

**SOME OBSERVATIONS ON THE ANCHORING
PADS OF GYMNOPETALUM COCHINCHINENSE
Kurz AND SOME OTHER CUCURBITACEOUS
PLANTS**

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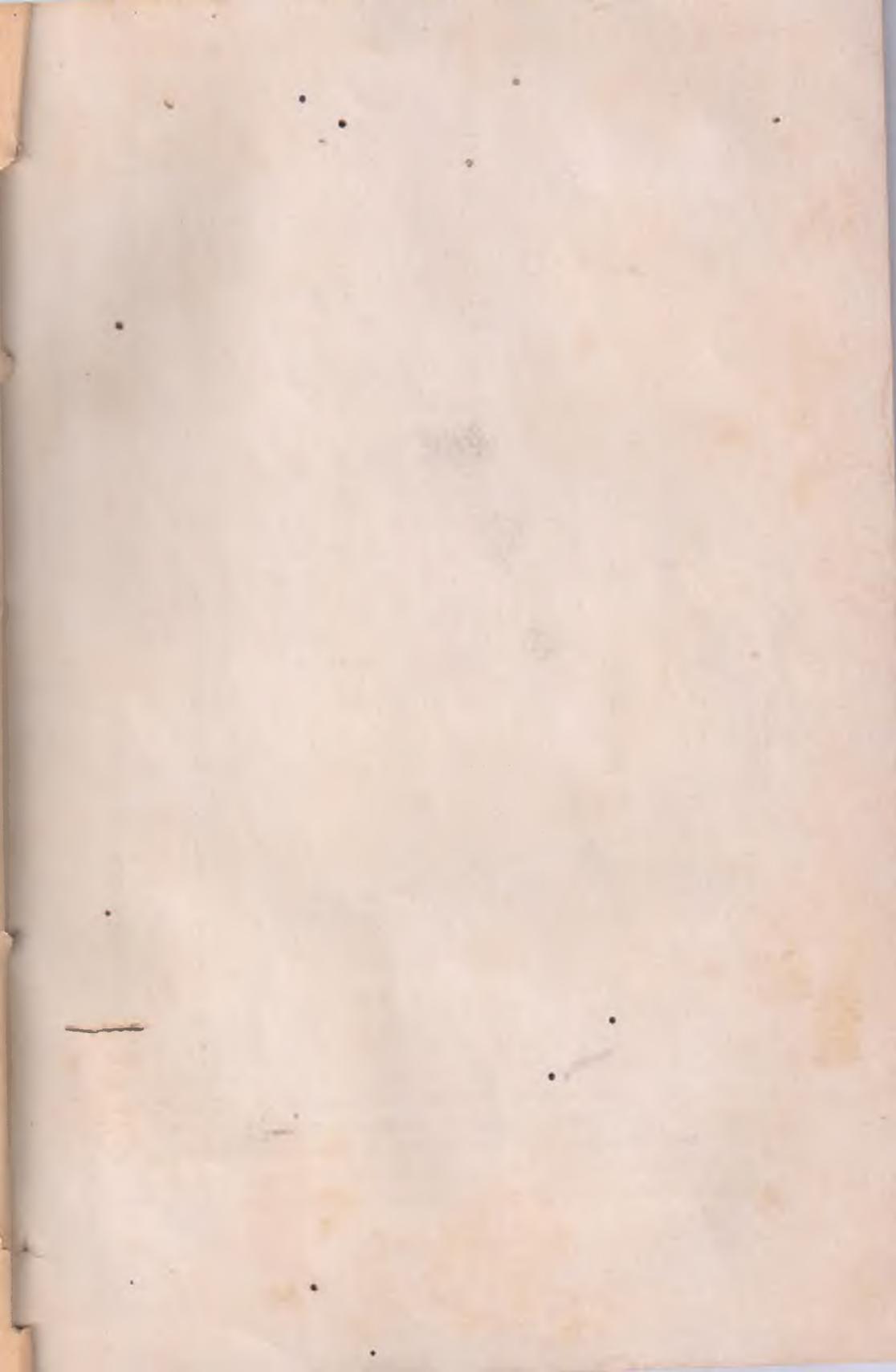
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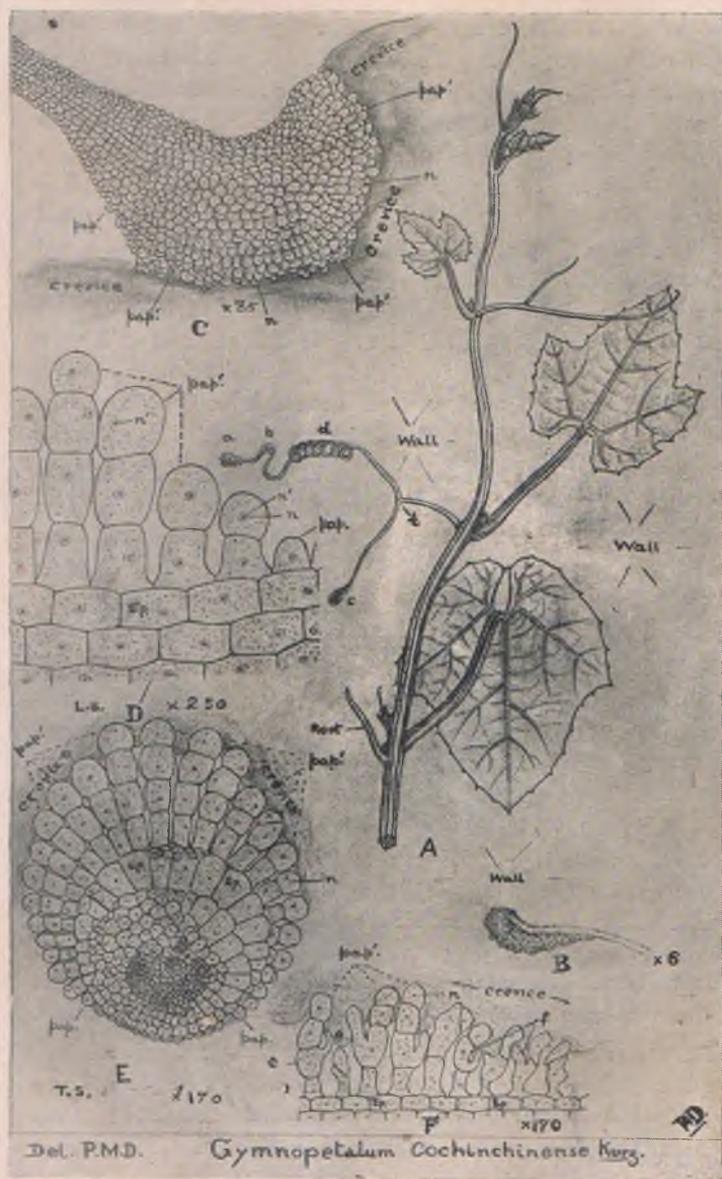
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It is a matter of common knowledge that, among 'tendrill-climbers', there are some plants, in which portions of tendrils are modified into 'anchoring pads' more commonly known as 'adhesive discs'. In ordinary text-books we often find *Ampelopsis quinquefolia* Michx. (= *Vitis hederacea* Ehrh.), a native of N. America, and *A. Vetchii* Hort. (= *Vitis inconstans* Miq.), a native of Japan, commonly quoted as examples of such disc-bearing plants. But, it should by no means be concluded therefrom that, such 'pads' or 'discs' are restricted to the tendrils of some species of *Vitis* (N. O. Ampelideae) only. As a matter of fact, such 'pads' or 'discs' have been noticed in some plants belonging to different natural orders e.g. Cucurbitaceae and Bignoniaceae as well. Darwin, in his very interesting book.—'The Movements and Habits of Climbing Plants,' has dealt in a masterly way with some of these plants.

In the present paper it is, therefore, proposed to confine the author's observations principally to the anchoring pads met with in the tendrils of *Gymnopetalum cochinchinense* Kurz and incidentally to a few other plants belonging to the natural order Cucurbitaceae. These observations are likely to prove interesting in view of the fact that, the majority of the plants mentioned here, being confined chiefly to the tropics, do not seem to have been studied by the previous workers viz: Darwin, Uhlworm, Goebel, Haberlandt, Yasuda and others. The author has, for reasons mentioned below, preferred to call ~~these~~ structures here as 'anchoring pads' instead of 'adhesive discs.' The term 'disc' seem to connote the idea of a flat circular surface as we find in the tendrils of *Ampelopsis quinquefolia* Michx. = *Vitis hederacea* Ehrh.) and *V. assamica* Laws.

The mature tendrils of *Gymnopetalum Cochinchinense* are usually branched (see fig. A) and it is on the apical and sub-apical regions of these arms that the anchoring pads are found to develop.





Del. P.M.D.

Gymnopetalum Cochinchinense Kütz.

Under normal conditions, when a tendril of this plant meets with a suitable support, it behaves like other ordinary tendrils and in course of a few days it coils round the latter. As a result of stimulation due to contact, hypertrophy usually sets out in the epidermal cells on the side of contact, and these become enlarged and thickened and the grip thus becomes firmer. No pad has been found to develop under such circumstances.

But if a tendril happens to come in contact with a large flat and rough surface (*e.g.* a sand-plastered wall), which is unsuitable for it to coil round, then, at first, the tips of its arms begin to crawl like root-tips into the minute crevices, and, later on, as a result of the repeated but temporary applications of contact-stimulus and of the mechanical retardation on the cells involved on the side of contact, certain secondary stimulatory effects are induced in the regions of contact. The cells in the regions of repeated contact (*e.g.* a, b, & c in fig. A) gradually begin to swell, showing that a certain amount of acceleration of growth has set out in the cells involved in those regions. Such whitish swellings are by no means confined to the convex side of the apices of tendrils, but have been noticed occasionally in the convexly-curved sub-apical regions of contact (*e.g.* b in fig. A.) too. In course of a few days, the stimulated epidermal cells in and around the convexly-curved regions of contact (a, b & c in fig. A.), begin to develop into very thin-walled little white knob-like unicellular papillae (pap. in figs. B & C.). In a few more days, with the progress of the cell-division and the development of the transverse cell-walls, these papillae grow out into white hypertrophied 2-4- or even 5-celled linear-oblong or clavate trichomes (pap. in figs. C.-E.). Each of these trichomes is seated on a cushion of bulbously-swollen epidermal cell. The tips of the arms of tendrils, at this stage, being studded with the papillae and trichomes on the side of contact, assume, more or less the shape of a club-shaped round brush with bristles on it on one side (figs. B & C.).

These trichomes, by entering into the nooks and crevices (see figs. C, E. & F.) with which they come in contact, fit themselves nicely to the unevenness of the surface of the uncongenial support. This contact is usually brought about more closely by the additional adhesion, to the uneven surface of the support, of the branches (see fig. F.) of some of the cells of the multicellular trichomes. The trichomes thus pave the way of bringing the pads into very intimate contact with the surface of the support. This contact becomes ultimately so intimate that, in one instance, the writer has seen a single tiny pad supporting the weight of all the branches with leaves

which would amount to not less than 150 grains (Apoth.). In such a case, wind or any other shaking-influence cannot easily dislodge the firmly attached pads from the crevices and any violent attempt to separate a tendril from its support usually ends in a part of the tendril-filament being detached, instead of the entire pad being completely detached. It should also be stated here that such regions of contact are usually fringed (see Figs. C-E) with multicellular trichomes ending in unicellular papillae, as we pass our eyes from the areas of contact to the margins. The free portion of a tendril-branch lying between an adherent pad and the axil does not, however, remain inactive, but, usually twists itself (see d in Fig. A) into a spiral coil and thus assists the plant in gradually scrambling over the uncongenial support. This probably illustrates a case of "Co-adaptation" coming into play. The pads in *Gymnopetalum cochinchinense* do not seem to appear in the absence of any contact stimulus and they have not been observed to become woody ultimately.

It will not perhaps be out of place to mention here that, shade and moisture seem to favour, while strong light and drought seem to retard, the development of these anchoring organs. The pads are negatively heliotropic.

The author has noticed that, in carefully detached pads, the thin-walled papillae and the cells of the trichomes are quite turgid and intact. The nuclei (n) are very clearly seen as tiny black specks in the cells in Fig. C, and the nucleoli (n') in the nuclei in the highly magnified Fig. D. Silica particles, adhering to the outer walls of the cells of the papillae and trichomes, appear as highly refractive dots under a powerful microscope.

Some of the papillae and trichomes (see fig. F) described above seem to resemble some of those noticed by Uhlworm on the surfaces of the calyx, petioles and internodes of *Cucurbita Pepo* L. and figured (see figs. 40, 43, 46-49) in Bot. Zeitung (1873) taf. X. The trichomes described above do not, however, agree with any of the 4 kinds of trichomes described and figured by Yasuda in Journ. Coll. Sc. Imp. Acad. Univ. Tokyo. XVIII (1903).

In dealing with the 'Adhesive disks of tendrils' Haberlandt (6. p. 208) says of those of *Ampelopsis* (= *Vitis*)—"The first result of contact stimulation is the abundant secretion of a mucilaginous substance, which owes its origin (in part at any rate) to the gelatinisation of the entire outer epidermal wall, with the exception of the cuticle and the innermost pellicle. According to Lengerken, mucilage is also secreted within the cell-cavity whence it passes to the outside. What-

ever its origin, the mucilage ultimately exudes, after rupturing the cuticle, and glues the disc to the substratum". A similar view is shared by several other renowned authors, e.g. Darwin (3. pp. 102, 135 and 147), Vines (21. p. 411), Kerner and Oliver (8. p. 699), Goebel (4. p. 268) and others. Darwin was of opinion that the discs of *Bignonia capreolata* Linn. (Bignoniaceae) and *Hanburya mexicana* Seem. (Cucurbitaceae) also secrete some sort of adhesive resinous cement. But, perhaps, it may be stated here that, up to this time, the writer has not come across any direct or convincing evidence to show that, the trichomes and papillae, constituting the anchoring pads of *Gymnopetalum cochinchinense* Kurz actually secrete any mucilaginous or resinous substance to glue the pads to the substratum of the support. Nevertheless, it is quite likely that, they do—although the quantity, considering the size of the pads, must necessarily be quite small. On the other hand, the presence of the turgid cells (see figs. D and E) of the papillae and trichomes, the branching (see fig. F) that occasionally takes place in the latter, and the nice way in which they fit themselves into the crevices, lead the author to suspect that, the process of attachment, at any rate, in the case of *Gymnopetalum cochinchinense* Kurz, is probably, at least partly, physical.

The development of these pads of *Gymnopetalum cochinchinense* Kurz, under adverse circumstances, where ordinary coiling-tendrils are of no use, seem to indicate that, among tendril climbers—which occupy a high place in the scale of organization—there are, at least, some plants, which are endowed with means of 'Double Adaptation. These plants, if placed under adverse circumstances, seem to take recourse to means (e.g. pads) which can be looked upon as alternative to the usual one (i.e. coiling-tendrils).

It will not perhaps be out of place to mention here that, although, some climbing and epiphytic plants (e.g. *Pothos angustifolius* Presl., *P. aurea* Linden., *Cymbidium aloifolium* Sw. and *Vanda Roxburghii* Br. etc.) are endowed with roots, which have the power of fixing themselves to supports, with the aid of capillary outgrowths from their epidermal cells, the papillae and multicellular trichomes met with on the anchoring pads of *Gymnopetalum cochinchinense* Kurz, when examined microscopically, could never be confounded with those unicellular capillary structures, which are, in fact, hardly distinguishable from the ordinary underground root-hairs, except in colour. It should also be stated here that, the adhesive-discs of *Vitis assamica* Laws., like those of *Ampelopsis quinquefolia* Michx. (= *Vitis hederacea* Ehrh.) (3 pp. 144-149), are composed of hypertrophically-enlarged globular cells with smooth hemispherical surfaces.

These globular Cells are quite different from the papillae and multicellular trichomes of *Gymnopetalum cochinchinense* Kurz. in both appearance and structure.

In conclusion, it may be added here that, among Cucurbitaceous plants, such anchoring pads have been also clearly noticed by the author, in dried specimens of *Trichosanthes palmata* Roxb. There are a few plants e.g., *Trichosanthes cucumerina* L., *Luffa aegyptiaca* Mill. and *L. acutangula* Roxb. in which such modification of tendrils into anchoring pads is suspected. In a few other plants e.g., *Trichosanthes cordata* Roxb., *T. dioica* Roxb. *Momordica dioica* Roxb., *M. cochinchinensis* Spreng., *Cucumis sativus* L., *Citrullus vulgaris* Schrad., *Cephalandra indica* Naud., *Cucurbita moschata* Duch., *Mukia scabrella* L. f. and *Zehneria umbellata* Thw., the slight thickening noticed in some portions of tendrils in contact with their supports, seem to suggest that, as a result of stimulation due to contact, the cells on the affected side suffer only from a moderate degree of hypertrophy. No thickening even has been observed in specimens of some plants e.g. *Lagenaria vulgaris* Ser., *Benincasa cerifera* Savi., *Momordica Charantia* L. and *Cucumis trigonus* Roxb., examined by the author. The majority of these plants are of tropical origin and the rest are cultivated² in the tropics. The writer regrets that, he had to base his conclusions, regarding the plants mentioned in this paragraph, on dried specimens.

Explanation of Figures

(Figures B-F drawn without the aid of a Camera Lucida.
Magnifications approximate.)

Fig. A.—A branch of *Gymnopetalum cochinchinense* Kurz. Nat. size. a, b, & c—anchoring pads, d—coiled portion of a tendril, t—tendril.

Fig. B.—An isolated pad. x 6.

Fig. C.—An anchoring pad growing in a crevice. x 35, n—nucleus, pap.—papilla, pap'.—trichome.

Fig. D.—A part of a longitudinal section of an anchoring pad showing enlarged trichomes. x 250, n—nucleus, n'—nucleolus, pap.—papilla, pap'.—trichome.

Fig. E.—Transverse section of a pad growing in a crevice. x 170. Ep.—epidermal cell, n—nucleus, pap.—papilla, pap'.—trichome.

Fig. F.—An artificial group of some of the branched trichomes from a pad growing in a crevice. x 170. e & f.—branched cells, Ep.—epidermal cell, n—nucleus, pap'.—trichome.

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(This list is not exhaustive.)

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24. Yasuda.—Comparative Anatomy of the Cucurbitaceae etc.
Journ. Coll. of Sc. Imp. Acad. Univ. Tokyo.
XVIII (1903).

The author regrets that he could not consult some interesting contributions *e.g.* Van Tieghem's *Sym. de struct.*, in *Ann. Sc. Nat.* Ser. 5.t. xiii (1870-1) and Tondera's *Gefässbundelsyst. d. Cucurbit* sitz. in *Ber. Weiner Akad.*, cxii. Abt. 1 (1903) and a few others, as these were not available to him.