handedness of vexillum petal appear to be related to the habitual self-pollination in most Papilionaceae.

According to Ghosh and Davis[9], right handed flowers produce more fruits than the left handed ones

TABLE II

Distribution of left and right handed flowers in some Papilionaceae

Sl. No.	Taxon	Left	Right	L + R	L–R	LH/RH	LH%	χ^2 and P value
1.	*Heylandia latibrosa*	191	96	297	95	1·99	66·55	31·45 $<0{\cdot}001$
2.	*Tephrosia hamiltonii*	138	71	209	67	1·94	66·03	21·48 $< 0{\cdot}001$
3.	*Indigofera tinctoria*	65	43	108	22	1·51	60·19	4·48 $< 0{\cdot}05$
4.	*Cajanus cajan*	349	337	686	12	1·035	50·83	2·199 $> 0{\cdot}05$
	Total	743	547	1290	196	1·358	57·6	29·78 $< 0{\cdot}001$

drawn. In the present context, the L and R flowers represent mirror image patterns and hence bioisomers (Bahadur *et al.*[3–5]).

Hutchinson[11] has effectively employed the twisting of the keel petals and styles for taxonomic purposes. Gunn and Kluve[10] have used androecium and gynoecium characters for similar purpose. Furthermore, Smartt[12] has pointed out that the Asiatic species of *Phaseolus* show clockwise-contortion of the style and the American species show the counter-clockwise contortion. Whether the corolla handedness presently studied or the contortion of style observed by Smartt is due to geophysical forces. According to Davis[7] asymmetry like the one presently studied is due to such a cause in *Mikania scandens* and *Cocos nucifera*. According to Bahadur and Reddy[1], however, the in *Hibiscus canabinus*. Further investigations on the economically important Papilionaceae are in progress.

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A CONTRIBUTION TO THE EMBRYOLOGY OF *SANSEVIERIA ZEYLANICA* WILLD.

Sansevieria, a member of the family Haemodoraceae (Bentham and Hooker[1]) is of considerable taxonomic interest eversince the placement of this in Agavaceae by Hutchinson[2]. Since the genus is embryologically unknown, the author has made an embryological study of one of its available species and used the same for the assessment of the systematic position of the genus.

The primary archesporium in the anther is a row of subhypodermal cells (Figs. 1 and 2). Soon after differentiation the primary archesporial cells undergo periclinal divisions to form a layer of sporogenous cells inwards and a layer of primary parietal cells outwards. The primary parietal layer divides anticlinally and periclinally producing 3 wall layers beneath the epidermis (Figs. 3 and 4). The innermost wall layer forms the secretory tapetum and the outermost wall layer forms the endothecium with fibrous thickenings (Fig. 5). The tapetal nuclei divide mitotically and the cells become bi-nucleate by the time the nuclei of pollen mother cells are in the prophase of first mitotic division. The two nuclei are closely adpressed to each other. The mature tapetal cells become vacuolated. As the anther matures, the growth of the pollen mother cells and the tapetum crushes the wall layers between the endothecium and the tapetum. With further growth of the anther the epidermis becomes very much stretched. The divisions of the microspore mother cells are successive and the microspore tetrads are isobilateral (Fig. 6). The pollen grains are shed at the two-celled stage and their exine is finely granular.

Ovules are anatropous, bitegmic and tenuinucellate. A single hypodermal archesporial cell differentiates in the nucellus before the initiation of integumentary primorida (Fig. 7). The archesporial cell can be recognised by its larger size, bigger nucleus and denser cytoplasm (Fig. 8). It enlarges and functions as the megaspore mother cell directly without cutting off a parietal cell. The megaspore mother cell undergoes two meiotic divisions and usually forms a linear or a T-shaped tetrad of megaspores (Figs. 9 and 10). Of the four, only the chalazal one is functional and the other three degenerate (Fig. 11). Three successive free nuclear divisions in the functional megaspore follow resulting in a monosporic eight-nucleate embryo sac (Figs. 11, 12 and 13) of the polygonum type. The eight nuclei organize themselves into a three-celled egg apparatus (Fig. 14), three antipodal cells and two polar nuclei which fuse near the chalazal region of the embryo sac to form a secondary nucleus. A prominent hypostase is present (Fig. 15). Embryo development could not be followed due to the formation of a clear abscission layer in the middle of the pedicel which results in the withering and falling off of flowers.

Bentham and Hooker placed *Sansevieria* along with *Ophiopogon* in the tribe Ophiopogoneae of the family Haemodoraceae. Engler and Prantl grouped both the genera in Liliaceae under the subfamily Dracaenoideae. Hutchinson deviated altoghether from the two classifications and transferred *Dracaena* and *Sansevieria* to the family Agavaceae. Embryological evidence indicates that *Sansevierai* differs considerably from the other members of Agavaceae in having a row of hypodermal cells as archesporium, and three wall layers (10–12 layers in Agave) in the anther, tenuinucellate ovules (crassinucellate in *Agave* and *Doryanthes*), absence of a parietal cell, absence of the placement of antipodals one above the other and absence of tubular projection in the embryo sac. In view of the above facts, the transfer of this genus to Agavaceae as done by Hutchinson seems to be unnecessary and this conclusion is also supported by cytological studies (Sharma and Chaudhuri[4] and Lakshmi[3]). An embryological study of related genera in Haemodoraceae and Liliaceae may throw further light on the current systematic position of the genus.