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Amazonian Myrmecophytes and their Ants.

By

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The myrmecophytes and their ants on which this paper is based were collected by the junior author while acting as entomologist to the Harvard tropical medical corps, which in 1924 accompanied the Hamilton Rice Seventh Expedition to the Amazon[1]. The plants have been identified by Dr. IVAN M. JOHNSTON of the Gray Herbarium. The paper consists of two parts, one comprising the detailed field-notes and drawings of the junior author, the other a taxonomic account by the senior author of the Formicidae taken in the cavities and myrmecodomatia of the plants.

Part I. Myrmecophytes.

Cecropia.

The species of the very interesting genus *Cecropia*, belonging to the family Moraceae, appear to be quite numerous in Amazonia.

[1] See "Contributions from the Harvard Institute for Tropical Biology and Medicine, No. IV". Cambridge, Harvard Univer. Press., 1926.

As one travels along the main river or its affluents one encounters at frequent intervals species not previously observed, but not all of them are myrmecophilous. Only a few species have thus far been subjected to detailed investigation. Most of the published accounts refer to *C. adenopus* MIQUEL (= *C. peltata* VELLOZO, not of LINNAEUS), but this is peculiar in that its normal ant inhabitant, *Azteca muelleri* EMERY, establishes in the bole of the older plants a spindle-shaped carton nest of such dimensions that it is marked on the outside by a distinct swelling of the stem. No such swelling was ever seen by the junior author in any of the Amazonian species although many thousands of specimens of half a dozen species were carefully examined during the trip. In addition to *C. adenopus* and two species studied in the sequel, the following Cecropias are definitely known to be myrmecophilous:

Cecropia angulata BAILEY, British Guiana. This is one of the few species in which the relations between the plant and the ants have been carefully studied (I. W. BAILEY, 1922).

C. robusta J. HUBER. Common along the lower Amazon in woods that are frequently flooded. Stated to be myrmecophilous (J. HUBER, 1910, p. 61).

C. bifurcata J. HUBER. Lower Rio Purús, Brazil. Cited as myrmecophilous (J. HUBER, 1910, p. 62).

C. laetivirens J. HUBER. Upper Rio Purús and Territory of Acre. Myrmecophilous (J. HUBER, 1910, p. 63).

C. paraënsis J. HUBER. Lower Amazon. Myrmecophilous (J. HUBER, 1910, p. 64).

C. distachya J. HUBER. Vicinity of Pará. Myrmecophilous (J. HUBER, 1910, p. 65).

C. lyratiloba MIQUEL (*C. paludosa* WARBURG). A swamp species of Southern Brazil which H. v. IHERING (1907) found inhabited by Azteca. It possesses trichilia.

C. sciadophylla MARTIUS. This species is doubtfully myrmecophilous since it possesses no trichilia at the bases of the petioles. According to E. H. SNETHLAGE (1923, p. 358), *C. Juranyiana* AL. RICHTER is merely a variety of *C. sciadophylla*. Another variety, described by SNETHLAGE as var. *decurrens*, was recorded by ULE as inhabited by *Azteca emeryi* FOREL. This record may be due to an error or the ants may merely have occupied the hollow stems. Prof. BAILEY, who observed the same var. *decurrens* near Kartabo, British Guiana, regards it as non-myrmecophytic. It

lacks trichilia and food-bodies, although it possesses a prostoma. He never found Aztecae in the hollow internodes, but these were sometimes occupied by inquiline ants, namely *Neoponera stipitum* FOREL, *Crematogaster limata* F. SMITH, *Cephalotes atratus* (LINNAEUS) and *Camponotus melanoticus* var. *hagmanni* FOREL.

C. riparia "WARBURG", SNETHLAGE (1923, p. 363). Brazil. This species is provided with trichilia at the bases of the petioles and ULE (1906) found the internodes occupied by *Azteca alfari* EMERY var. *aequilata* FOREL.

C. ficifolia "WARBURG", SNETHLAGE (1923, p. 365). Rio Acre, Brazil. The bases of the petioles bear trichilia and ULE mentions that the internodes were inhabited by *Azteca minor* FOREL.

C. montana "WARBURG", SNETHLAGE (1923, p. 368), of Peru, has trichilia and ULE found it inhabited by *Camponotus* (*Pseudocolobopsis*) *ulei* FOREL.

C. mexicana HEMSLEY. A number of ants have been found by ROSS (1909) in this Mexican species, namely *Azteca alfari* var. *fumaticeps* FOREL, *A. coeruleipennis* EMERY, and *A. xanthochroa* ROGER. The bases of the petioles appear to lack trichilia.

Many other species of Cecropia are known to possess trichilia, e. g. *C. carbonaria* MARTIUS and MIQUEL, *C. cyrtostachya* MIQUEL, *C. Dielsiana* SNETHLAGE, *C. Engleriana* SNETHLAGE, *C. Francisci* SNETHLAGE, *C. Glaziovii* SNETHLAGE, *C. leucophaea* PÖPPIG and MIQUEL, *C. multiflora* SNETHLAGE, *C. palmata* WILLDENOW (perhaps the same as *C. obtusa* TRÉCUL), *C. saxatilis* SNETHLAGE, *C. Ulei* SNETHLAGE and *C. Urbaniana* SNETHLAGE. Some botanists assume that all such species are ant-plants. It is, however, by no means certain that the presence of trichilia alone is sufficient to give them the status of true myrmecophytes. The senior author observed many years ago that the common *Cecropia* of Porto Rico (probably *C. Urbaniana* SNETHLAGE) produces coral-red food-bodies among the hairs of the trichilia and yet is never inhabited by Azteca (WHEELER, 1908, p. 122).

The Cecropias ("imbaubas" of the Brazilians, "céticos" of the Peruvians) generally grow in dense groves. Some of the species of the Amazonian Basin are commonly found in the second growth, in plantations, along road-sides and in waste places. They may be observed right in the towns and sometimes grow out of the walls of old buildings. This would seem to indicate that the seeds are scattered in the excrement of birds and bats that feed on the fruit. Other species prefer the alluvial woods, on what is known

in Brazil as "varzea", i. e. low-lying land that becomes water-logged when the rivers reach their highest level. Finally, a few species thrive in the "igapó", or true inundated forest, and are among the very first plants to colonize the shifting mud-banks in the river itself as well as the new alluvial land. During much of the year these Cecropias stand in swiftly flowing water many feet deep, so that the ant-colonies that inhabit them must have their food-supply restricted to the food-bodies produced by the plant and the honey dew furnished by the Coccids in their internodal cavities.

In connection with the theory that the Aztecas which live inside the trunks of the imbaubas act as a body-guard to the plants, it may be worth while to point out that the leaves of *Cecropia* are the favorite food of the sloths. A female three-toed sloth (*Bradypus tridactylus flaccidus* GRAY) kept alive for several days at Manáos, refused all other kinds of food [2].

J. HUBER (1906, p. 557) notes that in Amazonia a kind of wax is sometimes extracted from the hollow internodes of Cecropia. He is not certain whether this substance is produced by the tree or, as some claim, by a bee that nests in the trunk. In British Guiana the senior author found small stingless bees of the genus *Trigona* nesting in the internodes of Cecropia and building cells of a very pale yellow wax.

Ants were collected by the junior author from the following three different species of Cecropia during his Amazonian trip:

Cecropia leucocoma MIQUEL.

Cecropia leucocoma MIQUEL, 1853, in MARTIUS, Flora Brasiliensis, IV, pt. 1, p. 142. SNETHLAGE, 1923, Notizbl. Bot. Gart. Mus. Berlin-Dahlem, VIII, p. 361.

Cecropia arenaria WARBURG, 1906, ex ULE, in KARSTEN and SCHENCK, Vegetationsbilder, IV, Heft 1, p. [4], Pl. II (name only).

Cecropia leucocoma is the common species of the genus on the dry ground, or "terra firma", near Manáos, and usually grows in places where the forest has been partly destroyed [3]. It is a small

[2] For accounts of the habits of *Bradypus* see A. MENEGAUX, 1909, "Contribution à l'étude des Edentés actuels. Famille des Bradypodidés." Arch. Zool. Expér. Gén., 41, 3, p. 277—344, and H. LÜDERWALDT, 1918, "Observaçoes sobre a preguiça (*Bradypus tridactylus* L.) em liberdade e no captiveiro." Rev. Mus. Paulista, 10, p. 793—812.

[3] *C. leucocoma* was described from specimens collected by SPRUCE at "Barra prov. Solimoês." Barra is the old designation for the locality now called Manáos. An excellent photograph taken at Manáos was published by ULE, 1906, under the name *C. arenaria*.

tree about 15 feet high and its internodes are almost always inhabited by ants. The hairy cushions, or trichilia at the bases of the petioles, producing the food bodies (Müllerian bodies), the chambers of the stem, separated by nodal septa, which are perforated by the ants, and the stoma, or opening in the depression (prostoma) at the upper end of a furrow above the attachment of the leaf, all agree with similar structures described for *Cecropia adenopus* and *C. angulata*. The leaves of *C. leucocoma* are very deeply palmate, the divisions of the blade reaching to a short distance from the petiole. The latter, the under side of the leaf and the bracts which enclose the flower spikes as well as the terminal buds, are densely covered with a short, soft, white, somewhat silky felt. The upper side of the leaf is green, with a slight sprinkling of felt, and contrasts sharply with the white under side. The male flowers are placed on long, slender, cylindrical spikes about 10 to 14 cm long and 6 to 8 mm thick, usually four together at the end of a peduncle 6 to 8 cm long. The spikes also are felty-white. This species was flowering at the beginning of August.

One tree examined at Florès, near Manáos, Aug. 9, was inhabited by *Azteca schimperi* EMERY. Not only were the internodes occupied by the ants, but the insects had built a carton nest on the upper part of the trunk. This nest, which was about 30 cm long and 15 cm across, was constructed around the trunk but the bark of the tree was unaltered and the bole was not in the least swollen. A part of the colony which had built this outside carton nest was inhabiting the internodes of the same tree. Many ants were running over the leaves and among them adults and larvae of a peculiar Reduviid bug were noticed. They were not molested by the ants although the bug may, perhaps, feed on them. This was not observed, however. On the leaves were also found a larval roach and a longicorn beetle, which was surrounded by many ants that appeared to be licking its anal region. Two species of Coccids found at the bases of the leaves were identified by Dr. H. MORRISON as *Pseudococcus rotundus* MORRISON and a species of Akermes.

The internodes of another *Cecropia leucocoma* at Florès were inhabited by a smaller ant, *Azteca alfari* EMERY var. *mixta* FOREL.

Cecropia obtusa TRÉCUL.

Cecropia obtusa TRÉCUL, 1847, Ann. Sci. Nat. Bot., (3) VIII, p. 79. SNETHLAGE, 1923, Notizbl. Bot. Gart. Mus. Berlin-Dahlem, VIII, p. 363.

This tree is frequently encountered along the edges of the forest on dry ground ("terra firma") in the region of the lower Rio Negro and Rio Branco. It was found in flower at San Alberto, near the mouth of the latter stream, on August 25. The leaves are green above and whitish beneath but the contrast between the two surfaces is not as great as in *C. leucocoma*. It is readily distinguished from that species by the leaf-blade, which is incised to only half its width, so that the leaves may be described as palmatilobate. The ant inhabiting *C. obtusa* at San Alberto was *Azteca alfari* subsp. *cecropiae* FOREL. Coccids were numerous in the cavities of the internodes inhabited by the ants.

Cecropia sp. indet.

A member of the genus Cecropia, common in the remnants of woods and along the roadsides near Pará, was not found in bloom so that specific identification is impossible. It is a rather small tree, generally 15 to 20 feet high, with very large leaves, which are practically glabrous beneath. The internodes of the stem and branches were found to be inhabited by *Azteca alfari* var. *ovaticeps* FOREL.

Rubiaceae.

The Rubiaceae are a natural group of plants extremely well represented in the tropics and of all families contain the largest number of myrmecophytes. But, strange to say, most of these occur in the Old World. Not more than half a dozen species are known from South America and these belong to three genera: *Duroia*, *Remijia* and *Patima*. The first and second were included in the junior author's «Synopsis of Myrmecophytes» (J. BEQUAERT, 1922, p. 529). Of the genus Patima a myrmecophilous species was discovered in 1922 by Mr. HERBERT LANG in British Guiana and described by Dr. I. M. JOHNSTON (1924, p. 83).

Duroia LINNAEUS FIL.

This genus is confined to tropical South America and includes ten species. Four of these are known to be myrmecophilous and have been studied by SPRUCE (1908), SCHUMANN (1888) and ULE (1906). Three of them, namely *D. hirsuta* PÖPPIG and ENDLICHER, *D. petiolaris* J. D. HOOKER, and *D. dioica* KARSTEN, present swollen internodes which are inhabited by ants. The fourth species, *D. saccifera* MARTIUS, has peculiar sac-like myrmecodomatia

at the bases of the leaf-blades. The junior author's observations relate to this species which was the only one he encountered on his trip.

Duroia saccifera (MARTIUS) (Fig. 1).

Amaioua (?) *saccifera* MARTIUS, 1829, in J. A. and J. H. SCHULTES, Systema Veget., VII, 1, p. 91.

Amaiona saccifera SPRUCE, 1908, Notes of a Botanist on the Amazon, II, p. 396.

Duroia saccifera BENTHAM and HOOKER, 1873, Gen. Plantarum, II, p. 82. K. SCHUMANN, 1888, PRINGSHEIM's Jahrb. Wiss. Bot., XIX, p. 395, Pl. X, figs. 4—6; 1889, in MARTIUS, Flora Brasiliensis, VI, 6, p. 362, Pl. 146, fig. I; 1891, in ENGLER and PRANTL, Die natürlichen Pflanzenfam., IV, 4. Abt., p. 12, fig. 5B and p. 83. ULE, 1906, in KARSTEN and SCHENCK, Vegetationsbilder, IV, Heft 1, p. [13].

Duroia saccifera was first observed by the junior author at Florès, on the outskirts of Manáos, where it was growing in small numbers in dense thickets of second growth woods[4]. It forms either a low bush, about 6 feet high, with hard, woody twigs, or a small tree, 8 to 10 feet high, with an unbranched main stem of about 5 feet. The leaves are placed in whorls of three, more rarely opposite, especially in young plants, and near the base of the branches. They measure 15 to 30 cm in length and 5.5 to 12 cm in greatest width and are elongate-oval, with entire margins, ending in a short slender point. The basal half is gradually attenuate, the base itself briefly rounded off. The petiole is very short and almost wholly occupied by the lateral pouches. At the tips of the branches the leaves form an elongate bud enclosed in a large bract, which drops off after the leaves develop. The entire plant is covered with hispid, somewhat whitish hairs, which are particularly long on the stem, the midrib of the leaves and the myrmecodomatia. Neither flowers nor fruit were seen. The latter are described by SPRUCE (1908, p. 396) as follows: "The fruit resembles a large plum (except that like the leaves it is harshly hairy), and when ripe is soft and edible; but long before it reaches that stage the ants crowd on it and seem to suck the juices through the pores of the cuticle."

[4] The plant was originally described from "Barro do Rio Negro", the former name of Manáos.

The myrmecodomatia of *D. saccifera* are two pouches at the base of the leaf on each side of the petiole. These sacs are completely separated from each other by the whole width of the petiole on the upper as well as on the under side of the leaf. They are nearly symmetrical, ovate, 10 to 14 mm long, 6 to 7 mm wide and 4 to 6 mm thick, and are completely closed at the lower end and along the petiole, but open at the upper end by a narrow slit in the deep, sinuous notch which divides the base of the leaf-blade from the pouch. The pouches might be regarded as having been formed by the recurving of the decurrent bases of the blade to the upper side of the leaf, and the growing fast of the free edges of the recurved portion to the petiole. If this conception of their mode of origin is correct, the

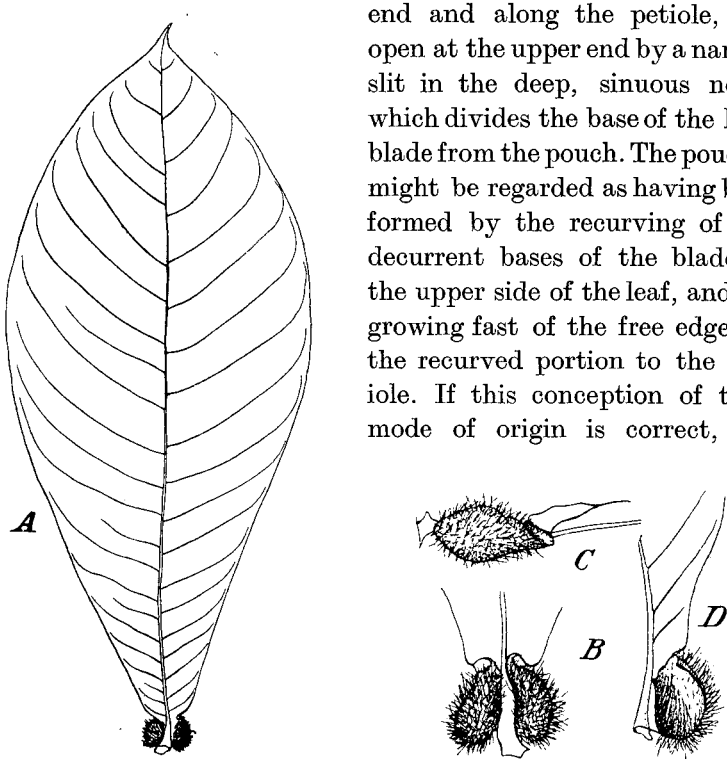

Fig. 1. *Duroia saccifera* Martius. A: leaf from the upper side, × ⅓. B: myrmecodomatia from the under side, × 1. C: the same from the side, × 1. D: the same in a longitudinal section, × 1.

outer surface of the domatia corresponds to the under side of the blade and their inner surface to the upper side. Both the inner and outer surfaces are densely covered with long, hispid hairs. Those of the inner surface converge towards the upper slit, which they partly close up [5]. The ants found in the myrmecodomatia were

[5] In the original description of the plant the pouches are described as follows: "Mira saccorum constructio: lineâ 5 â. vel. 6 â. ab insertione petioli 6 lin. longi, supra plani, crassi, hirti, reflectitur uterque margo versus nervum medium cum eodem concrescens, volvitur dein iterum extus, et in pagina superiore folii iterum cum petiolo coalescit, ita, ut eisde sacculi formentur 2 inflati, apice rimâ obliquâ aperti, ovati, fusci, nervosi, hirti, intus glabri, reticulato-nervosi, 5 lin., 2—2½ lin. in diametro." (MARTIUS, 1829, p. 92). No mention is made of the presence of ants.

Solenopsis corticalis FOREL and *Brachymyrmex heeri* FOREL var. *aphidicola* FOREL.

It is interesting to note that in spite of the pouches being inhabited by ants, the young leaves of this plant were badly damaged by leaf-cutting ants (Attini), while the older leaves were eaten by caterpillars.

The same species of Duroia was observed at Carmo, on the right bank of the Rio Branco, Sept. 1. In this locality the ants found in the pouches were *Azteca ulei* FOREL var. *cordiae* FOREL. ULE (1906) found the pouches of *D. saccifera* in the forests of the Rio Negro to be tenanted by *Allomerus octoarticulatus* MAYR.

Melastomataceae.

Tococa.

The myrmecodomatia in this genus are protruding sacs, or pouches, produced by an evagination of the base of the leaf-blade towards the upper (dorsal) side of the leaf. They open on the under side of the leaf in the axil between the midrib and the next longitudinal vein. In most cases there are two pouches at the base of a single leaf, each half of the blade having produced one, but the two sacs of the pair are broadly grown together on the side though always completely separated by a partition. Sometimes one of the two pouches is vestigial or much smaller than the other, and species have been described which have only a single pouch to each leaf. In some species the pouches are still borne by the blade and are entirely or partly included in it; in others they are attached to the petiole, often at a considerable distance from the base of the blade, but even in these cases a hollow channel running along the upper surface of the petiole, connects each sac with its opening, which is still situated in the axil of the midrib on the under side of the leaf.

Since the pouches are simple evaginations of the leaf-blade, they are naturally hollow, and the ants have nothing whatsoever to do either with their production or with the formation of their opening. There is not the slightest possibility that they can be galls, since they are produced with their usual size and shape even in seedlings that have never been attacked by the insects. They are inherited structures and, moreover, their shape and position are characteristic of the several species. That they owe their origin to acarodomatia which for some obscure reason be-

came enormously enlarged, is a fanciful hypothesis which it seems impossible either to substantiate or to disprove with any facts.

About 40 species of Tococa have been described from South America. These may be separated into the four following groups, according to the myrmecodomatia: (a) with pouches on the petiole only; (b) with pouches partly on the petiole and partly included in the leaf-blade; (c) with pouches entirely included in the leaf-blade; (d) without pouches.

RÜBSAAMEN (1908, Marcellia, 7, p. 69—71) has described a number of galls found on various species of Tococa in Brazil:

(1) *Tococa setifera* PILGER. Gall on leaf at apex of branches, produced by an Anguillulid Nematode. Marary Juruá, Amazonas.

(2) *Tococa* sp. Gall on leaves, produced by a Cecidomyid midge. Pará (Belem).

(3) *Tococa juruensis* PILGER. Gall on leaves, caused by a Lepidopterous larva. Fortaleza on the Lower Juruá.

(4) *Tococa Ulei* PILGER. Gall on leaves caused by a Lepidopterous larva. Leticia, Peru (near the Brazilian border).

(5) *Tococa* sp. Gall on twig, caused by a Lepidopterous larva. Juruá Miry, Amazonas.

(6) *Tococa bullata* MARTIUS. Acarocecidium on leaves. Cabo Frio, State of Rio de Janeiro.

Tococa formicaria MARTIUS (Figs. 2 and 3).

Tococa formicaria MARTIUS, 1828, ex A. DE CANDOLLE, Prodromus Syst. Nat. Regn. Veget., III, p. 165; 1828, Nova Gen. Spec. Plant., III, p. 147, Pl. 278. COGNIAUX, 1888, in MARTIUS, Flora Brasiliensis, XIV, 4, p. 439; 1891, in A. and C. DE CANDOLLE, Monogr. Phanerog., VII, p. 962.

Tococa formicata STEUDEL, 1841, Nomenclat. Bot., 2nd Ed., II, p. 689.

Tococa didymophysa NAUDIN, 1851, Ann. Sci. Nat. Bot., (3) XVI, p. 90.

Tococa hirsuta STEUDEL, 1871, ex TRIANA, Trans. Linn. Soc. London, XXVIII, p. 132.

Tococa formicaria appears to be one of the most common and widely distributed Tococas of the Amazon Basin. Specimens observed at Vista Alegre, on the Rio Branco, were positively identified as this species by Dr. I. M. JOHNSTON of the Gray Herbarium. He feels inclined to refer to the same species other plants which the junior author saw commonly at Pará and Manáos.

There is apparently much variation in the pubescence as well as in the shape of the pouches among the several specimens collected, but it is extremely probable that much of this is due to the age of the plants as well as to the peculiar conditions of the environment, such as shady or more open thickets, swampy or drier soil, influence of cuttings, etc.

The most common Tococa at Pará forms, when fullgrown, a much ramified, woody bush, reaching a height of 10 to 12 feet. It was seen in bloom July 15. The numerous pale pink flowers are clustered in panicles at the ends of the branches; the flower stalks are violaceous red, as are also the dense stiff hairs of the calyx. Later (September 20), this species was found bearing fruit at Pará, a violaceous black berry containing numerous small seeds. The leaves vary considerably in size and shape and are ovate, rather abruptly narrowed into a long, sharp apex. The

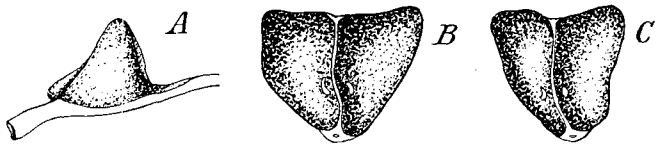

Fig. 2. *Tococa formicaria* Martius. Pará. A: myrmecodomatia from the side, × ⅔. B. and C: the same in cross-section, × 1.

margin of the leaf is but slightly crenulate, often almost entire. The ribs are prominent on the under side and are either green like the remainder of the blade, or in some specimens red, but this difference in color of the veins does not seem to be of specific value. In this species the two opposite leaves of a pair may bear pouches of about equal size, or the pouches may be reduced or in some cases totally absent from single leaves, and all of these different conditions may be found on the same bush. When the myrmecodomatia are not equally developed, they are always much bigger on the larger leaf of a pair. The pouches are inserted on the petiole far from the blade, which is much contracted and more or less heart-shaped at the base. The two pouches (Fig. 2) of a leaf are of about the same size and shape, very broadly connected in the middle line and the partition is distinctly thicker than the outer wall of the sacs. *T. formicaria* is peculiar in that there is generally but a slight or almost no depression separating the two pouches externally, so that the pair is, as a rule, almost straightly truncate at the top. While the outer surface of the

myrmecodomatia is more or less densely covered with the same long hairs as the petiole, the inner surfaces of the walls are smooth and bare.

It was interesting to observe in this plant at Pará an abundance of mite galls [probably of a Phytoptid (?)] on the leaf-blade

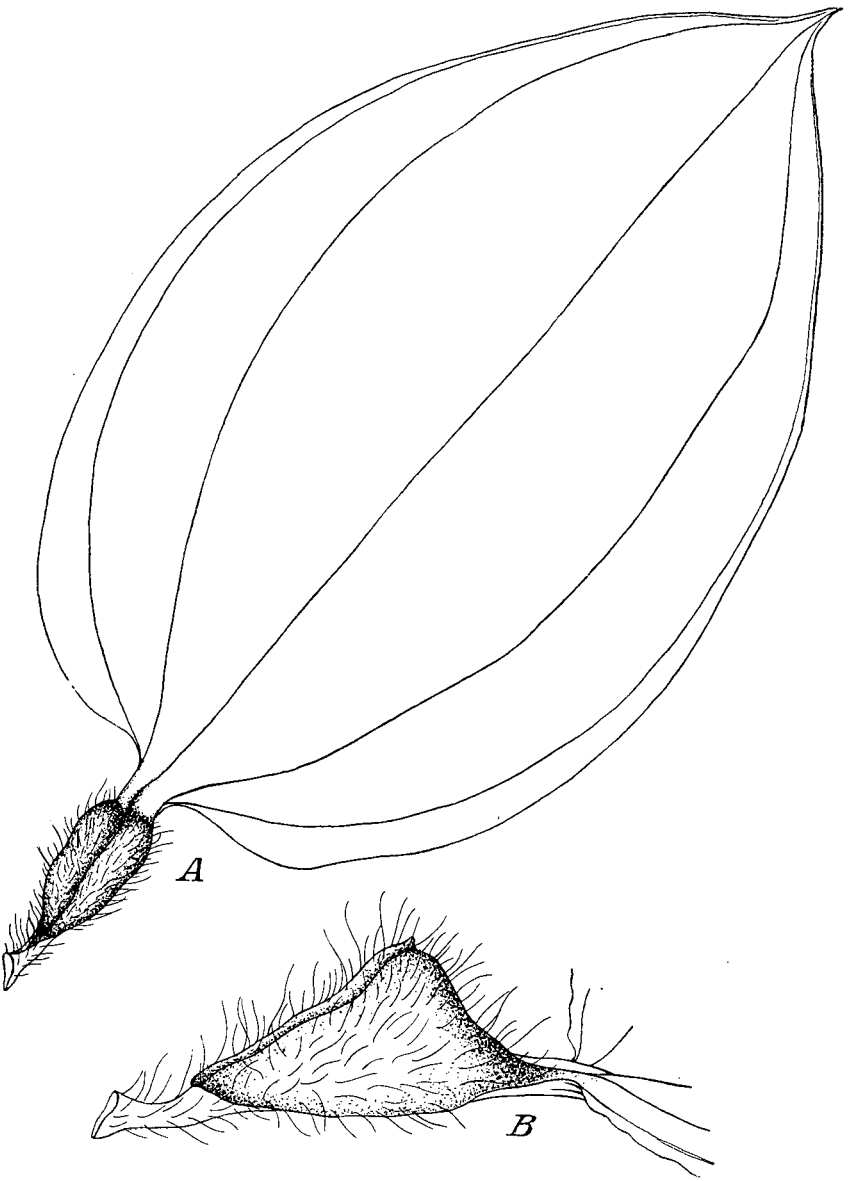

Fig. 3. *Tococa formicaria* Martius. Vista Alegre. A: leaf from the upper side, × ⅔. B: myrmecodomatia from the side, × 1½.

and even on the outer surface of the pouches. The galls consist of small curly excrescences of the epidermal cells, forming many irregular patches, of the type generally called "erineum". This acarocecidium is similar to that described by RÜBSAAMEN (1908, Marcellia, 7, p. 71) on the leaves of *T. bullata* MARTIUS from Cabo Frio, in the State of Rio de Janeiro. Leaves with portions eaten away by insect larvae are frequently found, even when their sacs are inhabited by ants.

The Tococa, to which the foregoing description applies, is commonly found on the outskirts of the town of Pará, growing in the remnants of woods and along road-sides. In its pouches the following ants were taken: *Azteca trailli* EMERY subsp. *tococae* FOREL, *Azteca bequaerti* WHEELER and *Azteca ulei* FOREL. Each plant was tenanted by only a single species of ant, which may be regarded as its regular or specific inhabitant. There were Coccids in some of the ant-inhabited sacs.

At Vista Alegre, on the Rio Branco, *T. formicaria* was found growing as a large, beautiful bush in the forest patches lining the banks of the river. Here the pouches (Fig. 3) were unusually large, frequently reaching a length of 30 mm, a width of 15 mm, and a height of 18 mm. Curiously enough, they were always found to be occupied by the same ant (*Azteca bequaerti* WHEELER), a very aggressive species. In a very small plant which had as yet only a few leaves, most of the pouches were found to be empty, but two contained each a solitary deälated queen of this ant.

A species of Tococa observed in the second growth vegetation at Florès, near Manáos (July 29), appears to be identical with the common Tococa of Pará and also probably represents *T. formicaria*. The flowers were at the time unopened. This plant generally formed a bush 7 to 10 feet high, with elongate-oval leaves, the ribs being red on the under side. The stem was densely hispid and the leaves also rugosely hairy. Very often, but not always, the pouches were wholly or in part vinaceous or violaceous red. In this locality the ants found in the myrmecodomatia were *Azteca ulei* FOREL var. *cordiae* FOREL. In one of the pouches there was an incipient colony, comprising a deälated queen, a few workers, several larvae and two or three Coccids. The workers carried away the Coccids as well as the larvae.

Tococa sp. (near *formicaria*) (Fig. 4).

Another species of Tococa was found on the outskirts of Pará, growing with the preceding along roadsides. It differs from the latter in two particulars, which may possibly be of specific value: the margin of the leaves is quite deeply and regularly crenulate and the two pouches of each pair are separated on the upper side by a very deep channel or notch. The plant is a rather low, semi-herbaceous shrub, the specimens seen in flower at the time (July 13) reaching a height of about 4 feet. The leaves are broadly ovate, 9 to 12 cm wide and 15 to 17 cm long, rounded off at the base and rather gradually narrowed into a long, pointed apex. In this species the two leaves of a pair are of about the same size and are both provided with similar myrmecodomatia. The pouches (Fig. 4) are relatively much higher and shorter than in *T. formicaria* and very densely covered with long hispid hairs. The partition separating them is rather thin, hardly thicker than the outer wall. Often one of the pouches is higher than its fellow. On one plant, which was examined in detail, many of the pouches were empty; some of the remainder contained only a small caterpillar. Perhaps a dozen contained ants, but as a rule they occurred in only one of the pouches of a leaf. It seemed that the inhabitants of a single pouch formed an independent colony which did not even communicate with its neighbours of the same leaf. Often the leaves had been badly eaten by insect larvae. The common ant in the pouches was *Strumigenys tococae* WHEELER, but some of them contained also colonies of the much larger *Neoponera crenata* ROGER var. *moesta* MAYR. This latter species is evidently an accidental inhabitant as it is more frequently taken in dead twigs (see p. 31). Most of the colonies of *Str. tococae* were small and apparently incipient, with a single deälated queen, larvae and pupae. No Coccids were found among these ants.

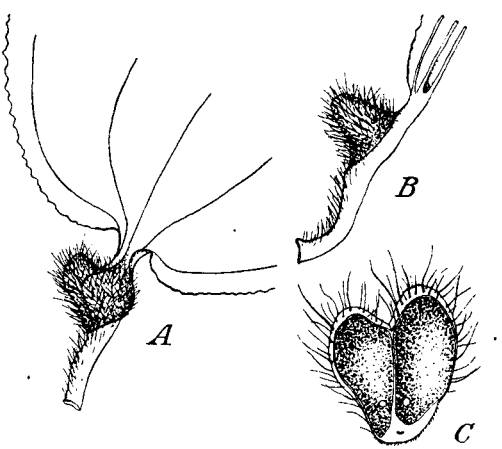

Fig. 4. *Tococa* species. Pará. A: base of leaf from the upper side, × ⅔. B: myrmecodomatia from the side, × ⅔. C: the same in cross-section, × 1½.

Tococa longisepala Cogniaux (Fig. 5).

Tococa longisepala Cogniaux, 1888, in Martius, Flora Brasiliensis, XIV, 4, p. 449, Pl. 96; 1891, in A. and C. de Candolle, Monogr. Phanerog., VII, p. 968[6].

Tococa longisepala is a remarkable plant found August 25 near Carvoeiro, a small village situated on the right bank of the Rio Negro, close to its confluence with the Rio Branco. It formed a low, woody bush about 6 feet high, growing in the water of a swamp. At the time only flower buds were seen on some of the branches. Three peculiarities distinguish it from *T. formicaria* and similar species: namely, the much lengthened leaves, the absence of pilosity and the partial enclosure of the pouches in the leaf-blade. The leaves are entirely green, elongate-oval, somewhat truncate at the base and gradually attenuated at the apex into a long point. The margins are nearly entire and bear two or three rows of short, spaced cilia, while there is a narrow line of rufous felt along the longitudinal ribs on the under side of the leaf. Otherwise the plant is almost completely glabrous, even the calyx being hairless. As a rule only one of the leaves of a pair possesses pouches, the other being without even a trace of them. On the lower leaf-pairs of the branches they are sometimes absent on both leaves, or mere traces are present on a single leaf. The myrmecodomatia (Fig. 5) are generally large, 18 to 25 mm long, 7 to 15 mm wide and about 10 mm high. They are separated on the upper side by a deep groove and are strongly gibbous. The basal part of the blade extends as two lobes along the upper two-thirds of the swelling, while its

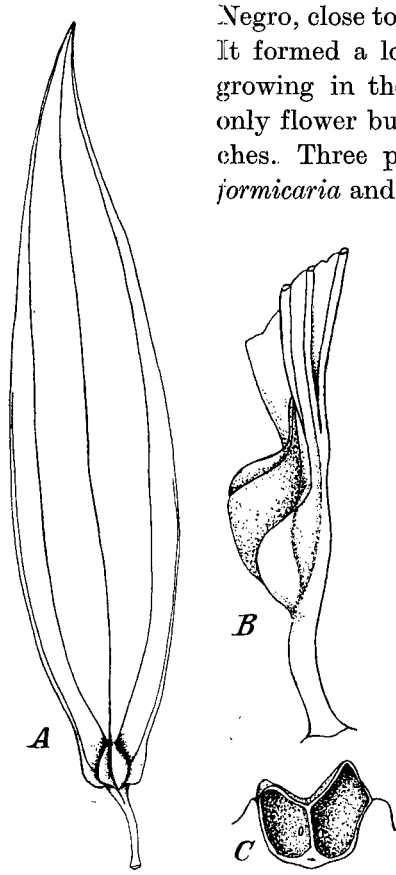

Fig. 5. *Tococa longisepala* Cogniaux. A: leaf from the upper side, × ⅓. B: myrmecodomatia from the side, × 1½. C: the same in cross-section.

[6] The species was described from specimens collected by Spruce in the vicinity of Manáos and on the Rio Uaupès.

lower third forms the apical portion of the petiole. As usual, each of the pouches opens on the under side of the leaf in the axil of the midrib and the next longitudinal vein. The three main ribs bifurcate a considerable distance above the base of the blade. Some leaves were seen to have the pouch developed only on one half of the base.

Two species of ants were taken from the pouches, namely, *Paratrechina* (*Nylanderia*) *tococae* WHEELER and *Azteca traili* EMERY subsp. *tococae* FOREL var. *elatior* FOREL. In a young specimen of the plant the pouches were found to be inhabited by deälated queens of the latter ant, a single individual in each pouch. Sometimes there was one in each pouch of a pair on the same leaf. The leaves of this Tococa had been badly lacerated by leaf-cutting ants (Attini).

Maieta AUBLET (*Calophysca* DE CANDOLLE).

The genus Maieta, which contains some eight species, is confined to tropical America, from Guatemala to Peru and Brazil. The pouches are placed on the leaf-blade or on the peticole and have the same origin as in Tococa, being evaginations of the leaf-blade towards the dorsal side. They open in a similar manner by a narrow aperture in the axil of the midrib and the adjacent longitudinal vein. Each leaf bears two pouches broadly grown together along the middle line.

Maieta guianensis AUBLET (Fig. 6).

Maieta guianensis AUBLET, 1775, Hist. Plantes Guiane Française, I, p. 443, Pl. 176. HUTH, 1887, Myrmecophile und myrmecophobe Pflanzen, p. 10, fig. COGNIAUX, 1888, in MARTIUS, Flora Brasiliensis, XIV, 4, p. 463; 1891, in A. and C. DE CANDOLLE, Monogr. Phanerog., VII, p. 975.

Melastoma Maieta DESROUSSEAUX, 1795, in LAMARCK, Encycl. Méthod. Bot., IV, p. 35.

Maieta hypophysca A. DE CANDOLLE, 1828, Prodromus Syst. Nat. Regn. Veget., III, p. 166. MARTIUS, 1828, Nova Gen. Spec. Plant., III, p. 150, Pl. 280.

Maieta dispar MIQUEL, 1844, Linnaea, XVIII, p. 277.

The singular *Maieta guianensis* was found in a deep wooded ravine on the outskirts of Pará[7]. It is a very low woody bush,

[7] This ravine may be recommended to the casual visitor to Pará as one of the few spots in which good collecting may still be had in the immediate vicinity of the town. It is situated to the right of the railroad

reaching little over two feet in height and branching close to the ground. It was observed only in densely shady places, but on dry ground. Neither flowers nor fruit were seen at the time (September 19). The leaves are dark green on both sides, soft, with but few, short, stiff hairs scattered over the upper surface; the under side is glabrous, except along the main ribs near the base. The margins are only superficially crenulate. The blade is almost regularly elliptical and rather suddenly contracted into a very long, slender point. As a rule only one of the opposite leaves of each pair bears myrmecodomatia and is then considerably larger than its fellow, 12 to 20 cm long and 4 to 8 cm wide. The basal portion, which envelops the pouches, is rather abruptly narrowed, 2 to 3 cm long and 5 to 16 mm wide. Without the myrmecodomatia the leaf is only 2 to 10 cm long and 1 to 5 cm wide and tapers gradually at the base. Occasionally both leaves of a pair bear pouches, in which case they are alike. Usually, however, all the leaves on one side of a branch bear myrmecodomatia while those on the opposite side are all smaller and without pouches. This arrangement gives the plant a very peculiar appearance.

The myrmecodomatia form a pair of pouches of about equal size at the base of the leaf, which nevertheless forms a broad wing on either side of the swellings so that they are completely separated from the petiole. Along the midrib the two sacs are separated by a broad partition and on the outside by a moderately deep but narrow longitudinal groove. By far the greater part of the swelling is situated on the upper surface of the leaf, where it forms a protuberance 2 to 3 cm long, 5 to 8 mm wide and about 5 mm high. It is highest at the base whence it gradually slopes towards the junction of the three main ribs of the leaf. The under surface bears many scattered, stiff, brownish hairs, which are much longer than elsewhere on the leaf. The inner surface of the sacs is glabrous but exhibits a peculiar structure not seen in any species of Tococa examined. There are numerous small warty outgrowths, arising from the midrib or from the ventral wall of the pouch, and projecting into its cavity. Sometimes the outgrowths arise from the partition between the two pouches. These warts resemble the haustoria, or suckers by means of which certain parasitic plants penetrate the tissues of the host plant, but they end

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to Bragança, just beyond the junction ("Entroncamento") of the branch railway to Pinheiro and is within easy walking distance of the terminus of the street car line to SOUZA.

freely in the cavity. They are not caused by the ants since they are found in very young pouches that have never been inhabited.

Most of the pouches examined were occupied by a minute yellowish ant, *Pheidole minutula* MAYR subsp. *folicola* FOREL. Those in each pouch seemed to form an independent colony, consisting of a single queen, several large-headed soldiers, some workers, larvae and pupae. Small Coccids were also found among the ants in some of the domatia.

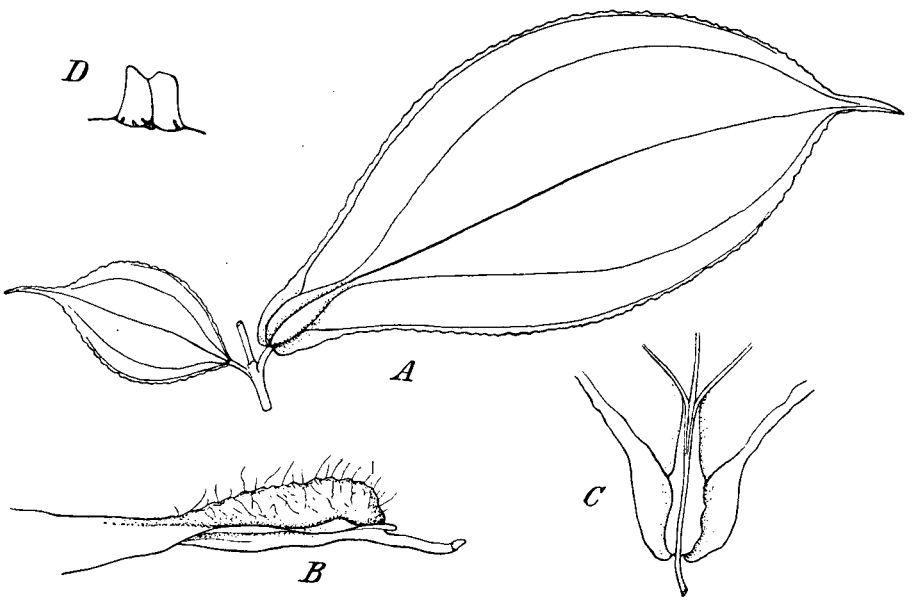

Fig. 6. *Maieta guianensis* Aublet. A: a pair of leaves from the upper side, × ⅔. B: myrmecodomatium from the side, × 1½. C: the same from the under side, × 1½. D: the same in cross-section, × 1½.

SPRUCE appears to be the only observer who has paid some attention to the myrmecodomatia of Maieta. In his posthumous work (1908) he states that in *M. guianensis* the leaves bear pouches and that in addition the branches are fistulose and swollen at the nodes. In the specimens studied by the junior author the branches were normal and not in the least swollen nor hollow at the nodes. Perhaps SPRUCE's observations were made on another species or, more probably, he wrongly interpreted as myrmecodomatia certain Lepidopterous galls on the stems. Such galls have, in fact, been described by RÜBSAAMEN for this same plant (1908, Marcellia, 7, p. 155).

Boraginaceae.

Cordia hispidissima A. DE CANDOLLE (Fig. 7).

Cordia hispidissima A. DE CANDOLLE, 1845, Prodromus Syst. Nat. Regn. Veget., IX, p. 475. FRESENIUS, 1857, in MARTIUS, Flora Brasiliensis, VIII, 1, p. 17.

Cordia hispidissima was observed on but one occasion, at Carmo, a small village on the right bank of the lower Rio Branco, in what appeared to be second growth forest. The plant was a low bush of the undergrowth, reaching at most a height of two feet, but it was not seen in flower. Only the tops of the branches are swollen to form a spindle-shaped, hollow myrmecodomatium, opening naturally at the top between the bases of the leaves and lateral twigs. The outside of the swelling is densely covered with long, hispid, erect brownish hairs, like those of the stem and petioles. The inner surface bears shorter, somewhat appressed and much sparser pile. At the top of the swelling there are three or four leaves, placed close together, almost in a whorl. They are dark green, with entire margin, 8 to 20 cm long and 5.5 to 11 cm wide, briefly petiolate, regularly elliptical and ending rather abruptly in a drawn-out point. Both surfaces are rugose and with a few stiff, short hairs on the veins of the under side and along the margin.

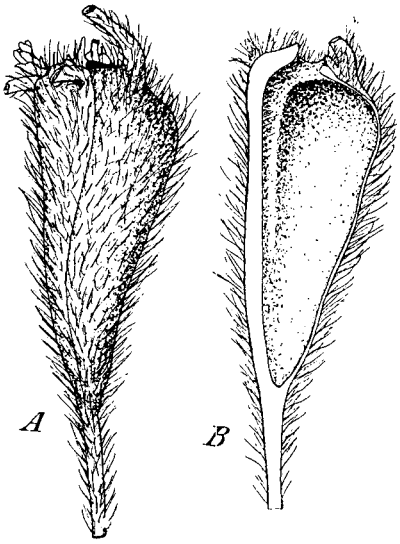

Fig. 7. *Cordia hispidissima* A. de Candolle. A: a myrmecodomatium, ×1½. B: the same in cross-section, ×1½.

The morphology of the myrmecodomatia has been recently studied by BAILEY (1924) both in this species and in *Cordia nodosa*. In the swellings of the former examined by the junior author quite a varied fauna was found. One swelling contained a book scorpion (*Chelifer*) occupying the lowermost portion of the cavity which was enclosed above by a white web-like partition; another was occupied by a medium-sized spider. Other domatia contained small colonies of a Ponerine ant, *Neoponera unidentata* MAYR var. *eburneipes* WHEELER. Each of these colonies consisted of 4 to 6 workers,

with eggs, larvae and pupae, the last enclosed in cocoons. This is a rather timid ant which did not attempt to defend itself.

Part II. Formicidae.

Subfamily Ponerinae.

1. Neoponera unidentata MAYR var. *eburneipes* var. nov.

Worker and Female (deälated). Differing from the typical *unidentata* in the color of the legs and the shape of the petiole. The former, including the coxae, are pale ivory yellow, the trochanters, distal portions of femora, knees, tips of tibiae and the tarsi brown. The middle portion of the posterior declivity of the petiole is very convex so that when the segment is seen in profile the surface is subangulate. The sculpture is much as in the typical form, the pubescence very fine and appressed. Head and mandibles subopaque, the former finely and evenly punctate; the remainder of the body more shining than in the typical form, with finer and more superficial puncturation. Upper surface of the clypeal tooth flattened, very finely longitudinally striate and without a median groove.

Described from 16 workers and a single female taken September 1, 1924, at Carmo, on the Rio Branco, from the cauline swellings of *Cordia hispidissima* DE C. This same variety is in the senior author's collection also from Kartabo (W. M. WHEELER), Bartica (W. BEEBE) and Chenapown, British Guiana. As a rule it inhabits dead twigs on living trees, is very active and when handled stings rather severely.

Examination of the specimens of *N. unidentata* in the senior author's collection shows that this widely distributed Ponerine, which ranges from Mexico to Argentina, presents several local varieties, some of which may be briefly described.

N. unidentata MAYR (typical). The worker and female were originally described from the Amazon. No specimens have been seen from Brazil which agree exactly with MAYR's description, but a single worker taken by R. J. CREW in British Guiana is very close.

Var. *rugulosa* EMERY. This form described from Peru, has the puncturation of the pro- and mesonotum coarser and confluent to form transverse or irregularly oblique rugules. Several workers and deälated females from Callanga, Peru (STAUDINGER) in the senior author's collection agree with EMERY's description and also

exhibit some of the gradations, which he mentions, towards the typical form. All have the sides of the epinotum longitudinally rugulose. The margins of the pronotum, as he states, are more projecting and the mesonotum is more flattened, with sharper lateral margins. The clypeal tooth is grooved in the middle above. The legs are colored nearly as in the typical *unidentata*, i. e. they are dark brown, with the coxae and bases of the femora yellowish brown. The fore coxae are black, however, except at the tip, whereas in the typical form they are yellowish brown. To this variety also three specimens from the Rio Madeira, Brazil and one from the Rio Uaupès may be referred, though they differ somewhat in sculpture. All have the sides of the epinotum even more sharply rugulose than the Peruvian specimens, and two of the specimens from the Rio Madeira have the thorax above merely densely punctate and subopaque like the head.

√√ Var. *maya* var. nov.

Worker. Characterized by the distinctly longer, denser and more golden pubescence on all parts of the body. The pilosity is also coarser and more abundant, and the mandibles are more shining than in the typical *unidentata* and the var. *eburneipes*. The sculpture and the coloration of the legs are as in the typical form of the species. The senior author has this variety from Trece Aguas, Alta Vera Paz, Guatemala (SCHWARZ and BARBER), Bugaba, Panama, 1500 ft. (CHAMPION) and Santa Lucrecia, Vera Cruz, Mexico (F. K. KNAB).

√√ Var. *trinidadensis* var. nov.

Worker. Differing from all the preceding forms in the feebler sculpture and more shining surface of the whole body. The punctures on the pro- and mesonotum are almost effaced, those on the head are fine and rather superficial, on the gaster and petiole extremely fine and indistinct. The pilosity and pubescence are moderate, the former shorter and more appressed than in *maya*. The legs and antennae are uniformly reddish brown.

Three specimens from Port of Spain, Trinidad (WHEELER).

SANTSCHI has described yet another from of *N. unidentata* from Córdoba, Argentina as subsp. *sulcatula*. It is related to *rugulosa* EMERY, "but the sculpture of the head is reticulate-punctate (longitudinally rugose-reticulate in *rugulosa*). The thoracic dorsum is more superficially reticulate-punctate than the head and almost as shining as the abdomen. Mandibles, clypeus, scapes and legs reddish, funicles and tarsi infuscated."

2. Neoponera crenata ROGER var. *moesta* MAYR.

Ten workers taken July 13 from the foliar domatia of *Tococa* sp. (near *formicaria*) at Pará. Like *N. unidentata* this ant regularly lives in the dead twigs of trees and shrubs.

Subfamily Myrmicinae.

3. Pheidole minutula MAYR subsp. *folicola* FOREL.

Numerous soldiers, workers and winged females taken Sept. 19 from the foliar sacs of *Maieta guianensis* AUBL. at Pará. The types of this subspecies were found by ULE in the foliar sacs of the same plant and of *M. poeppigii* MART. at Juruá Miry, Juruá, Brazil. In 1920 the senior author found all the leaf sacs of *Tococa aristata* BENTH. at Kalacoon, British Guiana, occupied by flourishing colonies of the typical *minutula*. It would seem, therefore, that this diminutive ant is definitely associated with Melastomataceae of the genera Tococa and Maieta.

4. Crematogaster (Orthocrema) limata F. SMITH.

Many workers taken by the junior author July 9 at Manáos, living in epiphyte covered ant-gardens in parabiosis with *Camponotus (Myrmothrix) femoratus* FABR. (vide infra). ULE has also taken the typical *limata* in ant-gardens in Amazonas. The form which the senior author took in these structures in British Guiana and also living in parabiosis with *C. femoratus* was the subsp. *parabiotica* FOREL, a smaller, darker form than the typical *limata*, with shorter epinotal spines and hairs. This subspecies frequently nests in dead wood or abandoned termitaria in Colombia and Central America. In these localities FOREL and the senior author often found it living in parabiosis with *Dolichoderus (Monacis) debilis* EMERY var. *parabioticus* FOREL.

5. Solenopsis corticalis FOREL.

Several workers of a form very close to the typical *S. corticalis* taken July 29 at Manáos from the foliar sacs of *Duroia saccifera*. FOREL has described a subspecies of this ant, *amazonensis*, taken by ULE from the spaces between the overlapping leaves of a Tillandsia (Pseudocatopsis) at Cerro de Escaler, Peru.

6. Strumigenys tococae sp. nov. ✓✓

Worker. Length 3.3—3.5 mm.

Allied to *S. rogeri* EMERY but decidedly larger. Head somewhat more than one and one-half times as long as broad, narrowed

anteriorly, deeply and semicircularly excised behind, and with rounded occipital lobes, the eyes moderately large and convex, in front of the middle of the sides. Clypeus small, subtriangular, broader than long. Mandibles somewhat more than half as long as the head, straight and linear, not flattened, their basal three-fifths with parallel external and internal borders, distally gradually narrowed to the slender rather abruptly incurved apical teeth. The inner border of the terminal two-fifths of each mandible bears two stout, distinctly oblique teeth, the first at the point where the mandible begins to narrow, the second half way to the apical teeth. The first tooth is distinctly shorter than the second (the reverse of the condition in *S. rogeri*). Antennae slender, the scapes subterete, reaching to about the posterior fifth of the head; first funicular joint as long as joints 2 and 3 together, the second being half as long as the third; joint 4 distinctly longer than 2 and 3 and the terminal joint fusiform, nearly as long as 2 to 4 together. Thorax slender, broadest through the pronotum which has rounded humeri and a rather convex dorsum. Mesonotum convex and subcarinate in the middle. Epinotum with subequal base and declivity in profile, the former nearly straight, flattened in the middle and sharply marginate on each side, the latter sloping, without translucent laminae; spines well-developed, longer than broad, acute, flattened. Metasternal teeth somewhat shorter than the spines but nearly as acute. Petiole with rounded, transversely elliptical node, in profile rising abruptly from the short peduncle and with well-developed spongiform masses around its sides and posterior border and depending from its ventral surface. Postpetiolar node similar but broader and with similar but more extensive fungiform masses. First gastric segment convex, broadly subelliptical, with feebly concave anterior border. Legs rather slender.

Opaque; mandibles somewhat, gaster decidedly shining. Head, thorax and pedicel densely and evenly reticulate; mandibles, scapes and legs finely, gaster sparsely punctate, the base of the first segment strongly longitudinally striate.

Clypeus, head and thorax with sparse, evenly distributed, pale, appressed, scale-like hairs; anterior border of scapes with a series of about a dozen curved hairs which are slightly enlarged at their tips; mandibles with numerous ordinary, subappressed hairs; those on the scapes and legs appressed and scale-like. Gaster with very long, delicate, erect, sparse hairs. A few of these occur also on the humeri and pedicel.

Yellowish ferruginous; mandibles, legs and gaster paler.

Described from numerous specimens taken July 13 at Pará, in the foliar sacs of *Tococa* [near *formicaria* MART. (?)].

This species is quite distinct from any of the neotropical Strumigenys of which the senior author has seen specimens or descriptions. It is allied to *S. rogeri* EMERY, *S. trinidadensis* WHEELER, *saliens* MAYR, *cordovensis* MANN and *biolleyi* FOREL.

Subfamily Dolichoderinae.

7. Azteca alfari EMERY var. *mixta* FOREL.

A number of workers, taken August 9 at Florès, Manáos, in the internodes of *Cecropia leucocoma* MIQUEL, agree well with FOREL's description of this variety, except that they are of smaller average length (2—2.3 mm) and exhibit very little polymorphism. They may therefore be from incipient or young colonies. The types are from Paraguay (FIEBRIG). FOREL has recorded the variety also as taken by VON IHERING in the internodes of *Cecropia peltata* (= *adenopus*) at São Paulo, Brazil.

8. Azteca alfari var. *ovaticeps* FOREL.

Numerous workers and a deälated female taken July 15 from internodes of *Cecropia* sp. at Pará.

9. Azteca alfari subsp. *cecropiae* FOREL.

Many workers and males taken August 25 at San Alberto from the hollow internodes of *Cecropia obtusa* TRÉCUL.

10. Azteca schimperi EMERY.

Numerous workers taken August 9 at Manáos, nesting partly in a carton nest on the trunk and partly in the internodes of a *Cecropia leucocoma* MIQUEL.

11. Azteca trailli EMERY subsp. *tococae* FOREL.

A number of workers taken July 15 from the foliar pouches of *Tococa* [near *formicaria* MARTIUS (?)] at Pará. These specimens have been compared with cotypes received from Prof. FOREL. The variety was based on material collected by ULE in the foliar pouches of *Tococa guianensis* AUBLET at Juruá Miry, Juruá, Amazonas.

12. Azteca trailli subsp. *tococae* var. *elatior* FOREL.

Worker. Length 2—3 mm.

Differs from the typical *tococae* in having the mesonotum more depressed, as in the typical *trailli*, and the epinotum higher,

with less sloping declivity. The eyes are in the middle of the head and the antennal scapes of the large worker extend only a short distance beyond the posterior corners of the head. The petiolar node is rather more rounded and less angulate above in profile than in the typical *traili*. The surface of the body is more shining and the color is decidedly darker, being blackish brown, with the mandibles, clypeus and anterior half of the head testaceous. In small workers the whole head may be testaceous though darker posteriorly. Antennal scapes, first funicular joint and tarsi dull yellowish; remainder of funiculi and the femora and tibiae, except their bases and tips, dark brown.

Female (deälated, undescribed). Length 8—9 mm.

Head subrectangular, scarcely more than one-fifth longer than broad, not much narrowed in front of the eyes, which are more than a fifth as long as the sides and only slightly convex. Posterior border and sides of head behind eyes nearly straight, the latter subparallel. Mandibles convex and rather large. Scapes reaching only to the posterior fourth of the head. Thorax long, narrowed at the pronotum and anterior portion of the mesonotum which is nearly one-fourth longer than broad. Epinotum rounded, sloping, without distinct base and declivity. Petiolar node inclined forward, in profile rather sharply cuneate, the ventral portion of the petiole posteriorly convex. Gaster elongate elliptical.

Much less shining than the worker; mandibles nearly opaque, densely and finely punctulate, with scattered larger punctures.

Pilosity erect or suberect, grayish, long and abundant on the head, thorax and gaster, conspicuous also on the scapes and legs.

Dark brown, mandibles darker and more blackish; clypeus, cheeks, anterior portion of front, scapes and first funicular joint, tarsi, thoracic sutures and borders of gastric segments paler brown, the anterior part of the head sometimes more yellowish.

Numerous workers and six females taken August 25 at Carvoeiro from the foliar pouches of *Tococa longisepala* Cogniaux.

The workers agree very closely with cotypes received from Prof. Forel and taken by J. Huber at Bom Lugar, on the Rio Purús, Amazonas, in the foliar sacs of an undetermined *Tococa*. Forel has described with some doubt a specimen taken by Ule at São Joachim, Rio Negro in the foliar pouches of *Tococa bullifera* as the female of the typical *traili*. In this specimen, however, the head is more elongate, being more than one-fourth longer than broad, and the antennal scapes are decidedly long, reaching to

within one-tenth of the length of the head from its posterior border. It seems probable that this female belongs to some other species of Azteca.

13. Azteca ulei FOREL.

Several minor workers taken July 15 at Pará in the foliar pouches of *Tococa* sp. (*formicaria*?) are referred to this species. They apparently belonged to incipient colonies since they measure only 1.5 to 2 mm. FOREL gives the measurements of the types as 2.3 to 4.8 mm. They were taken by ULE at Juruá Miry, Juruá, Amazonas among Gesneraceae forming an ant-garden.

14. Azteca ulei FOREL var. *cordiae* FOREL.

Two lots of specimens, one comprising numerous small workers taken September 1 at Carmo in the foliar sacs of *Duroia saccifera* HOOKER and one comprising numerous small workers and two deälated females taken July 29 at Manáos in the foliar sacs of *Tococa formicaria* MARTIUS. The workers agree closely with two cotypes in the senior author's collection.

The female (undescribed) measures only 7 mm. Head and thorax shaped much as in *A. traili* subsp. *tococae* var. *elatior* but the head somewhat shorter, scarcely one and one-fifth times as long as broad. Antennal scapes reaching a little beyond the beginning of the posterior fourth of the head. Mesonotum convex anteriorly, nearly one and one-third times as long as broad. Epinotum rounded and rather convex, without distinct base and declivity. Petiole inclined forward, the node in profile high and acutely pointed; seen from behind elongate-elliptical, nearly twice as high as broad and more bluntly pointed. Gaster elongate elliptical.

Shining and finely shagreened; mandibles also sparsely and rather coarsely punctate.

Hairs erect or suberect, grayish, moderately abundant on the body, scapes and legs. Pubescence dilute, most evident on the head and gaster but not concealing the surface.

Dark brown; mandibles reddish, with black teeth; cheeks, antennae, articulations of thorax, tarsi and knees yellowish; tips of scapes and last joint of funiculi infuscated; borders of gastric segments reddish brown.

15. Azteca bequaerti sp. nov.

Worker. Length 2—3.5 mm.

Allied to *A. olitrix* FOREL and *A. duckei* FOREL. Head of the large worker slightly longer than broad, shaped much as in

olitrix, with the sides of its posterior three-fifths straight and subparallel and those of the anterior two-fifths curved and converging anteriorly; the posterior border rather deeply concave. In the smaller worker the head is more elongate. Mandibles convex, 8-toothed. Clypeus feebly bisinuate. Eyes just in front of the middle of the head. Antennal scapes even in the large worker extending clearly beyond the posterior corners of the head. All the funicular joints longer than broad, though the penultimate joint is very nearly as broad as long. Thorax shaped much as in *A. traili*, but the mesonotum more convex. Mesoëpinotal impression distinct but shallow; epinotum low, the base and declivity straight and subequal in profile, forming a large obtuse angle, the two surfaces not very clearly separated except laterally where the spiracles mark their junction. Petiole resembling that of *A. duckei*, the node in profile being rather high, angular and pointed, with straight anterior and posterior surfaces, the latter nearly twice as long as the former; the ventral surface of the segment with a rounded, dependent, somewhat translucent lobe.

Shining; mandibles finely and superficially shagreened and with a few coarse, scattered punctures.

Hairs grayish, rather bristly, erect, moderately abundant on the body, femora and tibiae, somewhat shorter on the legs. Pubescence fine, rather abundant, uniformly distributed on the body.

Sordid or grayish brown, posterior portion of head, thoracic dorsum and middle portion of each gastric segment darker brown. Mandibles reddish; cheeks, sides of clypeus and tarsi yellowish; antennae, femora and tibiae brown.

Female. Length 7—7.5 mm.

Head subrectangular, about one-fifth longer than broad, somewhat narrowed in front of the eyes, with rather deeply excised posterior border. Mandibles convex. Antennal scapes not reaching the posterior corners of the head by about twice their greatest diameter; the four penultimate funicular joints distinctly broader than long. Thorax rather slender, narrowed anteriorly; mesonotum one-fourth longer than broad; epinotum rounded but not convex, without distinct base and declivity. Petiolar node in profile high, erect, cuneate and pointed; from behind half again as high as broad, rapidly narrowed to a blunt point above; the ventral portion of the segment with a thick, obtusely angular projection. Gaster elongate elliptical.

Shining, rather sharply and minutely shagreened; mandibles glossy, very finely striated and coarsely and sparsely punctate.

Pilosity and pubescence yellowish, much as in the worker, though the hairs are more abundant on the thorax; pubescence most conspicuous on the head.

Head and thorax dark brown; mandibles deep reddish brown; clypeus, except a large brown spot in the middle, cheeks, antennae, tarsi, wing-insertions and in some specimens also the scutellum and middle of epinotum dull yellow; tips of antennal scapes infuscated. Petiole and gaster yellow; the dorsal segments each with a dark brown transverse band. This is lacking on the first segment in some specimens and occasionally the band on the second segment may be notched anteriorly or broken into two spots. Wings distinctly and uniformly infuscated, with dark brown stigma and somewhat paler brown veins.

Described from two lots of workers and females taken September 4 at Vista Allegre (type locality) and July 15 at Pará, both in the foliar pouches of *Tococa formicaria* MARTIUS.

This species is puzzling. The specimens cannot be referred to *A. duckei* because the female is very different. FOREL's description of the female *olitrix* is more nearly applicable to *bequaerti* but the former is larger (8 mm) and its petiole has a translucent lobe on the ventral side. Nothing is said about the petiolar node, which if it terminated in a conspicuous point, would probably have been noticed by FOREL. The species *traili* EMERY, *ulei* FOREL, *duckei* FOREL, *duroiae* FOREL, *minor* FOREL and *bequaerti* are all very closely related and much more material of them will have to be studied before their exact status as species can be determined. One is not even sure that the maxima workers of all of these forms have been seen. Apparently the females furnish more reliable characters for identification than the workers in the genus Azteca.

Subfamily Formicinae.

16. Brachymyrmex heeri FOREL var. *aphidicola* FOREL.

Several workers taken July 29 at Manáos from the foliar sacs of *Duroia saccifera* HOOKER.

17. Camponotus (Myrmothrix) femoratus FABRICIUS.

Many workers and four deälated females taken July 29 and August 5 from ant-gardens at Manáos. One lot of these specimens was living in parabiosis with *Crematogaster (Orthocrema) limata* F. SMITH.

18. Paratrechina (Nylanderia) tococae sp. nov.

Worker. Length 2.3—2.6 mm.

Head broadly subelliptical, about-one-fifth longer than broad, with slightly convex posterior border, as broad in front as behind. Eyes flat, about one-fifth as long as the sides of the head. Mandibles narrow, slender, with very oblique 6-toothed blades, which when closed are concealed under the clypeus; the latter convex, almost subcarinate, its anterior border entire and broadly-rounded. Antennae slender; scapes extending two-fifths their length beyond the posterior border of the head. Thorax shaped much as in *P. vividula* NYL. Pronotum broader than long, with rather prominent humeri, together with the mesonotum evenly and not very convexly rounded above; mesoepinotal constriction well-developed, with prominent spiracles. Epinotum anteriorly convex, nearly as high as the mesonotum, passing rather rapidly into the declivity which is distinctly concave below. Petiole from above trapezoidal, broader in front than behind, the node at its anterior end very low and somewhat sinuate in the middle. Gaster rather large.

Moderately shining; head and gaster distinctly reticulate, the former somewhat more opaque than the latter. Mandibles with sparse piligerous punctures.

Erect hairs coarse, brownish black, pointed, numerous on the head and gaster, sparse and shorter on the scapes, tibiae and femora; reduced to two pairs on the mesonotum, absent on the epinotum. Pubescence pale, appressed, rather dilute on the body; longer and more abundant on the head, fine on the scapes and legs.

Dark brown; thorax somewhat paler; borders of gastric segment, coxae and legs dull yellowish; middle portions of femora and tibiae infuscated; mandibles reddish.

Male. Length 2—2.4 mm.

Head through eyes slightly broader than long, subtrapezoidal, narrowed behind, with rather straight posterior and lateral borders. Eyes large, convex, somewhat more than two-fifths as long as the sides of the head. Mandibles small, narrow, 4-toothed. Clypeus resembling that of the worker. Antennal scapes extending one-half their length beyond the posterior border of the head. Thorax broadest through the mesonotum and gradually narrowed posteriorly. Petiole as in the worker. Genitalia resembling those of

vividula but distinct in having the longer ramus of the median pair ending in an acute point and the inner pair more ovoid.

Sculpture, pilosity and color much as in the worker, but the dark erect hairs less numerous and the pubescence much less distinct. The color, especially of the gaster and ventral portions of the thorax paler and the middle portions of the femora and tibiae not infuscated. Wings grayish, with rather pale gray veins; tegulae black.

Numerous specimens of both phases from a flourishing colony taken August 25 at Carvoeiro in the leaf-sacs of *Tococa longisepala* COGNIAUX.

This form approaches *vividula* but is clearly distinct in the shape of the head of the worker, the pronounced reticulate sculpture of the head and gaster and the shape of the genital appendages of the male.

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