

LOWER ORINOCO RIVER FUNGUS-GROWING ANTS
(HYMENOPTERA: FORMICIDAE, ATTINI)

BY

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Very little has appeared on the ants of the Orinoco River and still less on the fungus-growers. The author has previously published description of several new Attini from here. Biological observation made on these and others, however, remained largely unpublished and appear in this paper. They were made in January-February 1935 while on an expedition to this most interesting region and, because of lack of time for much collecting, represent only part of the fauna to be expected. Several observations on *Acromyrmex octospinosus* from elsewhere in Venezuela are included.

The genera of Attini are listed below beginning with the most primitive, *Cyphomyrmex*, and ending with the most advanced, *Atta*. Species which were not taken, but which will likely be discovered in the future are mentioned.

The area dealt with includes the river banks from Ciudad Bolivar down to, and through, the Delta. Because of the periodic flooding of much of the Delta from the tides, these predominantly terrestrial ants have had to make some adjustments. Doubtless some of the smaller species will be found nesting among epiphytic rootlets and in other places above ground in trees.

CYPHOMYRMEX

Only the species *rimosus* was taken along the river in the limited time available but there are likely other species. *C. bigibbosus* Emery or some form of it may be expected in the rain forest, nesting under or in rotted logs.

Cyphomyrmex rimosus Spinola

This species, most widespread of all fungus-growers, is probably of general occurrence in the entire Orinoco basin as well as in all Venezuela. The ants, however, are generally overlooked because of their small size (about 2 mm.), dull brown color and slow-moving habit. When alarmed they "feign death" readily and are then almost impossible to see.

A colony was examined at Barrancas at the head of the Delta, inland from the lagoon west of the village. The ants nested in sandy soil beside the base of a wooden post 85 mm. in diameter and also used tunnels in the post made by termites. The soil chambers were irregular and collapsed in excavating the loose soil. The site was shady and the base of the post was never exposed to more than patches of sunlight up to noon. The ant chambers were on the east side. Several score workers, pupae, larvae and a female were in the portion of the colony collected. A mite was taken in the soil about or in a chamber.

Another colony at Barrancas nested beside a colony of *Acromyrmex octospinosus*. The latter nested in soil close to a rotted stump while the *Cyphomyrmex* nested both in the stump and in a curled up piece of palm or maize leaf buried about 50 mm. in the soil about the *Acromyrmex* nest. Brood was in the dead leaf, as also in chambers in the rotted wood itself. The ants used, as substrate for their fungus, feces of several sizes apparently caterpillar, which were not ribbed as is often the case. The fungus was in the form of small bromatia scattered over the surface of the feces. When the nest was disturbed a small *Pheidole* immediately started to carry off the brood. In the portion of the colony which was collected were 221 workers and much worker brood, specially pupae. Many of the workers were callow as though they were a recent hatch of pupae maturing at about the same time. Since this was the dry season it may well be that during this period workers were produced, while shortly before the rainy season sexual brood may mature. No queen was taken and it is probable that there were several with enough additional workers to bring the adult population to about 300.

The two nests of fungus-growers, while close together, were unconnected although foraging workers of each must have continually passed by the nest of the other.

Cyphomyrmex rimosus curiapensis Weber

Cyphomyrmex rimosus Spinola *curiapensis*, Weber, Rev. Ent., 9: 190-191, 1938 ♀ ♀ ♂, *loc. cit.* 11: 411, Figs. 6, 8, 9, 1940, ♀ ♂, *loc. cit.*, 12: 401, 1941, *loc. cit.*, 17: 119-120, 1946, ♀.

Curiapensis is a comparatively large and coarsely tuberculate form. The type locality is the village of Curiapo on Isla Curiapo in the Orinoco Delta. It is also recorded from British Guiana.

The type colony was associated with one of the far larger fungus-grower, *Acromyrmex octospinosus*, in irregular cavities in the trunk of a tree. The *Cyphomyrmex* nested about 15 cm. above the larger ants whose nest itself extended about 75 cm. above the ground. The smaller ants were using spaces in humus and general debris between the outer and inner leaves at the base of an epiphyte. In the portion of the colony collected were 90 workers, five alate females and seven males, in addition to brood. It is probable that the colony amounted to nearer 200 adults than 100.

Associated with the *Cyphomyrmex* was a nest of the tiny myrmicine ant, *Wasmannia auropunctata* Roger whose chambers must have anastomosed with those of the other ant. They were probably not hostile. A small *Pheidole* nested here. Also there were eggs and young of a small centipede and workers of the following ants: *Crematogaster*, *Leptothorax*, *Cryptocerus*, *Pseudomyrma*, *Paratrechina longicornis* Latr. and *Nylanderia*. A few small red-brown Hemiptera with spiny legs collected with the *Cyphomyrmex* may have been myrmecophilous. The termite, *Mirotermes* (M.) *medioculatus* Emerson (det. Emerson) occurred about the nests of both fungus-growers as did sowbugs and small snails.

Cyphomyrmex rimosus venezuelensis Weber

Cyphomyrmex rimosus Spinola *venezuelensis*, Weber, Rev. Ent., 9: 188-189, 1938, ♀, *loc. cit.*, 11: 411, Fig. 5, 1940, ♀.

Venezuelensis is of average size and therefore is smaller than *curiapensis*. The type locality is a few miles downstream from Ciudad Bolivar.

The ants nested under an old log on the moist sand on the edge of the Orinoco beach, a site probably just above high water level since cacti were growing nearby. The general area was characterized by mesophytic to somewhat xerophytic vegetation.

The nest was a Y-shaped depression in the sand with a maximum length of 90 mm. and breadth at the forking of 40 mm. The depression was excavated deeper in some places than in others. In the most shallow was the brood, kept separate from the fungus garden. The latter appeared to be developed on insect cylindrical, ribbed excrement. There were also heads of a termite, *Nasutitermes* (N.) sp. and other insect carcasses. In the portion of the colony which was collected were 175 workers and, since no female was taken, the colony probably consisted of at least 200 adults. With the brood were what appeared to be Hymenopterous semi-pupae with bead-like 12 segmented antennae which may have been myrmecophilous. These were somewhat larger than the ant semi-pupae.

MYCOCEPURUS

Representatives of this small and spiny genus were not taken but may well occur along the river. The ants are most inconspicuous and nest in clay soil. They may be discovered by looking for tiny heaps of soil grains after rains, when they may be re-opening their nests. *M. smithi* Forel may be the species here.

MYRMICOCRYPTA

Species of this small and inconspicuous genus doubtless will be discovered along the lower Orinoco. The ants appear more adaptable than those of *Mycocepurus* and may be found nesting in clay soil, in humus or in rotted wood of standing trees or wood on the ground. Among the species which may occur here are *M. buenzlii* Borgmeier, *M. spinosa* Weber and undescribed species, *M. urichi* Weber was taken by Dr. P. Hummelinck on Isla Margarita.

APTEROSTIGMA

Several species of this smooth and hairy genus are sure to turn up here, *A. mayri* and *urichi* Forel especially but also possibly *wasmanni* Forel and several described by myself. The ants nest in humus or in rotted wood in rain forests as a rule. They are hard to see, since they remain motionless at the least disturbance and are humus-colored.

SERICOMYRMEX

The ants of this genus are covered with silky, often copper-colored, hairs but are tuberculate or spinose instead of smooth as in *Apterostigma*. *S. harekulli* or *wheeleri* Weber may be found nesting in clay soil, also *impeus* Wheeler and *urichi* Forel.

TRACHYMYRMEX

The ants of this genus are generally spiny and some may approach those of *Acromyrmex* in size and appearance although others are only 2 mm. long. The species are monomorphic and this character alone conveniently serves to separate a large species from an acromyrmex. One of the largerst occurs in Venezuela, *urichi*, and was originally described from nearby Trinidad, B. W. I. Another species which may occur along the Orinoco is *cornetzi* Forel and other species will likely be found. The small rain forest species nest in clay soil and are as inconspicuous as species of the preceding genera. Externally the nest may be indicated by a crater or turret of clay.

Trachymyrmex urichi Forel

This Trinidad species shows considerable adaptability in nesting habits and may nest in both forest and savannah or llanos areas. It is soil inhabiting, commonly in clay, and often has the usual crater entrance erected in the form of a turret.

About three kilometers north of Soledad, the village across the river from Ciudad Bolivar, the ants were found

along a small stream, a tributary of the Rio La Peña. Though on the llanos, the stream vegetation was declared by my ecologist companion to be more like that around the Mt. St. Benedict Monnastery in Trinidad, B. W. I. than typical xerophytic to mesophytic llanos vegetation. On the llanos proper, nearby, was a nest of *Atta laevigata*.

The ants had formed a turret nest entrance, beneath which a chamber containing large (9mm.) elliptical seeds was found at a depth of about 20 cm. from the top of the turret and below the first chamber was a second which contained the fungus garden. This chamber was elliptical, about 6 cm. high and 7 x 5 cm. in diameters. The substrate for the garden appeared to be partly the seeds of the kind in the first chamber, which seemed to have come from a climbing vine with moderate-sized entire leaves on a nearby tree. The rest of the substrate was a miscellany of vegetal material of small particles, partly wood. In the garden was brood, of which a few larvae were collected. These had a smooth integument with sparse hairs about the head, which contrasted markedly with the coarse, multifid hairs on a short, stout "trunk" of *Acromyrmex octospinosus* larvae, often to be found in nests near the *Trachymyrmex*.

Near Barrancas, at the head of the Delta, stray workers were found under a loose pile of moist twigs on damp soil where they may have been foraging for substrate.

ACROMYRMEX

The ants of the genus *Acromyrmex* resemble those of the genus *Atta*, commonly known as "bachacos" in Venezuela, and may locally be referred to as the small "bachacos". They lack the distinctive soldier caste, however, and are smaller in maxima worker size as well as in numbers of individuals in a nest or in total nest size.

Two subgenera of *Acromyrmex* occur in Venezuela, *Acromyrmex*, s. str., and *Moellerius*, taken near Ciudad Bolivar on the Orinoco, which is llanos-inhabiting and may be expected to be widespread in this habitat in the country. The two species of *Acromyrmex*, s. str. taken along the Lower

Orinoco are also of wide distribution but in a rain forest habitat. One, *A. hystrix*, is characteristic of Guiana in the broad sense (Orinoco Delta to the Amazon Delta), the other, *octospinosus*, is more widespread (Mexico to the Amazon)

A third species of *Acromyrmex*, s. str., *coronatus globuculis* Forel, may occur in the Delta.

Acromyrmex (s. str.) *hystrix* Latr.

Both in the Delta and in British Guiana this species nests above the ground (Weber, 1946, p. 153-154). In British Guiana, however, the localities were never flooded as they were in the Delta.

Two nests were examined along the Caños Horobuku (=Jorobuku), a tributary of the Rio Araturi, southeast of Curiapo in the Delta. One nest was at the mouth of the caños, the other about four miles upstream. Both were in magnificent swamp rain forest and in sites which were flooded at high tide. The ants consequently had to nest above the ground but were always able to forage by crawling over fallen palms and herbs which were not submerged.

One nest was in a mound formed by debris collecting at the base of a clump of palms and my photograph was used in the Wheeler 1937 book (Pl. II, right fig.). Fungus gardens extended under nearly the entire mass of the mound and the total bulk of the numerous gardens must have approximated at least one bushel (30 liters). The base of the mound exceeded a meter in diameter. Though this area was daily flooded by the tide, water came up only to the base of the mound. *Azteca* ants were dominant arboreal insects in this predominately arboreal fauna and were found everywhere, forming carton nests under *Montrichardia*, *Ficus* and other leaves, frequently over water, and tending coccids (Lecanid) on many plants, including *Phyllodendron* leaf petioles. The *Acromyrmex* must have had to forage over the *Azteca*-controlled plants but were probably tolerated.

The other nest was at a height of about two meters in a mass of moss-covered moots and humus between two *Manicaria* palm trunks which were standing close together. A single fungus garden, about 165 mm. high and 102 mm. broad, was

found and was dissected without finding a queen. Pupae, both large and small, were covered with an open, irregular mesh of mycelium while the larvae lacked this. The larvae were covered with short, stout hairs which tapered to a fine point that was sometimes finely divided. Occasional hairs were bifid or trifid down to the base. The mandibles were stout, triangular with an acute apical tooth, and were finely spinulose. The fragments of the garden were placed on a large leaf on the ground. The ants immediately started to take them back to the nest site and kept at this activity until long after dark (after 7:30 p.m.). By 6 o'clock the next morning they had removed all of the garden fragments to a point above the former site between the palm trunks. They were active during a light rain at this hour. By the late afternoon a fine new fungus garden had been formed in back, of and slightly above, the cavity left by the former garden. Since the relative humidity during this 24-hour period must have always approximated 100% there was no danger of dessication of the delicate fungus. The experiment demonstrated also that the ants do not necessarily have to weed out alien fungi as has generally been assumed. This was manifestly impossible under the present conditions. My belief is that the chemical environment created by the malaxated substrate and the ant fecal droplets favors the particular fungus grown by the ants (see Weber, 1945, 1946).

Acromyrmex (s. str.) *octospinosus* (Reich)

This is the species of *Acromyrmex* found in Trinidad, B. W. I. and an account of its biology, including that of an unprecedented intersex colony, may be found in Wheeler, 1937 and Weber, 1945. It seems to be the commonest species of the genus along the Venezuelan littoral.

A colony near Barrancas at the head of the Delta nested close to a *Cyphomyrmex rimosus* colony, described above. The *Acromyrmex* nested in soil close to a rotted stump. The ants had been actively excavating in the soil as shown by a fresh ridge of soil particles about 250 mm. long. At a depth of about 60 mm. a fungus garden was exposed but time was lacking for further observations. The garden was normal in

appearance and the whole situation resembled that of the usual Trinidad nest. While collecting the *Cyphomyrmex* the other ants removed much of their brood to some chamber at a greater depth which must have been connected with the first by a small tunnel. The ants were aggressive and bit the skin. The larger workers were covered with a whitish bloom on the thorax. Several larvae that were collected were conspicuously pilose, the hairs somewhat resembling stout, short palm trees in having a thick, short trunk, multifid above. These divisions were compound in some and the total divisions on half a circumference sometimes were six in number. These larvae therefore differed from the *A. hystrix* larvae in having thicker, shorter and more divided hairs. Mandibles were generally similar, being short, thick, triangular with acute apical tooth, and finely spinulose.

The surrounding vegetation was mesophytic and on the ground or in low bushes were lizards (*Ameiva a. praesignis* and *Cnemidophorus l. lemniscatus*, det. Shreve) which may well have preyed on the ants.

A colony at the village of Curiapo on Isla Curiapo in the Delta nested in the spaces between buttress roots above the ground. The ants necessarily had to nest above the ground in this area since it was inundated half the year (the rainy seasons) and during the remainder inundated by the daily tides. This specific site seemed to be above the dry season tides, however, so that there was soil continually exposed to the air.

At the base of the tree was a crater of soil and humus from the excavations of the ants. Directly above this, between the buttress roots, was the entrance to one part of the nest at a height of 61 cm. A chamber here, containing a fungus garden, was about 16 cm. high x 13 cm. wide. 5 cm. to one side, on the other side of a root, was another chamber with a garden 15 cm. high x 6.5 cm. wide. There was a third chamber on the opposite side of the trunk and above the other two. A hard carton termite nest (*Mirotermes (M.) medioculatus* Emreson) was beside the second chamber.

The fungus garden was gray on the outside, brown internally as in *Atta cephalotes* gardens of this region.

Brief observations were made in this species in three other localities in Venezuela: Caracas, Macuto near La Guaira and Puerto Cabello.

On a shaded hillside in Caracas May 11, 1936, a male was picked up and placed in a vial of alcohol just as a parasitic fungus was noticed protruding from it. The ant had been assumed dead, but after immersion in the fluid it moved sluggishly for a few moments.

The preceding day at Puerto Cabello a colony was found a short distance inland from the open beach. The ants were cutting leaves of a calabash tree about three meters high and their nest was at its base. Major workers were carrying both partially dead and dried leaf sections as well as green leaves.

A colony near Macuto August 16, 1936 nested in a dry stream bed in a slight eminence from which grew a clump of bananas and a cluster of shoots from an old tree stump. The soil was made damp at this spot by leakage or overflow from a small reservoir; elsewhere the area was xerophytic to mesophytic and was characterized by the cactus, *Lemairei* (*Cereus*) *griseus*. The coccid-tending ant, *Acropyga* (*Rhizomyrma*) *rutgersi* Bunzli was nesting in small chambers anastomosing with those of the fungus grower (see Weber, 1944, p. 106). The *Acromyrmex* nested in a cavity in the old tree stump between two of the shoots which gave the nest admirable protection except for a single opening 125 high, 100 mm. broad and elliptical in from. The fungus garden was 90 mm. inside this opening and was over 250 mm. long, fitting the irregular cavity closely. It was bluish gray externally and contained small masses of substrate which were dark reddish brown to blackish brown in color. The mycelium grew in tufts on the substrate and in the form of somewhat loose bromatia. Pupae were covered with the mycelium but the larvae were largely naked except for occasional mycelial tufts. No large sexual brood was seen. Within the nest were leaf sections exactly comparable to those of *Atta cephalotes*. The ants were aggressive in attacking but were ineffectual since their bites did not break the skin. Domestic chickens of a mongrel breed came by to investigate the proceedings and ate the ants.

Acromyrmex (Moellerius) balzani Emery, ssp.
planorum Weber (Fig. 1)

Acromyrmex (Moellerius) balzani Emery, *planorum*,
Weber, Rev. Ent. 7: 409, 1937, ♀.

A. (Moellerius) balzani Forel, var., Wheeler, Mosaics and
other anomalies among ants, Cambridge, Mass., 1937, p. 8
Pl. II.

The Venezuelan species of *Moellerius* is easily distinguished by its flat eyes, those of *Acromyrmex* being convex. *M. landolti* Forel and *M. balzani* Emery are closely related, the former being originally described from Colombia, the latter from Paraguay. Several forms, including the present, have been attached to *balzani* but may be closer to *landolti*.

The type locality of *planorum* is the llanos about 17 kilometers north of Ciudad Bolivar, a region of Quaternary sediments. It was characterized by my companion, the late Dr. J. G. Myers, as a *Trachypogon-Curatella* savannah. He listed the following plants in the order of dominance within the major groups as follows:

Grasses: *Trachypogon plumosus* (woolly variant)
(*Cymbopogon rufus*?) (edge of road)
Andropogon condensatus
Axonopus aureus
Aristida sp.
Paspalum anceps (shade of *Curatella*)

Other herbs:

Polygala sp.
Paepalanthus capillaceus

Woody plants:

Curatella americana
Bowdichia virgilioides
B. coccolobaefolia
Byrsonima crassifolia
Casearia carpinifolia (in shade of *Curatella*.)

This was also the habitat of the interesting *Pogonomyrmex (Ephebomyrmex) venezuelensis* Weber, of a *Pseudo-*

myrma in the *Curatella*, of a *Camponotus* tending Aleyrodids on the *Trachypogon* and of the termite *Nasutitermes* (N.) *pilifrons* (Holmgren), det. Emerson. *Atta laevigata* occurred a few kilometers away.

The figure (Plate II, left) in the Wheeler mosaic book is from one of my photographs which, however, does not show the nest superstructure (Fig. 1). This was in the form of a striking turret a few centimeters high of grass section which resembled those of certain *Trachymyrmex* except that it was not of clay. At a depth of 140 mm. from the soil level was a chamber 95 mm. high x 95 x 155 mm. in lateral diameters, being elliptical in form. A perpendicular tunnel about a centimeter in diameter led directly from the turret to the side of the chamber. The tunnel continued directly down to a second and smaller chamber which was at a depth of 400 mm. from the soil level. This was 48 mm. high x 50 x 85 mm. Another tunnel led down from the first chamber and past the second chamber, somewhat paralleling the other tunnel and not appearing in the photographs. Also not appearing were the openings in the floor of the first chamber, being four in number and of variable diameter. To one side of the second chamber a tunnel led downward and may have indicated the beginnings of a third chamber but time was lacking for further excavating.

The fungus gardens in both chambers were sessile or supported from rootlets of the *Trachypogon plumosus* grass. The substrate consisted of sections 3-10 mm. long of this and other grasses, some quite woolly. The sections were partly in fascicules, these aggregates having the densest fungal growth. The fungus was in the form of a whitish, loose mycelial network with somewhat circular white cottony patches, small in size and suggesting a loose form of bromatia. Occasional small bodies of a light amber color were interspersed with these (freshly manured bromatia?). These latter were more dense than the white cottony form and may have represented a higher development of bromatia.

Many of the ants were covered with a whitish bloom composed of tiny whitish patches, chiefly on the back of the head, thorax and pedicel. The ants were not vicious and

while they did attack the skin of the fingers little harm was done since the skin was not broken. The larger sizes could bite perceptibly.

ATTA

The Venezuelan term for *Atta* is "bachaco" and the ants are among the best known of insects. It is possible that the leaf-cutting activities of *Atta cephalotes* in the Orinoco Delta may be partly responsible for the nomadic habits of the Indian tribes (e.g. the warrau). The Indians laboriously clear a small area in the rain forest and plant it to maize and cassava. Sooner or later the *Atta* find the cassava and proceed to strip the leaves so that the plants may be stunted if not killed. The Indians may leave the area for a new part of the forest rather than attempt to combat the pest. They have other reasons for leaving, of course, including plagues of mosquitoes. During the dry season in the Delta from October to April mosquitoes are so numerous that the people may at least locally move elsewhere to escape them.

The same three species of *Atta* that occur in British Guiana are to be found in Venezuela, *laevigata*, *sexdens* and *cephalotes* (see Weber, 1946). In British Guiana *laevigata* is found in the savannah areas of the interior while *cephalotes* occupies the northwestern portions and *sexdens* the eastern part of the colony. In the lower Orinoco basin *cephalotes* appears to be the species of the forested Delta while *sexdens* occurs at Ciudad Bolivar in more mesophytic, grass-woodland type of country. Here also *laevigata* appears to be a savannah or llanos species and was taken a few kilometers north of Ciudad Bolivar. *Sexdens* and *cephalotes* are both found at the junction of the Cuyuni and Mazaruni rivers in British Guiana and similarly along the Orinoco a meeting place of the two species will be discovered.

Atta laevigata F. Smith

Atta laevigata, Weber, Rev. Ent., 17: 164 - 165.

The above reference cites the present llanos record and one from the Kukenan River in the Mt. Roraima district.

Colonies were seen on the llanos about three to eight kilometers north of Soledad, the village across the Orinoco from Ciudad Bolivar, nesting under trees as well as in the open. One nest, under bushes and trees, had been dug into by armadillos. There were the usual craters of varying size, some with irregularly elliptical openings 100 x 40 mm. When a twig was thrust down these the large soldiers came out readily, as well as the largest workers. The smallest, of course remained in the fungus gardens. At this time of day (noon) no ants were outside the nest until it was disturbed. Time was unfortunately lacking for further observations.

Atta sexdens L.

The distribution in British Guiana and its apparent absence from that portion of the colony adjoining the Orinoco Delta has been noted above.

A large colony on the Venezuelan Gulf Oil headquarters at Ciudad Bolivar was examined during the dry season on January 25. At this time the ants had about 15 active crater entrances, including six of large size. The largest crater was 24 cm. high and 125 cm. in maximum diameter. The entrances to four large crater were 30, 45, 65 and 65 mm. in diameter respectively, the larger being elliptical and 10-20 mm. wide. The chambers containing the fungus gardens were shallow and spread horizontally, one of 16 x 20 cm. diameter being at a depth of 8 cm., another of similar dimensions being at a depth of 11 cm. beneath the general soil level or 28 cm. directly beneath the top of a crater. The latter garden contained pupae and larvae. Not all chambers were directly beneath craters, one at a depth of 25 cm. was 40 cm. to one side of the nearest crater entrance. The gardens were elliptical in form to spherical, a representative spherical garden being 14 cm. in diameter. All seen were sessile, resting directly on the floor of the chamber and without contact with the sides or ceiling. No gardens were found at a depth of 60 cm. although hardly 10% of the nest was seen.

The soil in which the ants nested was dry and hard, being a gray to black sandy humus. The hardness necessitated the use of a pick axe in excavating. Despite the general gray to

black color of the soil the craters themselves were distinctly paler and of an orange-brown color. Was this due to formic acid excreted by the ants or to an acid condition of the gradens and excrement excreted on the latter? Seemingly, the color difference was caused by the ants since their whole activities below ground were confined to the same gray to black soil.

The fungus gardens were gray in color and deteriorated rapidly when exposed to the hot, dry air of this day. They gave off a sweetish odor somewhat like sorghum and less like molasses. No bromatia or "kohlrabi" structures were seen in any part of the gradens. The fungus itself was in the form of strands of a white mycelium covering the moist and apparently partly fermented particles of triturated leaves. In an apparent indiscriminate manner eggs were mixed with other brood in the cells of the gardens. A centipede was taken from the corridor to a garden.

What impressed me at the time was the unusually high proportions of soldiers compared with those of a *cephalotes* colony. They seemed easily to outnumber the maxima and media workers. The soldiers were aggressive and not only ruined my new, heavy, all-wool socks by cutting many holes in them but draw blood easily.

Atta cephalotes L. (Fig. 2.)

This ant is doubtless one of the animals important to the human inhabitants of the Delta. Without modern insecticides the people find it exceedingly difficult to exterminate a large colony, a colony which might ruin a crop of cassava or other plants.

It is probably of general distribution throughout the Delta and adjacent rain forests as the following specific records indicate: below Barrancas along the Caño Piacoa; main channel of Rio Grande north of Isla Tortola; between Caños Araguaito and Araguas opposite Isla Sacoroco; Caño Orocaima, tributary to Caño Toro, the latter a branch of the Brazo Imataca.

A young nest was dissected in the fringe forest of the Caño Orocaima along a path used by people living in several huts, (Fig. 2). Nearby was dense rain forest. Externally the nest appeared as a crater 125 mm. in diameter and 30 mm. high; a tunnel 115 mm. long and 23 mm. in diameter led to the nest chamber. This was elliptical, 73 mm. high x 102 mm. wide. Extending down from the first chamber as a continuation of the original tunnel was a cavity 64 mm. deep and 40 mm. wide which probably represented the beginning of a second chamber the original chamber was largely filled by a sessile fungus garden, 70 x 74 mm., which, however, was supported in part by several horizontal roots running through it. The garden was grayish externally, brownish internally. I tasted the inner part and found a suggestion of mushroom flavor; the outer part had a flavor less definable and more pasty.

The queen responsible for the colony was found at one side, supported partly by the roots but also clinging to the garden. She was sluggish and remained in the same place until I finished the excavation. When placed in 93% ethyl alcohol she floated, whereas worker ants sink, indicating that wing and other muscles had been replaced by air.

No maxima workers and no soldiers had yet been reared in this colony although soldier pupae of moderate size were present.

It is possible that the queen came from a mature colony farther along the path. This contained large, possibly sexual, larvae. The young colony queen may have left this colony at the onset of the last rainy season or an earlier one.

On a small island of the Caño Piacoa a mature colony was found by tracing its trails through dense jungle. The island was perhaps 800 meters long and hardly 100 meters in greatest width. At high water during the rainy season the island was clearly reduced to less than half the present size. From the west point of the island ant trails led about 200 meters above water during the rainy season to the nest on the south side, which was six or seven meters at the very most above low water level and probably not more than three meters above water during the rainy season. The trails led from bushes of the sandspit at the west end along the shore

flooded at high tide, as well as among rushes, mangroves, bamboo-like grass (*Gynerium saggitatum*) and other vegetation growing as a dense jungle. Mosquitos were almost unbearable and a noisy hoatzin colony roosted near the nest. These birds and the Attas may well have fed upon leaves of the same plants since the bird crops were filled with green leaves and they did not appear to be wide-ranging.

Chambers containing fungus garden were as shallow as 125 mm. in the nest. The main entrance was at the base of a small tree 85 mm. in diameter. This nest also contained large, possibly sexual, larvae; one after years of preservation still being 8 mm. in shrunken length. It had been killed by the workers in their frenzy when the chambers were exposed.

Trails led in all directions from the nest and it is quite probable that the ants dominated the entire island. A comparable example was found on the tiny island of Kykoveral in the Mazaruni River, British Guiana (Weber, 1946, p. 162).

A large nest on the left bank of Rio Grande opposite Isla Sacoroco was in the form of a low, truncate cone. It was about 1.4 meters high x 3.7 meters in diameter and contained scores of holes, especially on the south side, which were made by large bees. On the north side stood a hard carton nest of termites (*Nasutitermes*) about 65 cm. x 25 cm. in diameter. The termite nest contained small ant brood (not fungus-grower) as well as termites. *Pheidole* and other ants nested in the mound and fly larvae, like trypetid, occurred in a discoid fruit which had fallen on the mound from trees above.

This nest was obviously the center of a biocoenose since it probably was the apex of a small area of soil which was not flooded at high water. The elevation above high tide was estimated to be hardly more than 4.6 meters and during the rainy season water would probably come close to the foot of the mound. It was on a slight slope crowned with a jungle of creepers, prickly and spiny vines and palms and other vegetation. To the south the ground sloped sharply to a depression covered with dense grass, then came a slight rise of vines and bushes and beyond that the sandy beach.

There were many small openings to the nest, none being as much as 10 cm. in diameter. The largest openings were under the termite nest. The fungus gardens were shallow, being under six or so centimeters of reddish-gray clay. Seven or more gardens were exposed and brood was seen in none.

The bees probably used the mound merely as a nesting site. They seemed to be digging horizontally in the upper soil. One was heard buzzing incessantly under the soil and when I cut into it the insect tumbled out of a cell in fungus garden. It had likely borrowed accidentally into this for ants attacked another bee when it was unearthed from an ant tunnel.

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EXPLANATION OF PLATES 1 AND 2

- Plate. 1. Nest of *Acromyrmex (Moellerius) balzani planorum* Weber on the llanos. The grass is *Trachypogon plumosus* and formed much of the substrate for the ant fungus garden. The grass turret entrance to the nest has been removed.
- Plate. 2. Nest formed by young *Atta cephalotes* queen and her first broods. The queen is clinging to the fungus garden immediately above the nearer horizontal root.

Photos. N. A. Weber.



Plate 1



Plate 2