MACARANGA TRILOBA: A New Myrmecophilous Plant,

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[With Plates V. and VI].

FROM what structural feature or combination of features are we entitled to infer that a plant is myrmecophilous, *i.e.* that it is definitely adapted to provide attractions for ants in return for protection by them? One writer considers an appropriate cavity for the ants to shelter in a sufficient sign of adaptation; another that extra-nuptial nectaries should always be present. A third thinks that the latter appeal no more to ants than to any other marauding insect with designs upon pollen, and that proteids in "food-bodies" should be offered. All look anxiously for signs of ants on the plants themselves and find these difficult to obtain in herbarium material, because the ants hurriedly leave the plants as soon as they are gathered, or desert them when they are drying. The material of *Macaranga triloba* on which the present observations were made was collected and brought home by Mr. Tansley, whose attention was drawn to the apparent myrmecophily of the plant by Mr. H. N. Ridley, the Director of the Royal Botanic Gardens, Singapore. This material consists of a few dried sprays and three seedlings (preserved in spirit), about 12 to 18 inches high, which were growing wild in the Singapore gardens. The plant seems (so far as can be gathered from the limited material at hand) to unite in itself all the essential characters of myrmecophily, *viz.* an appropriate cavity as a nesting place, a thin region which facilitates the boring of holes for ingress, and food-bodies, conceivably of a proteid nature, besides extra-nuptial nectaries—thus forming a combination only equalled by the two myrmecophilous species of Acacia (*A. cornigera* and *A. sphaerocephala*) (2) and by *Humboldtia laurifolia* (1). The tree belongs to the tropical genus *Macaranga* of the Euphorbiaceae, and is identified as *Macaranga triloba*. The seedling has hollow internodes in the woody stems (see fig. 2), one peltate leaf and a pair of stipules at each node. Of the stipules, some are caducous, some persist. When they are protecting the bud, they are erect; older ones are retroverted and become closely appressed to the stem (see fig. 1.)

The appropriate cavity is found in the hollow internodes, which are swollen in young stems. The pith seems to break down

naturally, and not to be eaten away by ants, for a transverse section shows a peripheral ring, 8 or 9 cells thick, inside the wood and bounded on the inside by continuous cell-walls. This cavity may perhaps be regarded as the result of adaptation to ant inhabitants on the part of the plant (see figures 10 and 2).

Ingress is also facilitated by the plant. Grooves run vertically up the stem from the leaf axil to the next node, and these are probably caused, as in *Cecropia* (2) by the pressure of the axillary bud on the soft young tissues and the longitudinal stretching of the stem. The grooves are somewhat wider at the upper end, but the stretching of the circumference has less effect than it has in *Cecropia*. The grooves are not present on all internodes, but in nearly all the grooves there are one, two, or three holes leading to the cavity within and placed near the end of the internode (fig 1). In some of the internodes without grooves there are holes which only penetrate a short distance and show signs of considerable cambial activity. Some of these holes are stopped by a plug of latex, possibly of caoutchouc. The latex cells, which are very prominent, have yellow, brown or red contents (see figs. 10 and 11).

In young stems there is a distinct nodal plate, but this is perforated in older material, probably by the ants, as in *Cecropia;* so that there is free communication between the internodes and a hole is unnecessary in every one.

As in *Humboldtia laurifolia* (1) and *Duroia hirsuta* (3) the food-bodies in *Macaranga triloba* are on the stipules. Here however they are found on the morphological under side, which becomes, in old retroverted stipules, the concave side where they are hidden from all but the initiated (see Figs. 1 and 3). They are of a very peculiar structure and consistency and much more work will be necessary before I can give a satisfactory account of them. They are not however unique among food-bodies eaten by ants in being abnormal, for Schimper says of the Beltian corpuscles (2): "Sie unterscheiden sich jedoch von allen bekannten Drüsen durch bestimmte Merkmale,.....nämlich durch bedeutendere Grösse, längerer Dauer, Reichthum an Eiweissstoffen, leichtes Abfallen beim Berühren." Their shape is spherical or pear-shaped, they are of a golden yellow colour, and their contents greatly obscure their structure. Absolute alcohol and clove oil cleared them somewhat and showed them to be multicellular, with external hexagonal marks, presumably cell-walls. They can be ruptured with considerable pressure under a cover-slip and then exude drops of a liquid

which does not mix with glycerine (see figs. 5, 8 and 9). It will be remembered that Francis Darwin (4) showed that the Beltian corpuscles contain oil—insoluble in glycerine but soluble in absolute alcohol. Associated with these "food-bodies" are glands resembling the Lupulin-glands of the female inflorescence of the Hop, which De Bary calls "Bladder-glands." The bladder is formed by the cuticle, which is separated from the epidermis by the secretion. In *Macaranga* there can be seen, in surface view, a plate of 8 or 9 cells, with radial and periclinal walls, below the bladder. If the multicellular food–bodies arise from these glands it must be by further division by anticlinal walls so that the circular plate of cells becomes a sphere. Satisfactory intermediate stages are wanting, but in some of the glands hexagonal markings are seen on the cuticle similar to those on the food-bodies (see figs. 4 and 6). The cuticle of the food-bodies is very tough; it resists crushing and few re-agents can penetrate it.

Nectaries are borne at the serrated tips of the leaves. They are identical with those described by Beccari in *Macaranga caladiifolia*, which species differs from the one under discussion in the shape and position of the stipules and in the absence of food-bodies in them. The nectaries in *M. caladiifolia* are cup-shaped glands found at the extremity of veins near the base of the peltate leaf (see figs. 7, 12 and 13).

Finally there were found in the internodes many ants, not only adults, but also pupae and larvae. Their presence, which is apparently an unusual feature, is probably due to the fact that the material was put into spirit within a few hours of gathering, so that the ants had no time to escape, or would not leave their pupae in the internodes and could not drag them through the holes. The ants have been identified by Colonel Bingham as belonging to an apparently undescribed species of *Cremastogaster* near *C. daisyi*, Forel.

This is the case for *Macaranga triloba* as a claimant for Myrmecophily. Of course one cannot but agree with K. Schumann when he says: "Der Beweis dass ein Gewächs als Ameisenpflanze zu betrachten ist, kann im strengsten Sinne des Wortes nur an den Localitäten geführt werden, wo dasselbe seine Heimath hat. Vor allem muss durch das Experiment gezeigt werden, dass die Entfernung der Insecten auf das Gewächs einen bemerkbar schadigenden Einfluss ausübt." Such an experiment has yet to be tried on *Macaranga triloba* in its native habitat, but the striking

combination of features found in it can only be explained as adaptive and it may therefore be regarded as fully entitled to enter the ranks of the myrmecophilous until it has been submitted to Schumann's test and has failed to justify its position.

LIST OF LITERATURE CITED.

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(3) K. Schumann. Einige neue Ameisenpflanzen. Pringsheim's Jahrbuch für wiss. Botanik. Band XIX. 1888.

(4) F. Darwin. Glandular bodies in *Acacia sphaerocephala* and *Cecropia peltata*. Linnean Society's Journal. Botany. Vol. XV.

(5) Beccari. Malesia II. Piante ospitatrici ossia piante della Malesia e della Papuasia.

(6) De Bary. Comparative Anatomy of Phanerogams and Ferns.

EXPLANATION OF FIGURES ON PLATES V. and VI. ILLUSTRATING MISS WINIFRED SMITH'S PAPER ON *MACARANGA TRILOBA*.

PLATE V.

Fig. 1.—Part of stem natural size, *s*, stipules; *ap*, aperture; *gr*, groove.

Fig. 2.—Split stem to show hollow internodes. Natural size.

Fig. 3.—Concave side of stipule, *fb*, food-bodies; *c*, cavity; *a*, place of attachment to stem. (× 6).

Fig. 4.—Vertical section through bladder gland and epidermis of inside of stipule, *e*, epidermis; *pc*, plate of cells, *c*, cuticle; *bg*, bladder gland. (× 293).

Fig. 5.—Vertical section through bladder gland and food-body on inside of stipule, *fb*, food-body. (× 293).

Fig. 6.—Bladder gland, surface view. (× 355).

Fig. 7.—Vertical section through nectary. (× 80).

Fig. 8.—Food-body, surface view, cleared in absolute alcohol and clove oil. (× 134).

Fig, 9.—Large food-body, crushed, exuding oil drops in glycerine. (× 60),

PLATE VI.

Fig. 10.—Transverse section through part of hollow stem with partial perforation repaired by latex plug (*l.p.*) and cambium; *m*, Pith; x^2 secondary Xylem; *c*, cork (Diagrammatic). (× 60).

Fig. 11.—Transverse section through part of hollow stem to show complete perforation; lettering as in Fig. 10. (Diagrammatic.) (× 33).

Fig. 12.—Surface view of nectary showing its relation to vascular bundles of leaf. (× 46),

Fig. 13.—Under side of leaf showing system of veining and position of nectaries, *n*. Natural size.

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