The Biology of the Fungus-growing Ants. Part VIII. The Trinidad, B. W. I., Species.

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(With 1 text-figure and 8 plates)

The present paper deals with the fungus-growing ant fauna of Trinidad, British West Indies, of which the large leaf-cutting ants *(Acromyrmex* and *Atta)* are the most important economically but by no means more scientifically interesting than the other genera. A large part of the study deals with the habits of the inconspicuous small species in observation nests.

The species are listed separately below with the distribution, nests, observation nests and biology given for each. The observation nests refer to those which I was able to keep in the laboratory at the Imperial College of Tropical Agriculture, St. Augustine. There are at least 29 species and subespecies of fungus-growing ants in Trinidad and the habits of many of these are described.

An important phase of the fungus-growing activity seems to have been generally overlooked. The ants regularly, from highest to lowest species, manure the substrate with clear amber fecal droplets. Undoubtedly an important contribution to the metabolism of the fungus is the nitrogeneous waste so added which permits a much wider selection of substrate. Consequently the fungi thrived on processed farine, for example, which otherwise might have been an incomplete food. Bearing on the identity of the fungi is the fact that species of various genera cultivated and ate one another's fungus gardens and ate parts of sporophores of *Agaricus arvensius* and *Phallus* sp. (probably *impudicus*).

Physiography.

The island of Trinidad is essentialy a part of Northern South America since it extends to within eight miles of Venezuela and its flora and fauna are derived from the mainland. It has, nevertheless, some peculiarities of its own, presumably due to such isolation as there is. Though close to Venezuela the waters separating the island are swift-flowing. The tide flows in and out through the deep Bocas del Dragon or "Dragon's Mouths" in the northern part with considerable force and would make it difficult for terrestrial animals to be floated across. The waters of the Orinoco River mingle with the ocean and wash the southern part, creating strong currents. Driftwood carrying terrestrial animals has ample opportunity to land on these low, sandy shores. The Orinoco, however, has just flown

through the thousands of square miles of the Delta and some of this swamp rain forest fauna may not find suitable conditions on the adjacent part of Trinidad. The island would appear to be connected at the north through a series of islands, including Monos, Chacachacare and Patos, the latter only three miles from the mainland, but the swift currents alluded to and the prevailing trade winds from the east render connections difficult.

The area is 1750 square miles and includes a considerable diversity in physiographic and meteorologic conditions. The northern portion contains the unbroken Northern Range of hills which attains an elevation of 3085 feet above sea level. The southern portion is also marked by hills which attain a height of 997 feet in the southeast but is mostly under 500 feet. The remainder is largely level or rolling except for a central range of hills attaining a height of 1009 feet. There are two large swamps, the Caroni of mangrove on the west and the Nariva of savannah and mixed rain forest on the east. The central and western plains are extensively cultivated, cacao, coconut and sugar cane being important crops.

The Northern Range intercepts considerable rain and has annual rainfall exceeding 120 inches in places. In general rainfall decreases in north-south zones so that the western plain has an annual rainfall of barely 40 inches. A considerable portion of the island has an annual rainfall over 70 inches which is ample for a large part of the South American flora and fauna. For the physiography and vegetation of Trinidad see Marshall, 1934.

Affinities of the Attine Fauna.

The South American character of the Trinidad fauna is well illustrated by this tribe of ants. Although the Lesser Antilles came close to Trinidad, they, like the West Indies in general, apparently lack species of *Myrmicocrypta, Apterostigma* and *Sericomyrmex.* It is not that the general environment is unsuited since St. Vincent and Dominica, for example, have luxuriant rain forest that would appear satisfactory to them. The volcanic soils may not be a proper substitute for clay. The species common to Trinidad and the West Indies are *Cyphomyrmex rimosus* and *Mycocepurus smithi,* which are also widespread north of Brazil. *Mycetophylax brittoni* has a restricted distribution, being found in Puerto Rico, Grenada, and as the subspecies *littoralis* in Trinidad and Isla Margarita, Venezuela. This is accounted for, in part at least, by it habitat, clear, sandy beaches. *Acromyrmex octospinosus,* common in Trinidad, occurs as the subspecies *cubanus* in Cuba and other subspecies are found in Central America. The species that Trinidad shares with Central America include the above species, except the *Mycetophylax,* and in addition *Apterostigma mayri* and *Atta cephalotes.* The South American affinities are so close that many forms are identical with those known from Venezuela, the Guianas and probably Brazil. One might expect the Trinidad fauna to be somewhat depauperate when compared with the adjacent mainland and an indication is the fact that a fairly common species of *Cyphomyrmex, bigibbosus,* is known from Trinidad only by a single dealate female. Many species so far known only from Trinidad will doubtless be found on the mainland.

Historical.

The habits of the fungus-growing ants in Trinidad have been the subject of articles by Tanner (1892), Forel (1893, 1899), Urich (1895, 1923), Wheeler (1937) and myself (1937-1941) but have dealt almost exclusively with the two large species, *Atta cephalotes* and

Acromyrmex octospinosus. The habits of the great majority of the species have remained unknown and these were as interesting to me as the conspicuous species.

The taxonomy or classification of the Trinidad species is to be found in papers by Forel (1893, 1899, 1912). Wheeler (1916, 1922, 1925, 1937) and myself (1937-38). About half of the known forms were described by me but aside from the three commonest species, the next most common species *Apterostigma urichi, mayri* and *wasmanni, Sericomyrmex urichi,* and *Trachymyrmex urichi* were described by Forel through the efforts of Urich.

Any account of Trinidad ants should pay tribute to Frederick W. Urich who for half a century was interested in these as well as many other animals. That he did not publish more of his vast store of knowledge is greatly to be regretted. There are several explanations. He made a good beginning as a young man and his two-page paper of 1895 on *Sericomyrmex* is excellent. Possibly several critical remarks in Wheeler's 1907 study of North American Attini offended his sensitive nature. At any rate later papers were locally published and did not contain such original observations. Like other residents of the tropics have found, it was not easy for him to have identifications made and the overwhelming luxuriantness of the fauna is so easily distracting. I was most fortunate in being "taken under his wing", so to speak, and with another student, Desmond Vesey-FitzGerald, we made many trips about this fascinating island.

In 1934-35 I was fortunate in being able to spend a year, largely in Trinidad, through a National Research Fellowship and returned in 1936. Ever since then the government entomologists have been sending me collections for study in view of my interest in the Trinidad fauna for which I wish to thank them. Most of the latter ants, of course, were not fungus-growers and it was unnecessary to send the two largest species whose names were well known. The records of these two, the *Atta* and the *Acromyrmex,* are consequently merely my own and could be considerably enlarged. The records of all of the other species, however, probably represent all known to date and are mostly mine.

In 1937 Dr. Wheeler published a book on a colony of *Acromyrmex* which I had collected in Trinidad that was remarkable for the numerous intersexes present. The book originally intended to be published jointly, was published under his sole authorship as a gesture to his memory. It not only contains observations on *Acromyrmex* but other fungus-growers as well.

Biology.

The fungus-growing ants, which are exclusively American, are usually inhabitants of tropical rain forests since they cultivate fungi which require high and constant humidity. By going underground the ants can maintain the necessary conditions but the smaller species do not excavate deeply. Some of these, like those of the genus *Apterostigma,* consequently nest under rotted logs or among debris on the forest floor and are therefore restricted in their range. The most adaptable Trinidad species are *Cyphomyrmex rimosus, Trachymyrmex urichi* and the large *Acromyrmex* and *Atta*. The former is able to maintain its small nest in a crevice in the soil or rotted wood wherever the humidity is adequate. The *Trachymyrmex,* though common in forests, may nest in the open on the Piarco Savannah where its habit of erecting a turret may conserve loss of moisture from its nest of moderate depth. The two large species may nest deeply enough and the evaporative loss from their large fungus

gardens in other places would be less proportionately than those from smaller gardens, the bulk increasing faster than the surface exposed. For a discussion of the habits of the genera see Weber, 1941.

Predators of Attine ants in Trinidad were the giant toad, *Bufo marinus* L., and the ant-eater, *Tamandua longicauda* Wagner. In the stomachs of these were found five genera and species: *Cyphomyrmex rimosus, Sericomyrmex urichi, Trachymyrmex urichi, Acromyrmex octospinosus* and *Atta cephalotes*. The most important parasites were phorid flies and these undoubltedly result in the deaths of many more Attas than the above predators. Myrmecophiles, particularly of the Collembola, *Lepisma* and *Myrmecophila* types may live in the nests.

The ants are of neutral importance to other animals, including ants, since they are exclusively vegetarian. Amphisbaenans are occasionally found in the large *Atta* nests but they are probably at the most facultative predators and not symbionts.

The fact that they are exclusively vegetarian explains why these ants freely nest and forage by one another as well as by other ants. Even the fierce army ants respect the larger fungus-growers.

Population counts are given for several species. The larvae and naked pupae are commonly swathed in mycelium from the fungus garden but the workers may clean them on occasion. Several more or less abortive marriage or dissemination flights are described in observation nests. Males and females are often found in the nests before and after the onset of the rainy season (April-June).

Many of the species forage at night for substrate as well as in the day.

Cyphomyrmex rimosus workers failed to eat *Mycetophylax littoralis* and *Myrmicocrypta buenzlii* fungus. A *Cyphomyrmex bigibbosus* female ate bromatia of *Cyphomyrmex rimosus* though its own garden would have been very different.

Mycocepurus trinidadensis workers fed on *Sericomyrmex urichi* and *Atta cephalotes* fungi but refused *Apterostigma urichi* fungi.

Myrmicocrypta urichi workers ate *Mycetophylax littoralis* fungi. *Myrmicocrypta buenzlii* workers tended *M. urichi* fungus.

Mycetophylax littoralis ants fed on the fungus of *Mycocepurus trinidadensis.*

Apterostigma wasmanni ants fed on the fungus of *Sericomyrmex urichi.*

Trachymyrmex urichi ants cultivated *T. bivittatus, T. ruthae* and *Acromyrmex octospinosus* fungi. *T. ruthae* workers ate *Sericomyrmex urichi* and *Atta cephalotes* fungi.

Acromyrmex octospinosus workers ate *Trachymyrmex urichi* and *Atta cephalotes* fungi.

Atta cephalotes workers ate *Sericomyrmex urichi* and *Acromyrmex octospinosus* fungi.

Cyphomyrmex.

Perhaps the most primitive of the Attini is the genus *Cyphomyrmex* whose genotype is *rimosus,* the latter being unique among all fungus-growers in the peculiar type of fungus that the ants develop. There are over a score of species with about the same additional number of subspecies which range in distribution from the southern United States to Argentina. The ants are among the smallest in the tribe and are usually not strongly

sculptured, always lacking acutely pointed spines with hairs. The fungus garden developed by all species except *rimosus* is of the fluffy mycelial type common to the tribe.

Cyphomyrmex rimosus Spinola.

The most widespread of all species of fungus-growing ants was described by Spinola in 1850 (Mem. Accad. Sc. Torino (2), 13:65) from the worker and male castes. It or its numerous forms have the distribution of the entire tribe and no other species has half the range. The unique fungus is in the form of irregularly polygonal bodies called bromatia about a half-millimeter in diameter. These vary in color from opaque white to somewhat translucent brown and appear to develop by budding. They are not creations of the ants as has been claimed but the ants constantly wear them down by attrition so that they do not develop further. They lack hyphae and are grown on insect feces. *Rimosus* is probably the commonest and most widely distributed attine in Trinidad but is so small and inconspicuous as to be seldom noticed. The ants are dull brown, slightly over two millimeters in length, and slow moving, becoming motionless at the slightest disturbance, so as to be hard to see. There are over a dozen forms recorded and minute study may indicate that there are several forms in Trinidad deserving recognition. The ants are sufficiently variable to make decisions difficult unless the specimens available for study are so few as not to reveal this variability. Though common in Trinidad the ants are of neutral importance to agriculture since they do not cut green leaves and, because of their small size, have unimportant nests.

Distribution. — These ants may be expected in any locality in Trinidad. Wheeler (1922) records *rimosus* and *minutus*, the latter of which is considered a synonym of the former, both from the Botanical Gardens only. I have taken this species at Macqueripe Bay, 5.VIII.35; Gasparillo River, Sta. Cruz, 29.XI.34; San Miguel R., 8.I.35; Tacarigua R., 18.XI.34; Spring Hill Est., 1200 ft., 6.IV.35; Maracas Valley, 23.III.35, 1.X.35, 31.VI.36; Morne LaCroix, 800 ft., 7.IV.35; Mason's Est., Arima, 28.IV.35; Cumana Bay, 18.IV.35; San Rafael, 31.V.35; Melajo R., Mora Forest, 19.V.35; foothills north of Tunapuna, 16.III.35, 14.V.35, 25.V.35, 24-29.VII.35; St. Augustine, 29.XI.34, 22.III.35; 10.IV.35, 25.V.35, 5.VI.35, 9-19.VII.35; Mayaro Bay, 25.XI.34, 13.I.35, 8-11.III.35,

15-16.VI.35; Ortoire R., Rio Claro, 3.I.35; Trinity Hills Forest Reserve, 22.XII.34; Pilote R., Guayaguyare Bay, 22.XII.34; Basin Hill Forest Res., 1.IV.35; Guapo Bay, 4.IV.45; Patos Island, 21.VII.35.

Nests. — The ants require a situation with high humidity but appear unable to excavate to any great extent nor do they need to. They are consequently often found using small cavities in the soil or elsewhere which were made by other means. A curled-up dead leaf half buried in humus on the rain forest floor, for instance, is adequate. They may use tunnels made by wood-boring insects in rotted wood or nest under small stones or sticks. By contrast with the other Attini their nests are highly irregular in form in consequence of this flexibility. A few Trinidad examples illustrate this feature of the species:

A colony nested about 45 cm. up from a road in the rocky, abrupt bank. The exposure was northeast. The ants had usurped the old nest entrance of a wasp or spider since there was a tunnel of agglutinated clay entering the nest chamber. Both tunnel and chamber were horizontal and under a flattish rock. The tunnel was about 25 mm. long and the chamber somewhat less in diameter and at a slightly lower level.

Another colony had a similar location, being on the north side of the bank beside a road and with a southeast exposure. The first chambers were about 50 mm. into the red clay soil, others extended to a depth of 110 mm. These appeared to be only slightly modified cracks normally developing in soil at times, and were highly irregular. The fungus garden was sessile on piles of caterpillar or other insect feces which turned alcohol yellowish green when preserved in a vial.

Three other colonies resembled the above two. One had a nest in the side of a small (14 cm.) drainage ditch with a southeast exposure. The chamber was about 10 cm. down from the soil surface and 50 mm. into the side of the ditch. The fungus was gray in color. A second colony had a nest in the side of a road about 10 cm. in. The chamber was at the end of a tunnel about 10 mm. in diameter. A third colony nested in yellow sand in a road cut in high forest.

Other colonies showed more variation. One nested in trenches beneath a rotted coconut log on the ground and in adjacent furrows in the wood. The excavations apparently had been made by a beetle or other insect. The luxuriant brown bromatia were grown on excrement. Another nested in an upright dead log 1.5

meters high and 45 cm. in diameter. The wood had split under the bark to form deep cracks. One was 135 mm. long and 5 mm. in maximum width. The ants were collected with difficulty since they took refuge in the deepest part of the crack and the wood was hard but damp. Another colony was nesting nearby in a nearby trunk.

An unusual nest was found in excavating a nest of *Apterostigma urichi.* The latter nest was suspended from a hollow twig which proved to contain a small colony of the *Cyphomyrmex.*

Though typically found on or in the ground one colony nested among wet leaves and twigs suspended 30 cm. or so above ground. Other colonies were nesting in humus and debris between the basal leaves and stem of ground bromeliads about two meters tall on Patos Island between Trinidad and Venezuela. The plants grew in dense cactus and small deciduous tree forest five to eight meters high at an elevation about 300 feet above the sea. This island is only 329 feet high and is on the lee of the Northern Range in Trinidad which attains heights over 3000 feet. It consequently is xerophytic and the soil is dry, yet because clouds so often blanket it the plants are frequently dripping wet. This cloud — or fog — derived moisture permits the *Cyphomyrmex* to grow their fungus gardens.

Observation Nests. — A colony collected March 6 at the Imperial College was placed in a large observation nest which contained also two fused colonies of *Trachymyrmex urichi.* The ants were mutually tolerant. To this nest was added a third colony of *T. urichi* in the afternoon of March 14. By the next morning these fused colonies had taken possession of much of the *Cyphomyrmex* soil. The latter ants were wandering about. A worker was seen at 11 a. m. carrying a small piece of dried bread to the site in which the ants were attempting to maintain their nest against the *Trachymyrmex.* Another carried an unidentifiable small piece of vegetal matter. By the following morning the ants had again been dispossessed and were in process of moving to the other end of the arena to the soil formerly occupied by one of the first *Trachymyrmex* colonies. They would probably have tolerated one another were it not for the fact that the *Trachymyrmex* were using so much space for excavation. No animosity was shown between the two species. Four days later they had succeeded in building up a flourishing garden with many light brown bromatia and beside the garden was situated the brood. The larvae appeared to have a scanty, diffuse, whitish

mycelial envelope as in *Atta* larvae. As substrate the ants were using dried caterpillar excrement that had been brought from the Orinoco River, Venezuela for this purpose. By March 24 the ants had to move again because of the excavations of the *Trachymyrmex*. No animosity was shown again. By the following morning the ants had developed a double-chambered nest, one for the garden the other for the brood. While I watched a few moments the following night none was seen outside the chambers. By March 27 the ants had developed two fungus gardens separated by an interval of about 25 mm. They were given two pellets of bat dung. One of the gardens the next day had paler than usual bromatia, probably reared on yellow sweet potato. A little brood was near both gardens. The bat dung had been moved out of sight. Again by the next day the ants had to move because of the *Trachymyrmex* activities. March 30 at 5:35 p. m., when the afternoon sun was striking the glass side of the arena, a winged female was seen attempting flight. She must have been reared in the observation nest. The ants were moved to a separate nest. On the next morning numerous yellow bromatia were evident, yellower than the previous day. The sexual pupae and larvae were covered with whitish mycelial masses much as is the habit in pupae of higher Attini. On April 1 workers were seen examining caterpillar feces. On April 2 winged males as well as females were moving about. On April 4 and 5 workers were engaged in cutting out pieces of bread from the midst of moldy substrate (banana, sweet potato and bread) which certainly had *Penicillium* and other alien fungi. During the next five days a flourishing garden was maintained despite the growth of alien fungi close to the nest and even in soil beside the brood. On April 10 I discovered in cleaning the *Trachymyrmex* nest that I had left a good share of the *Cyphomyrmex* colony in it March 30. This portion, too, had winged males and females. It seemed to be doing well in a melange of *Trachymyrmex, Cephalotes atratus* workers (including several intersexes described in W. M. Wheeler's 1937 book on mosaics) tending membracids on *Pithecolobium saman* twigs, an *Azteca* colony in the latter and stray Pseudomyrmas, all confined in a large nest for convenience. The two parts of the *Cyphomyrmex* colony were reunited and yellow sweet potato given to them. Within a few minutes workers from both groups were carrying off particles of substrate as well as tugging at old caterpillar feces with no evidence of hostility. The next morning three slightly agitated males were out in the

arena and workers were actively working the soil. By the following day the two groups had definitely coalesced despite living apart for 11 days and there were no casualties. April 13 they used farine shreds, an unusual substrate for this species, and three or four males were out in the arena. April 16 one male was dead in the arena and the next day two males were running about. April 18 males were quietly resting or dying on debris outside the nest. Two workers were deep in a hole made in moldy sweet potato, digging out substrate for their nest and later in the day three were similarly engaged. April 20 another dead male was found and workers were cutting bread. They immediately started to cut boiled sweet potato when they were given it. Another male was dead April 26 and on April 30 an unusually small dead male was found.

During May and early June winged males and females continued to be found in the nest. Late in May the ants moved again in response to a drying out of the former site. The ants continued to tunnel into somewhat dry and moldy sweet potato yet maintained the usual appearance of their bromatia. Males were found dead intermittently.

July 7 at noon five workers and a winged female were placed in a small container of moist soil. At 5:20 p. m. a fragment about 3×10 mm of the fungus garden of a *Mycetophylax littoralis* colony was given them. Several workers immediately came up, walked over it, explored the piece briefly but did not attempt to eat any, then walked away. Six minutes later others came but only explored it. They were given farine. The next morning the fragment was still in good condition and the ants had carried a shred of farine to it on which two tufts of mycelium had already sprouted, one tuft appearing exactly like that usually developed in a garden. There was at least one fecal droplet on the garden. The ants were not seen to eat. One worker was dead the next day and the garden appeared untouched but with little mycelium left. During the nex three days the garden became reduced to withered substrate and was discarded. During the following four days all of the ants gradually died.

A colony collected on the Mt. St. Benedict Monastery Road March 16 was placed in a large observation nest which contained a nest of *Trachymyrmex urichi*. The members of the colony kept largely out of sight and were on March 27 found to have established a flourishing garden in soil discarded by the other species. They had used sweet potato for substrate and the bromatia were paler

and more watery in appearance than usual. They were later given bread and caterpillar feces, the latter used by the ants. On April 1 the garden appeared to have two types of bromatia growing separately, one translucently pale brown the other more variable in size and a more opaque white. The latter type continued to develope in the next few days into a larger size than I had yet seen. Larvae were piled on the floor near some gardens; in other places they were on a higher level. April 10 some of the opaque bromatia were carried about by the ants and placed away from the substrate. These bromatia were later seen to be derived from the customary pale brown type by transitions. During the remainder of April they used also farine and more caterpillar excrement, bringing the latter when dry to a moist situation to acquire moisture. The proportions of the whitish to the brownish bromatia varied during this period. By May 20 they had moved to a new site, this time to debris outside an *Apterostigma wasmanni* nest. They used farine freely during May and June as well as yam. The garden continued to flourish during early July and the colony was ended later.

Part of a colony collected May 14 from the foothills north of St. Augustine was placed in a small observation nest. Within 24 hours they had collected their scattered garden and placed the bromatia on the under surface of the glass cover. These were brown in color, darker than those described above. By May 23, however, the bromatia had become a pale, opalescent and grayish white, probably because they had grown on yellow sweet potato and farine. Collembola were watched under the binocular in the nest May 25. The ants were hostile to them but they moved too fast for the slow-moving attines. An ant was seen to pick up a bromatium, revolve it about using the front two or three legs, tips of mandibles and antennal tips. As it did this the ant assiduously lapped the bromatium with its mouthparts. It then carefully placed the bromatium in another part of the pile from which it had taken the food and picked up another. The process was repeated a second and third time. By this constant handling mycelial growth would be prevented. By the end of June the colony was in good condition except for a large number of white Collembola and many mites on the unused substrate.

A colony from the preceding locality collected May 25 was found to have many males and females as well as the usual rich brown bromatia in quantities. By June 12 the colony was flourishing, using farine and yellow sweet potato.

Four workers, one alate female and three males were removed from this nest June 12, 8:30 a. m. and placed in a small container where they were starved until June 18. One worker and the female died in the interval. They were then given a small portion of the fungus garden of a pale yellow variant of *rimosus* from the south of Trinidad. This portion contained two bromatia. A worker first discovered a bromatium and immediately started lapping it. After two or three minutes the ant carried most of the bromatium to a depression at one side where a male discovered it. This male, too, lapped it avidly, showing that male Attini may eat fungus at least on occasion. The other two workers slowly went over the substrate, lapping the particles. At 8:56 a. m. a worker curved the tip of its gaster to a piece of substrate and defecated a color-less droplet which immediately diffused into it. The male remained lapping on the bromatium. The next morning the ants were given two fresh feces of mole cricket or cockroach. One worker immediately explored them but did nothing further. On the following morning one male was dead and the ants appeared to have devoured substrate as well as bromatia for none was to be seen. By June 21 one male and one worker remained alive but they died within a few days.

Part of a small colony kept during June presented nothing unusual except that larvae of different sizes up to the large, mature worker size as well as several pupae were covered with a network of mycelium. Mites or Collembola completely dismembered some of the dead ants in a week or so.

A colony collected June 15 under coconuts at Mayaro Bay contained males and was noteworthy in that it maintained itself with little attention until it was ended Sept. 25. At this time a few pupae, several queens, workers and small quantity of bromatia were left. These latter were brown in color and probably grown on fecal droplets since no substrate was present.

On July 7, however, seven workers were removed from the above colony at noon and placed in a small container with moist soil. At 5:46 p. m. they were given a part of the dry fungus garden of a colony of *Myrmicocrypta buenzlii*. Within the next six minutes some of the workers came up to it, touched it briefly with antennal tips or waved the latter towards it but in no instance did the ants attempt to explore or eat it. One ant mounted the piece and proceeded to clean itself thoroughly. By the following morning they had deposited at least 10 fecal droplets on the garden. About the same number were present on each of

three successive mornings but no ants were seen in attendance and by July 12 the fungus was sprouting widly. The ants were dead by July 15 and had probably not eaten any of the fungus.

A few workers were taken from a colony July 11 and placed in an observation nest. The following afternoon they were given sections of the stipe and pileus of the sporophore of an *Agaricus arvensis* (det. Dr. Briton-Jones), freshly collected. Two minutes later a nearby worker came up quickly, rasped a bit off of the stipe, then curved its gaster to the remainder and defecated a colorless fecal droplet on it, followed by a second and larger droplet. The second droplet, however, stuck to the gaster as it ran off but was released by the ant placing the gaster on damp soil which absorbed it. Within two additional minutes two other workers had eaten parts of the stipe. At intervals they and several others came up to rasp off bits of both stipe and pileus but chiefly the former. No one ate much. The ants did not eat in this manner to obtain water for their container was saturated and the soil wet. By July 15 the ants were dead.

Several colonies taken July 21 on the summit of Patos Island (300 ft.), between Trinidad and Venezuela, were placed for a few days in observation nests. The ants were living between the basal leaves of ground bromeliads. They used farine for substrate and developed pale, gray bromatia close to which in one colony a packet of eggs was placed.

A colony collected July 24 in the foothills north of St. Augustine was interesting chiefly because the unusually small size of the workers coincided with the unusually small size of the bromatia. These latter were grown on similarly small pieces of substrate, possibly fragments of insect feces, and were not given artificial substrate. The bromatia were a pale, grayish brown.

Biology. — An indication of the manner in which this species starts its colony is afforded by a dealate female kept in an observation nest. She was found May 6 running up a wall at the Imperial College and was placed in a small container with moist sand. By May 11 she had laid five eggs, four being in packets of two each. The eggs were in an area on the floor cleared of sand grains. The closest grain was a bright amber and moist as though it had been manured with her liquid feces. The next morning there were three eggs in one pile and a single egg a short distance away, all tended by the ant. On May 13 at 11 a.m. nine sand grains had been arranged in a loose pile beneath which

could be seen two eggs. Possibly she was attempting to produce a fungus garden. At 5 p. m. only one egg could be seen. This remained here until after May 16. Between May 16 and 21 the egg disappeared and she died, May 25. It is, of course, customary for queen ants to eat many of the eggs they lay though she may have succeeded in rearing a first brood had she been able to develope a fungus garden. Doubtless the sand grains were an unsuitable substitute but no indication of a fungus appeared at any time. Whether the *rimosus* female carries the necessary hyphae to start a garden or whether she carries a bromatium remains to be ascertained.

That females may found their colonies independently is also indicated by the finding of one dealate and by herself in yellow sand near a colony June 16 and finding of winged female crawling on a piece of wood May 22, apparently seeking a nesting site.

The average colony of this species consists of about one hundred adults but may vary considerably on either side of this figure. From a nest of *rimosus* in Panama I took 174 workers and 44 dealate females. The subspecies *comalensis* of Texas forms colonies with a hundred or more workers, the subspecies *venezuelensis* type colony had 175 workers in the major part collected and the subspecies *curiapensis*, also of Venezuela, had 90 workers in the part collected. Males and winged females may be found from March to June. The larvae and pupae are covered with a mycelium as in higher Attini although a mycelium is lacking with the bromatia.

The ants use varied habitats. On the east coast they are found at the very eastward prolongation of the Nariva Swamp under mangrove and palms; nearby at Cocos Bay they are found nesting on the beach under coconuts just above high tide level. They are commonly found under cacao but are unimportant. The ants are predominately forest species but can find the requisite humidity and nesting sites under stones or wood even in open situations. The unusual situation prevailing on Patos Island is described under "Nests".

Like other Attini these ants commonly nest close to other colonies of fungus-growers. A colony in the twig from which a garden of *Apterostigma urichi* was suspended is described under "Nests". Other colonies have been found in the multiple crater mounds of *Atta cephalotes*. A colony nested in clay about 25 mm. from the surface under cacao in the immediate vicinity of

the type nest of *Acropyga (Rhizomyrma) berwicki* Wheeler, a coccid-tending ant.

The winged males and females allow themselves to be carried by workers in any position but are always curled up. One method is for a worker to grasp the prosternites of the alate with the mandibles and carry it over the worker's back, head forward and ventral surface down.

They also resemble some of the other species in being nocturnal, being found carrying substrate or wandering about on the ground at night.

Cyphomyrmex rimosus spp. *trinitatis* Weber.

One of the most sharply sculptured of the *rimosus* forms is *trinitatis*, described in 1938 (Rev. Ent., 9:189; 12:415, Fig. 4) from the summit of El Tucuché (3072 feet) in the Northern Range of Trinidad. I also found it on Barro Colorado Island, Panama Canal Zone (1941, Rev. Ent., 12:103). The annual rainfall of both places is close to 100 inches, that of Barro Colorado being an average of about 110 inches. The summit of Tucuché is often bathed in clouds.

The type colony occupied an area about 10×10 cm. under a piece of wood in a grassy clearing. The Panama colonies were in dense shade on steep slopes, one under a rock, another under a piece of decayed wood and a third between two dead leaves on the ground. The cloudiness of Tucuché might create more similar ecologic conditions than the open, grassy situation would suggest.

Cyphomyrmex bigibbosus Emery.

Emery described *bigibbosus* in 1894 (Bull. Soc. Ent. Ital. 26:226) on the basis of the worker caste from Pará, Brazil. Two subspecies were later described from British Guiana by Wheeler and myself. An additional subspecies is known from Bolivia. To date the only record for Trinidad is that of a dealate female of the typical form which I found in the Northern Range along the Arima — Blanchiseusse Road — at an elevation of about 1800 feet on June 23, 1935. The fact that this species has not been found before or since in Trinidad despite intensive collecting indicates that it is a relict here. My records in British Guiana of the typical form and its subspecies are from heavy rain forest and the species should be found in similar forest in

the Northern Range of Trinidad. The annual rainfall at the site where the female was taken is doubtless approximately 100 inches.

The ant was walking on a half-decayed log in the sunny part of a rocky ravine. No other specimens could be found and she may have recently left the parental nest to found her own colony.

Observation Nest. — She was placed in a container of wet sand with a layer of rotted wood and humus from that part of the log on which she was found. For three days she seemed mostly to be wandering about, exploring all parts. No evidence of a fungus garden was to be seen by June 27. That morning she was given about 30 bromatia, some grown on farine, from a nest of *Cyphomyrmex rimosus*. These were placed on a piece of clean blotting paper and four to seven millimeters from its edge. The ant did not sense their presence although she felt of the very rim of the paper. A few minutes later she walked over a part of the paper to within one or two millimeters of the bromatia without evidencing awareness. 20 minutes later she was standing by the fungus and five minutes later was lapping up the farine substrate, clearly wearing it down and drying it. From 9:25 to 9:29 on she was eating a bromatium which she took up between her fore feet and mouth parts as does *Cyphomyrmex rimosus*. She repeated the performance with another bromatium. Under the binocular it could be seen that though hyphae did penetrate the piece of farine she also ingested an appreciable part of the farine alone. She was away from the piece from 9:31 to 9:33, returning to lap more substrate at another place, then returned to a larger piece of farine. Under the binocular again I watched the *hypopharynx* protrude past the maxillary and labial segments to rasp off the substrate with a piston-plunging motion, the paired segments forming somewhat of a cylinder. She left at 9:35 to clean herself, returning at 9:41. The ant took up a piece of the garden but dropped it when I took up the cover to the nest, returning 90 seconds later to lap more. Again, at 9:44, she left for a moment to clean her antennae and mouth parts and then came back to a juicier piece of substrate. I wondered whether she could be taking in substrate for food for possible hyphae in her infra-buccal chamber. She was gone for a few minutes, then came back near the garden to clean herself for several moments, frequently curving the apex of her gaster to her head, opening the cloaca and licking this opening momentarily. No passage of

liquid or solid could be seen to take place when viewed favorably in side view. The terminal segments of the gaster were extended widely as it was full of eggs. When examined again at 10:01 she was still engaged in feeding on the substrate, leaving at 10:03 for a few seconds, returning for a moment, only to leave once more. She died June 29, being found stuck by the head to moisture on the glass cover.

Mycocepurus.

These tiny ants, mostly only two or three millimeters long, are easily separated from those of the other genera by their comparative lack of conspicuous hairs and by the acute and numerous spines of the thorax. Most of these are in the form of a circlet on the anterior part of the thorax. The frontal carinae are also close together and the lobes small.

Mycocepurus smithi Forel spp. *trinidadensis* Weber.

Mycocepurus smithi is widely distributed in the Caribbean Region and was originally described from St. Vincent. It occurs on such others of the Lesser Antilles as St. Lucia and Antigua; *smithi* or its forms are also known from Cuba, Puerto Rico, Mexico, Panama Canal and Surinam. The subspecies *trinidadensis* was described in 1937 (Rev. Ent. 7:378-9, Fig. 1) from a colony found at an elevation of about 1800 feet in the Northern Range north of Arima, Trinidad June 23, 1935. This subspecies may be told from the typical form by the mostly smooth surface within the circlet of thoracic spines which may bear a pair of small tubercles but is not thrown up into a semi-circular ridge as it is in the latter.

Distribution. — I have collected it in the following localities: Macqueripe Bay, under cacao, 5.VIII.35; Sta. Cruz near Port of Spain, 29.XI.35; Imperial College of Tropical Agriculture, numerous times; Mt. St. Benedict, 1.I.35; Maracas Valley and foot of falls, 19 and 23.III.35, 27.V.35, 1.X.35; Tacarigua River, Caura Valley, 300-400 ft., 17.III.35; Aripo Valley, 1000-2500 ft., 19.IV.35; W slope Morne LaCroix, 750 ft., 7.IV.35; Spring Hill Estate north of Arima under cocoa, 1200 ft., 7.IV.35; San Rafael Cocoa Estate under cocoa, 31.V.35; Basin Hill Forest Reserve, 700 ft., 1.IV.35; Cocos Bay, on beach, 3.I.35; Mayaro Bay, numerous times 1934 and 1935; Nariva Swamp, 5.XII.34, 21.IV.35; Trinity Hills Reserve near

Pilote River, 22.XII.34. Professor Mc. C. Callan sent me workers from Tumpuna Reserve and under cacao at Las Hermanas Estate. It is evidently distributed generally over the island and commonly in heavy clay.

N e s t s. — The usual external indication of the nest is a small crater, which, however, may easily be washed away leaving simply a bare hole. The craters may be numerous in favorable sites and close together. Although most commonly seen in clay soil the ants may nest in coral sand near the seashore and in rocky or pebbly humus. A tunnel barely large enough for these tiny ants leads irregularly below the crater to one or several chambers, the uppermost chamber being four to nine centimeters below but doubtless subject to considerably more variation depending upon soil conditions. The chambers are hard to find because the tiny and tortuous tunnel may easily be lost and the chambers well to one side of the crater. Ants were found excavating soil 15 cm. down. A nest in clay at Spring Hill Estate had the first chamber nine centimeters down and several centimeters to one side of the crater. This was about 20 mm. wide × 15 mm. high and empty except for a small pile of soil granules. A second chamber was 16 cm down and contained the fungus garden and brood. No roots penetrated the garden and it was sessile. The chamber was elliptical, 20×25 mm and nearly filled by the garden. The fungus is gray in appearance and grown on vegetal material and possibly insect feces. Workers were found cutting flowers of *Mitracarpus (portoricensis?)* and others were seen carrying feces, apparently of bats, as well as caterpillar feces.

O b s e r v a t i o n N e s t s. — The part of the type colony collected was placed in an observation nest. On July 2 it could be seen that the ants had used shreds of woody plant stalks for substrate and had probably manured them. On July 6 five workers were removed (see below) and by July 27 only a dealate female and a winged female were left alive. A dealate female was found dead in the nest with the dead workers and the garden had degenerated. At 11:23 a. m. July 28 the two females were given a flourishing piece of the fungus garden of a colony of *Apterostigma urichi.* Neither ant noticed it. Two minutes later the alate walked into the piece in the course of her wanderings, hastily backed up and detoured around. At 11:29 the dealate walked by without paying any attention to it. By 3 p. m. the piece still appeared untouched and the ants were not near. At 3:01 a piece of the garden of an *Atta cephalotes* colony was given them. It

had been grown mostly on yellow sweet potato and lacked fecal droplets. The ants at first ran by, ignoring it. In a moment they returned excitedly and began rapidly exploring it with their antennal tips. Now and then they rushed off at a tangent but immediately returned. They made no effort to taste it, never extending the mouthparts yet several times they turned it over by crawling beneath and dislodging it in this manner. For about ten minutes they continued this somewhat feverish activity, then more desultorily, leaving the piece for a few moments. Once the dealate bit off a piece of a bromatium and carried it to one side, only to discard it. She tugged at several more but they were too firmly imbedded to be removed. By 3:47 both ants were in attendance and had evidently eaten some of the mycelium. 24 hours later both ants were in attendance, walking over the piece of garden carefully as though it were their own. They delicately lapped bits of the mycelium. In the meanwhile the *Apterostigma* garden had become covered with a long, white mycelium on which was a large fecal droplet. It had seemingly been otherwise ignored. Two days later both pieces had sprouted fungi widly, one hyphae, the other sporangia and had clearly been discarded. They were given pieces of the stipe, lacy velum and slimy gray pileus of *Phallus* sp., freshly collected, but the ants were not seen to explore or taste it, although one ant walked over a piece.

July 6 five workers were removed from this nest and placed in a small container with wet sand and clay. By the following morning the ants had tunnelled extensively into the soil and had roofed galleries on the surface, an unusual feature for Attini. They were given a piece of the fungus garden of *Sericomyrmex urichi* developed on fresh substrate. At noon they were watched under the binocular microscope. When first viewed one worker was motionless, with a few hyphae protruding from its mouth. For eight minutes it remained motionless in this manner and then walked over to the garden. Here it lapped up the hyphae in several places over a period of five minutes. Five hours later, however, most of the mycelium still remained and on it had been deposited a clear amber fecal droplet. On the following morning the garden was still in good shape. A worker was seen feeding on a strand of hyphae. One worker had drowned in a drop of moisture. By 11:30 a. m. July 9 one worker had died in hyphae of an alien fungus and little remained of the original garden; none of the ants was in attendance. The remaining three ants died on the following day.

The Spring Hill colony was placed in an observation nest and by the morning of April 8 had built up two separate gardens. Larvae and large pupae could be seen from below through the glass floor. During the next ten days the ants used yellow sweet potato and some farine for substrate. By April 20 the garden became somewhat dry and shriveling. Many workers were out on wet blotting paper and taking up moisture for the garden. 30 dead workers were removed from the nest April 26, leaving only a few alive. All of the colony, however, had not been secured originally so that this represented only a portion of the colony. The few remaining ants were not sufficient to maintain a garden and by the end of the month all had died.

B i o l o g y. — The colony of this species probably consists of one hundred or more adults. Like attines in general these ants frequently nest close to other species of the tribe, such as species of *Atta, Acromyrmex* and *Trachymyrmex*. The nests occur in a variety of habitats, such as under coconuts on the beach, under cacao, under *Heliconium,* in roadways, and beside the Boss House at the Imperial College on the shady, north side. The ants were found in tunnels about the type nest of *Acropyga (Rhizomyrma) berwicki* Wheeler and close to a nest of *Acropyga (R.) urichi* Weber. In all cases of nesting about other ants the association is doubtless fortuitous or due to the use of similar habitats. The various records from cacao estates also do not indicate any particular relationship and in any event the ants would probably not be harmful. That they may on occasion kill other insects was shown by a brief experiment. A larviparous fly bursting with larvae was placed in a nest with workers and was dismembered by them while the larvae emerged and crawled about. One *Mycocepurus* attacked a larva and held on firmly fór some time.

An analysis of the soil about the Spring Hill nest appears in Table I.

A dealate female found wandering about at the Imperial College July 10 may have recently come from a marriage flight.

M y r m i c o c r y p t a.

The workers and females of the genus *Myrmicocrypta* are readily told from those of the genera *Cyphomyrmex* and *Mycetophylax* by the sharp tubercles or spines on the thorax from which curved hairs project. Ants of the genus *Mycocepurus* have acute spines of the *Atta* type which do not bear hairs. Small

workers of *Trachymyrmex* have broader frontal carinae which are more widely spaced. All are of very small size and usually overlooked.

Myrmicocrypta squamosa F. Smith

Trinidad is included tentatively in the distribution of *squamosa* through a record of Forel's of a male which he took at Port of Spain (Forel, 1912, Mem. Soc. Ent. Belg. 19:189). The species was described from S. Paulo, Brazil by F. Smith (1860, Jour. Ent. 1:74, pl. 4, f. 14-17) from a female and a variety is known from Paraguay and Argentina. It hardly appears likely that a species described from as distant as S. Paulo is from Trinidad would occur here in view of the limited distribution of the other species in the genus and the fact that Urich or Wheeler did not take or record it subsequently, except to copy Forel's original record.

Myrmicocrypta buenzlii Borgmeier

Father Borgmeier described this species in 1934 (Arq. Inst. Biol. Veget., 1:104-105) from workers taken at Paramaribo, Surinam, and the late Dr. Wheeler identified some of my Trinidad specimens as this species the next year. Although apparently common in the Northern Range the ants are small and inconspicuous. They are distinctly paler and more ferruginous than *urichi* workers but similarly slow-moving and hard to see.

Distribution. — I took it in the Maracas Valley (March 19 and 23, 1935, 900 ft.); W slope, Morne La Croix, 750 ft. and NW slope also, 800 ft., 7.IV.35; foothills north of St. Augustine, 14.V.35. Professor Mc C. Callan sent me workers (Sp. 23) from cacao.

Nests. — Most of the nests were found in heavy clay soil and from 25 to 64 mm. below the surface. Rain had washed away any crater formed in several nests but one was surmounted by a turret in the form of a tapering cone 77 mm. high, 51 mm. in diameter at the top and 154 mm. in diameter at the base with a tunnel 3 mm. in diameter. One colony had two nests 115 mm. apart, one being under a flat stone. The nest chamber varied from 20 to 102 mm. in height and 22 to 102 mm. in diameter. The average depth of the nests was 47 mm., the average height of the chamber 54 mm., and the average lateral diameters 57×78 mm. An analysis of the soil of one nest appears in Table

I. These ants commonly nest in dense shade in regions of high rainfall (60-100 inches) and probably where the rainfall is more nearly 100 than 60 inches. Since the clay soil is frequently waterlogged this species developes an effective drainage system. Not only is the compact fungus garden in some but not all cases suspended from rootlets, but it commonly rests upon small, angular stones, frequently about 10 mm. in diameter. The spaces between the stones are kept clear. In these spaces may live minute, white insects such as Collembola which may be scavengers. The gardens appear compact and solid with a bulk estimated to be from 50 to 80 cc. The exterior is perforated by numerous holes, quite regular in shape, and is gray in color. The interior is lighter and more brownish and honeycombed. The fungus is in the form of white mycelial strands concentrated in places into more compact masses and developed on dark brown compact material interspersed with woody and juicy fragments.

Observation Nests. — Two colonies (Nos. 73 and 75) collected March 23, 1935 and five meters apart were placed in separate observation nests. By the following morning both had built up their fragmented gardens to a considerable extent and removed some clay particles to outside the nest chamber. On the following morning both gardens appeared flourishing. They had not taken various substrata placed in the nests but the workers of one colony appeared to have eaten a little papaya. During the rest of March they used both yellow sweet potato and bread for substrate to keep the gardens flourishing. One garden had holes of increased size and compact masses of mycelia scattered about. During early April No. 75 was noted as being more diurnal in activity than No. 73 and on April 17 was watched under a microscope in ordinary daylight. A worker came into view carrying a whitish translucent bit of material, perhaps bread or farine, about half the size of its head and with a tuft of mycelium protruding from one end. It carried the piece about for a time, in and out of several holes in the garden, and then placed it on a moist piece of clay. A white mite crawled up to the ant and appeared to be taking juices from its surface. Another larger mite came by but appeared photophobic. Later a mite was watched feeding on this piece of substrate which appeared to have been discarded close to a refuse pile. No. 73 colony during April regulated the moisture of its nest in several ways. The ants chewed pieces of wet blotting paper and placed them on the side of the garden facing the entrance to the nest.

They also built a mound of clay about the entrance which closed it except for a small entrance. This was lined with chewed particles of paper. *Monomorium floricola* workers invaded the nest April 20 and fed on bread. Later in the month the garden appeared to dry considerably. The other colony maintained a more flourishing garden. In April a colony of *Strumigenys* was placed in No. 75 nest and took up residence in soil debris cast out by the *Myrmicocrypta* but the ants were not molested.

On May 4 colony No. 73, having a rather dry garden, was transferred to a new observation nest which contained also colonies of *Apterostigma urichi* and *Pheidole apterostigmoides (q. v.)*. Workers of the latter spent the day investigating the *Myrmicocrypta* nest. The latter ants were sluggishly and not aggressively hostile though the *Pheidole* ran over the garden. On the following morning many *Myrmicocrypta* workers were dead and had been placed on the refuse heap outside the nest entrance. The queen was walking about apparently unharmed. No *Pheidole* were in this nest but they had probably fought the others during the night. The colony, however, was maintained successfully during May, June and July. On August 3 the garden was reduced in size, about half being dry and withered. The flourishing half was attached in several places to the glass ceiling. The mycelium was growing rather loosely, as in *Myce-tophylax,* was gray in color and had been developed largely on farine. Several males and a dealate female were visible as well as workers. On August 8 several males attempted flight when I caught them. The garden appeared withered but had many bromatia. On September 26 the colony was ended; the relatively dry fungus had remained relatively stable for months.

A colony collected April 7 had by the next day successfully built up its fragmented garden. During the next few days the ants used yellow sweet potato for substrate. By April 12 an alien ordinary-looking mold had developed on unused pieces of the potato and had developed a forest of fruiting bodies. A worker was watched wandering through this forest with difficulty to reach substrate and it later returned to the nest. Other workers similarly must have been showered with apparently alien fungal spores. The garden, however, thrived and maintained its customary appearance. The latter part of April they used farine as a substrate. The garden grew to the glass ceiling to which it became attached. During May the garden was variably maintained.

During June part of it dried, the mycelium and farine together drying and shrinking. The colony was ended in July.

Twelve workers from this April 7 colony were placed in a small container with moist sandy clay at noon on July 7. A few hours later (5:33) a piece of the fungus garden of *Myrmicocrypta urichi* was placed in the nest. This piece had only scattered strands of mycelium. The ants, however, immediately gathered around it and explored the piece. They were not seen to eat it. By the following morning the mycelium had grown, the ants were in attendance and two fecal droplets had been deposited on it. By July 11 the garden was still flourishing and the ants had carried it to a small cell excavated in the dish. By the next morning bromatia had developed for the first time. The nest had dried somewhat and the question presented itself on the relationship between drying and bromatia. On July 15 the garden appeared healthy and the ants normal. By July 22, however, the ants had died and the garden was sprouting wildly.

On July 18 ten workers from the same April 7 colony were placed with some of their own garden in an Erlenmeyer flask of sterile potato dextrose agar. The following morning ants were walking over the agar surface but there was yet no evidence of alien growth. By July 22, however, the surface had become a mosaic of alien growth although the garden seemed normal and most of the ants were in attendance on it. By July 26 only one worker was alive and the garden was sprouting wildly as in other neglected gardens.

A colony collected May 14 was kept in a large container with a portion of an *Atta cephalotes* colony until May 20. The Attas tolerated the smaller ants.

B i o l o g y. — There are several hundred workers to the colony of *buenzlii.*

M y r m i c o c r y p t a u r i c h i Weber

Like the other species of the genus, *urichi* is small and inconspicuous. The workers are dark in color and this character combined with their slow-moving gait and habitat renders them particularly hard to see. The species was described in 1937 (Rev. de Ent., 7:379-382, Figs. 2, 3) from Mayaro Bay, Trinidad.

D i s t r i b u t i o n. — *Urichi* has been taken by me at the south part of Mayaro Bay, 9.III.35 (Type collection) Pt. Radix, Mayaro 25-5.XI.34; Nariva Swamp, 25.VI.35; foothills north of St. Augustine 29.VII.35; Aripo Valley, 1000-2500 ft., 19.IV.

35; Imperial College, 10.VI.35; Tucuragua R., tributary of the Tacaragua R., 300 feet, 5.V.35. In a collection of ants made by Dr. P. Hummelinck of the University of Utrecht on islands off the Venezuelan coast this species is represented. A worker was taken by him at Abajo la Toma de Agua del Valle, Isla Margarita, 4.VII.36.

Nests. — The type nest was found in black sandy-loam beside a coconut tree in a coconut grove a few rods back from the beach. The nest was sheltered from the trade wind by a palm which leaned towards but not quite over it. A typical crater of 50 mm. diameter had a small hole in the center from which a tunnel led, at an angle, 50 mm. to the nest chamber. This chamber was 35-42 mm. high by 35×77 mm. diameters. A Nariva Swamp nest in moderate shade had a turret opening about 20 mm. high by about 13 mm. in diameter as well as two simple holes in a double crater. 57 mm. down and slightly to one side was the nest chamber. Originally this was 38 mm. high by 108 mm. long by 38-64 mm. wide but one side was filled with soil granules so that the chamber being used was about 38 mm. high by 38-50 mm. diameters. The fungus garden was pendant on rootlets and lacked drainage canale at the bottom. It was speckled with bromatia and developed on a brown to yellow substrate. The larvae were covered with a white mycelial mesh. Another nest near by had a similar turret on a simple crater. The chamber was 48 mm. down and 45×83 mm. diameters, containing a fungus garden suspended on rootlets.

Observation Nests. — The type nest collected March 9 was placed in a box which was emptied March 12 into a Petri dish with a beaker over it. The garden had all been removed to the bottom of the box. The ants busily started transferring the material to beneath the soil surface. Under the microscope the fungus appeared to be a whitish mycelium scantily covering particles of light yellow grass stems or other plant material interspersed with brown and amber unknown objects. This nest was placed in a large container with nests of *Trachymyrmex urichi* and *Mycetophylax brittoni littoralis*. All of the workers were slow and deliberate in their motions. A *Trachymyrmex* March 15 wandered over the *Myrmicocrypta* nest and explored the top, coming near the latter workers, but was not attacked. It even went down a nest entrance and came up without being pursued, then encountered a *Myrmicocrypta* carrying a load of substrate. When the *Trachymyrmex* extended its antenna

towards the other and advanced towards it the *Myrmicocrypta* dropped its load and fled. March 17-22 the ants were still engaged in removing their old substrate from the top of the nest, where it had been dumped, to the interior. When a flashlight was turned on the nest at 9:15 p. m. March 22 many ants were seen moving actively about on the nest; they were more active and numerous than at any previous time in the day. March 23-26 few workers were to be seen outside the nest. On the latter day the colony was transferred to another observation nest and the fungus garden was seen to be smaller than originally and freely exposed to the air of the nest chamber. It was suspended from fragments of coconut roots at the top. Under the microscope March 27 the mycelium appeared to be growing over pieces of whitish or pale yellow wood-like material and upon small dark pieces of indeterminable substance. The ants were going over the gardens continuously, feeling the mycelium delicately with the *tips* of their antennae. They were not affected by the diffuse light and behaved apparently normal. For the rest of the month and until the middle of April the gardens appeared to flourish. Various possible substrata such as grass, sweet potato and bread had been introduced from time to time but were apparently not used. During the remainder of April it was still successfully maintained and on April 30 the ants carried in farine (cassava) placed in the nest that day. The garden by May 5 had increased in size and luxuriantness as a result of the farine used. The garden was maintained successfully during May, June and July. June 4 several males with crumpled wings appeared at 3 p. m.

July 6 ten workers were taken from the nest and placed in a small dish of moist soil. The next morning a piece of the fungus garden of a colony of *Mycetophylax brittoni littoralis,* containing a large larva covered with mycelia, was placed in the dish. The ants were mostly out of sight in small tunnels which they were excavating and none was within 10 mm. of the fungus, most of them being about 20 mm. away. Within 30 seconds the ants had sensed the presence of the fungus and one by one walked slowly towards it, waving the antennae in front slowly. When they came up to it they delicately felt of the mycelium with the antennal tips. After a few seconds of such exploration they started lapping up the mycelium. In eating most of the ants took up small portions of the mycelial tufts with their mandibles and pressed on these as they lapped with the tongue. All ten fed and as many as eight would be on the piece at one time. They felt of the larva, even

lapping one or two of its mycelial tufts but displayed no hostility. Eighteen minutes later the fungus was over half gone and the larva was now curled up. Two minutes later a small piece of farine was placed 15 mm. from the ants and one walked directly to it but it remained untouched. Three hours later most of the fungus was gone as well as most of the mycelium on the larva and five hours still later all of the fungus was gone and the larva was smooth and shining but for several mycelial tufts. A worker was watched licking it. At this time another piece of *Mycetophylax* garden was given to the ants and they immediately clustered about it, eating some. By the next morning this too had disappeared and they readily took another piece. July 9 one worker was dead and the third piece of fungus garden completely gone. A fourth piece was given and eaten partly. By July 11 this piece was flourishing since it had adequate substrate and the ants had added more farine. By July 22 little of the garden was left and by July 24 the ants had died.

Biology. — The population of the colony appears to be about one hundred or somewhat more. The record from Isla Margarita off the Venezuelan coast indicates that this species may be found along the Old Spanish Main where ecological conditions are similar to those of Mayaro Bay on the east coast of Trinidad. On a brief call at Margarita in 1936 this island appeared to me to be low and sandy and coconut palms growing here would create conditions somewhat similar to Mayaro Bay. The adjacent mainland coast also visited in 1936 from Puerto Cabello to Trinidad appeared to be suitable for this species and it may be expected here. The Tucuragua River record is of a damaged worker and is uncertain but if the species really occurs here the habitat is different. It was taken in a cocoa plantation which contained also scattered coffee trees and was beside a nest of *Apterostigma mayri*. The record from the foothills north of St. Augustine also indicates more adaptability since the ant was at the base of a bamboo clump, partly cut down, which was on the hillside exposed entirely on the west and largely on the south. Like Mayaro Bay, however, the drainage of the soil was good and it appeared never to get waterlogged. The rare ant, *Thaumatomyrmex atrox* Weber, also occurred here and under bamboo at Kartabo Point, British Guiana. All of the known habitats indicate a preference for well-drained or sandy soil and in this the species is different from *Myrmicocrypta buenzlii*.

Mycetophylax.

There is but one species of this genus known from the entire Caribbean area. It was described from Puerto Rico and occurs also on Grenada, B. W. I., in both places only on the seashore. A species described as a *Myrmicocrypta* from Colombia *(M. emeryi* Forel) has been referred to *Mycetophylax* by Emery (Genera Insectorum). Forel, however, in 1911 refers to these ants as follows: "Non seulement les ☿ mais aussi les ♂ sont extrêmement voisins des *Trachymyrmex."* As *Mycetophylax* workers are unlike *Trachymyrmex,* it appears that Forel was correct originally. Other species of the genus occur in southern Brazil and Argentina. Mr. P. Hummelinck of the University of Utrecht, Holland sent me a worker which he took on an island off Venezuela. The genus in the Caribbean is unique in being confined to the sandy seashore.

The ants are easily recognized by their dark brown or black integument which is without sharp spines or projections. The ants have a more smoothly rounded head then other Attini.

Mycetophylax brittoni Wheeler spp. *littoralis* Weber

Distribution. — The subspecies *littoralis,* described in 1937 (Rev. Ent., 7:370-5), is known only from Mayaro Bay on the east coast of Trinidad but doubtless has a wider distribution along the east coast. It is unlikely that it will be found on most places of the west coast because of the muddier shore. Many parts of the north and south coasts are washed by the waves up to a precipitous slope and also unsuitable.

Nests. — The ants nest on the fringe of beach, narrow at high tide, between the edge of the coconut palms and the water. Seaward is a few feet of "chip-chip" pelecypod shells and beyond that the smoothly sloping beach. The coral sand in which they nest must be brackish to salty and the entrances must be occasionally closed by high waves. Such a situation is unique among Attini and would seem to be precarious. Because of the almost constant trade winds such sand as is brought up in excavating the nest would be blown away so a crater entrance is seldom found. Usually the external indication of the nest is an inconspicuous tiny hole barely big enough for an ant. From this a tortuous tunnel leads below to a depth of 10 to 65 cm. to the chamber which may be some distance to one side of the entrance.

One nest had the first chamber at a depth of 10 cm. and a second at 22 cm.; at 28 cm. the tunnel was lost. The globular chamber may be about 5 cm. in diameter but in one case was only 6×13 mm. In this is the sessile fungus garden, usually developed on short sections of grass. The mass of the garden in a small chamber was estimated to be about 2 cc. The substrate is light brownish and is covered with a whitish fine mycelium. A nest 250 cm. from the base of a coconut palm was an additional 100 cm. from a good growth of grass kept low by goats and cattle so that the ants had to travel a minimum of 350 cm. for their substrate. The trade wind, blowing from the sea, would prevent substrate from being blown closer as a regular occurrence. Creeping grass would sometimes extend to the coconuts and shorten the distance by that much.

Observation Nests. — Colonies of these ants from Mayaro Bay were kept in observation nest for varying periods. A colony was kept successfully from March 11 to the end of May, 1935, the fungus garden degenerating during June and the ants consequently dying. Males were present in both nests during March. Another colony collected at the same time lasted several weeks less, dying in early May. A colony collected June 16 flourished during July and August, 1935.

The ants in these nests are photophobic and observations are consequently not easily made. Their gardens were small and compact and usually roofed over with sand. For a substrate they accepted yellow sweet potato with good results and the fungus was cottony in appearance when grown on this substrate compared with a much looser fungus when grown on grass. There were white mycelial tufts with interspersed transparent droplets but not the *Atta* type of bromatia. They also used boiled cassava or farine (cassava shreds) but rejected papaya and banana. Grass seemed to be the substrate used in nature and this was used upon several occasions. The grass given them came from the Piarco Savannah and was likely of a different species than that in the vicinity of the ants at Mayaro Bay. The ants were observed to curve forward the tip of the gaster and deposit a pale, tiny fecal droplet which would immediately be absorbed by the grass.

The males in these nests were occasionally seen to wander outside the nest during March and on April 2 an indication perhaps that this was the usual time for the marriage flight and their consequent restlessness. They also wandered about on the

gardens. In the June nest males were observed as late as August 7.

That the observation nests were successful is also indicated by the fact that callows, which had been reared in the nest, matured uneventfully.

Phorid flies, black with red eyes, appeared in the colony which was collected June 16, on June 20 and on July 2 six or seven phorids running about the nest must have emerged from the nest, since it was tightly enclosed all of this time.

Biology. — A few score adults, probably less than 100 in most cases, constituted the colony. The larvae have tufts of hyphae on their otherwise shining skin. Phorid flies, as noted above, probably parasitize the ants and a worker in nature (13.I.35) was carrying a mite. A white Thysanuran (*Lepisma* ?) lived in an observation nest.

Apterostigma.

No other ants resemble those of the genus *Apterostigma* at all closely. They lack spines of any kind except that one aberrant species has small epinotal spines. The general outline of the body is smoothly rounded with a tendency to develope a pair of low ridges along the dorsal surface of the thorax. The frontal lobes, though approximated, are large and thick. Commonly there is an abundance of long, gray silky hairs. The genus is confined to Central and South America.

Apterostigma urichi Forel

The large and ungainly appearing *urichi* is one of the most striking attines in Trinidad. Despite their size, however, the ants are far from conspicuous on account of their spidery build and dull gray color. These characters serve to blend the ants in well with the forest floor. The species was described in 1893 (Ann. Soc. Ent. Belg. 37:603) from workers sent to Forel by Mr. F. W. Urich.

Distribution. — The species is doubtless widely distributed and I have taken it in the Northern Range (Mt. St. Benedict, 850 feet; Morne La Croix, 820 feet) and frequently in the foothills north of Tunapuna; also in the Basin Hill Forest Reserve (61° 17' 15" W, 10° 25' 20" N; 700 feet). Mr. D. Vesey FitzGerald brought me specimens from rotting roots of "Balisier" on Mt. Harris in Central Trinidad.

Nests. — The ants commonly nest in well-rotted logs on the ground or simply in a small pocket in humus under leaves. The chief requirements of their fungus evidently are constant high humidity, rapid drainage and probably good aeration. One nest was found in a rotted root of a fallen tree 30 to 40 cm. above ground. A typical nest consists of a single fungus garden covered by a silky envelope of mycelium, the garden being in an irregular cleft in humus or rotted wood. One nest was 5×6×10 cm. and they are often smaller. The colony may be polydomous and three nests which were found close together (not more than 30 cm. apart) may have constituted one colony. This habit has been observed elsewhere in *Apterostigma* (Weber, 1941). The fungus garden is usually suspended from twigs, decayed leaves or roots to which also is attached the external covering envelope of mycelium. Holes in the envelope, often near the bottom, permit ingress and egress of the ants. Occasionally no envelope has been found around the garden.

Observation Nests. — Colonies were kept in observation nests several times.

A colony, collected April 1, 1935, was kept to mid-June. Closely associated with the colony was a colony of the ant, later described as *Pheidole opaca apterostigmoides* Weber (1943), whose workers resembled of the Apterostigmas to an unusual degree. The fungus garden was badly broken up in taking it from the rotted wood of a fallen branch in which it occurred but there was no silken envelope in this case. By the following morning the ants had rebuilt the garden in an observation nest in irregular vertical columns of pellets extending from top to bottom of the nest. The fungus was apparently grown on rotted wood pellets or feces. During the day they were given pieces of bread and yellow sweet potato. By the following morning (April 3) they appeared to have incorporated some of the bread into the garden. Three workers were engaged in cutting off pieces of the potato. On April 4 additional growth of mycelium was noted. The next day the *Pheidole* ants were seen in a cell beneath the cell of the *Apterostigma* but in the same nest. They had been flourishing and the soldiers remained close to their brood. Between April 6 and 18 the garden continued to flourish. On April 8 the *Pheidole* moved out from beneath the Apterostigmas to a position at the side of the fungus garden and rested their brood on the glass bottom of the nest beneath a pile of cast-off pellets of the gardens. During April 10-18 *Pheidole* workers were often seen

close to the *Apterostigma* nest or workers, the latter paying no attention. On April 17 and 18 a male *Apterostigma* was seen and *Pheidole* pupae were taking on the coloration of callows. By April 20 the garden diminished in size and on this day a worker was seen to drink water. More water was given the nest and the next day the garden appeared to be more flourishing. A worker came to the nest with a particle of yellow sweet potato about the size of its head. Inside the nest it encountered four other workers in succession, each of which examined the piece of potato with the tips of its antennae while the carrier waited. The latter deposited the potato near the garden whereupon the four others examined it more carefully, licking it with their mouthparts as well as examining it with their antennae. The potato was left there. By April 26 the garden columns, often broken down, had remained as a sessile garden on wood and humus. The *Pheidole* had their larvae and pupae directly under the Apterostigmas but separated by a few millimeters of the wood and humus. On April 29, the garden appearing reduced, water, cassava and boiled sweet potato were introduced which in the next few days brought about an improved condition. Eight millimeters separated the nests of the two species. On May 2 a *Pheidole* worker was watched a few millimeters from the *Apterostigma* garden. It stood outstretched and motionless. An *Apterostigma* came up, waved its antennae in front of the *Pheidole* but without their outstretched antennae quite touching. Another *Apterostigma* came up as the other moved away and the *Pheidole* quickly recoiled for a moment. It soon went away while the *Apterostigma* continued their constant examination of the garden. In the following 24 hours the *Apterostigma* moved their garden to a small bottle. One male was with them. The *Pheidole* remained as before, their pupae on the glass bottom, their larvae stuck by their hairs to the sides and ceiling of the cell. Since this nest was rather dry the *Apterostigma* nest had probably also become too dry and caused the moving of the latter. The following morning both colonies were removed to another type of observation nest and in the process workers were interchanged. As they ran past one another the Apterostigmas and Pheidoles usually ignored one another except where they came close to one another's brood, in which case hostility was evidenced. During the month of May the ants moved their garden several times to places of more suitable humidity. When *Pheidole* and *Apterostigma* workers would come near each other more hostility was evidenced, the Apterostigmas sometimes seeking to

drive off the *Pheidoles* by waving antennae and rushing around on their long legs. Two Apterostigmas found dead with most of their legs removed on May 22 may have been dismembered by the Pheidoles. The male was found dead May 18 in a normal position but with its gaster gone and the remainder of the body covered by a compact whitish fungus. The *Pheidole* soldiers usually remained by the brood but one on May 28 was seen sparring antennae with an *Apterostigma*. A *Pheidole* worker came up and tried to drag the soldier away by the leg but to no avail. The *Apterostigma* ran around the soldier, touching the latter momentarily with outstretched antennae as well as the *Pheidole* worker. Finally the *Pheidole* worker dragged its soldier away. The colony was finally ended in mid-June and the *Pheidole* colony May 28 after the two colonies had become hostile.

A colony collected April 7, 1935 was kept under observation until May 5. The colony was very small yet it had a fungus garden covered with a silken mycelial envelope in a rotted log on the ground. Naked pupae were seen while making the collection. The colony was placed in a small observation nest but by the next morning little had been accomplished in reconstituting the garden. April 10 a single pellet of substrate covered with fungus was outside the cell, which the ants made in humus, and was attended by two workers. April 13 the only fungus garden visible was a small one on a single pellet substrate. By April 17 no fungus garden remained and the ants were given a small piece of fungus grown on yellow sweet potato by a colony of *Apterostigma wasmanni* in another nest. By the next morning this had disappeared. April 26 a larger piece of fungus garden grown by a colony of *Myrmicocrypta buenzlii* was placed beside two workers. One soon began exploring it, then the other although they did not eat any of the fungus. After a few moments they went away. April 28 this garden appeared the same and by April 29 it clearly was not thriving. By the following day the ants had torn it up and scattered the pieces. By May 5 the colony had died.

A colony collected May 30, 1935 and placed in an observation nest lived about one month. The ants at first were placed in an observation nest of *Trachymyrmex urichi* and for days the workers of the two species battled one another. The heavy-set *Trachymyrmex* were naturally the agressors and even the dealate females attacked the spindly Apterostigmas. Nevertheless the latter succeeded in building up a luxuriant fungus garden. By

June 12, however, the garden had disappeared and most of the workers had been killed by the *Trachymyrmex*. Those still alive on this day were mostly being carried about by the latter. On June 19 they were given a small piece of the fungus garden of *Apterostigma wasmanni*. 90 seconds later a worker with the two terminal joints of the right antenna missing came up to it. When near, the ant moved its antenna about slowly, moving in the general direction of the garden. The left antenna found the garden but waved off as a blind man would grope with a stick. The right antenna was useless and could not guide the ant to the garden. The left antenna swung back and finally guided the ant to the garden. The eyes appeared not to be used in the sligtest degree. The ant blundered off the garden, groping about nearby, and even pushing the garden aside with is head. When the mouthparts would be guided to the fungus garden the ant lapped the fungus. It lapped slowly, feebly and intermittently. Another ant with complete antennae came up, groped similarly, then lapped the fungus intermittently when its mouthparts were guided to the fungus. Again the eyes were apparently not used. Further proof that the antennae, and especially the terminal segment or two segments, were the sensory structures guiding the ants to the fungus was the fact that the ant with the missing right segments invariably went to the left side of the garden. June 21 two workers were feebly alive but with one or two segments missing from an antenna. They were given a piece of the garden of *Trachymyrmex urichi,* the piece being placed in front of one ant. The ant blundered into the piece, waving its antennae as before and apparently sensing the presence of food but unable to locate it. The piece was not eaten. By June 27 the ants were dead.

A colony collected July 12, 1935 was kept about a month and used mainly for experiments on artificial culture inoculations and media *(q. v.)*. July 17 it was noted that they had manured their garden with tiny, rather clear, watery fecal droplets. They incorporated a small hard seed in the substrate. July 19 a worker was seen carrying a pupa so heavily covered with mycelium as to be almost unrecognizable. August 7 two males were seen and the ants had sprinkled their garden with a number of deep amber fecal droplets.

July 18 four workers and about three cubic centimeters of the fungus garden of the above colony grown on natural substrate were placed in an Erlenmeyer flask of artificial culture medium. On the next day the garden was flourishing and there was no

evidence of any alien growth. July 22 a dense, fluffy growth of hyphae with fruiting bodies almost completely covered the surface of the medium. The four ants were clustered together on top of it and one fecal droplet was seen. The fungus probably was not the one which they cultivated but a common species. July 26 only two ants were alive and these were feeble.

Biology. — The average colony of *urichi* consists of a few score workers. These live within the silken envelope which usually surrounds the entire garden. Since the garden is composed of triable columns of substrate loosely arranged there is adequate space for all of the adults and brood. The latter is imbedded more or less loosely in the substrate as is common in Attini. Males were observed in nests in nature May 25, July 12 and November 27.

The army ant, *Eciton burchelli urichi* Forel, has been observed preying upon a colony of this species. The Ecitons poured into the garden covered by its silken envelope and drove out such adults as were not captured or these hidden in the cells of the garden. Phorid flies were observed hovering over the ruins of a broken up nest and may well have parasitized these ants. This species commonly nests close to other species, both Attini and non-Attini. The closest association was that described above with *Pheidole apterostigmoides*. Another nest was suspended from a rotted twig which itself contained a tiny colony of *Cyphomyrmex rimosus*. These two colonies were 17 cm. or less from colonies of *Apterostigma ierense* and *Trachymyrmex ruthae*. The four species doubtless found that temperature, humidity and other conditions were suitable and likely ignored one another. With an abundance of substrate available for all, competition was unlikely.

Apterostigma mayri Forel

Problably the most wide-spread species of *Apterostigma* is *mayri* which was described in 1893 (Ann. Soc. Ent. Belg. 37:604) from Trinidad. It occurs from Central America to Bolivia and Brazil. The ants are small, dull gray and without strong sculpturing. They move slowly and are seen with difficulty. There are no specific locality records from Trinidad except Diego Martin (Wheeler), "fungus gardens under logs in cacao plantation."

Distribution. — It may be expected in any rain forest area in Trinidad and I have collected it in the foothills north of

Tunapuna, 5.VII.35; Tucuragua River, 300 ft., 5.V.35; Tacarigua River, 500-1500 ft. 61° 23' W., 10° 42' N., 18.XI.34; Nariva Swamp, 61° 3' W., 10° 23' N., 22.IV.35; Fyzabad, near Siparia, 9.VI.35; Guayaguayare Bay, 20.IX.35.

Nests. — The small ants have a similarly small and inconspicuous nest. The nests are frequently in an irregular cavity of a few cubic centimeters in capacity which may be formed anywhere on the rain forest floor among fallen leaves, twigs or rocks or combinations of these. A nest on a cacao plantation was on top of the ground among half rotted cacao and other leaves among liliaceous plants 45 cm. high at the margin of cacao. The nest was attached to the vertical side of a small rock (5×8×14 cm.) and extended between two half rotted cacao leaves and parts of others. The fungus garden was irregular in shape and attached at the sides to the rock and above and below to the leaves. Pupae and larvae were in the cells of the garden. The fungus was the usual whitish mycelium, grown on irregular fragments of seemingly plant origin ranging in color from pale yellow through amber and browns to black. The substrate did not appear clearly to be of insect feces.

Observation Nests. — A part of a colony taken July 5 in the foothills had a few cubic centimeters of typical *Apterostigma* fungus garden and was placed in an observation nest. By July 24 the garden still remained but was rather dry and grown partly on farine. The colony was ended a few days later.

A colony collected May 5 along the Tucuragua River was placed in an observation nest. Within 24 hours the ants had built their fungus garden against the ceiling and to the floor. The ants moved very slowly. By May 20 the garden was small and not flourishing. The ants refused wood-boring beetle feces. There appeared to be two queens. The latter were definitely present in the nest May 23 and by this time the garden was reduced to a small fragment grown on yellow sweet potato. A tiny garden survived to May 25 and the ants clustered about it. Several workers were dead outside the nest. Between May 25 and June 8 the garden died completely and on the latter date a few sluggish workers were all seen. Three workers survived to June 11, three females and 25-30 workers being dead.

Biology. — The average colony probably contains several score individuals, one that I found in Panama having 44 workers and a queen. A Trinidad nest had 40-50 workers and three queens. The larvae are heavily coated with the same type

of mycelium as grows in the garden. The ants are commonly found in cacao plantations but are of neutral importance. They are so commonly found here probably because cacao demands the same rainfall and soil cover conditions in which the ants thrive. The ants were also taken as they walked over the thin soil cover of the Nariva Swamp rain forest and under bamboo in open lastro or second-growth scrub forest. The bamboo leaves appear to conserve moisture unusually well and are also a favored site.

Apterostigma mayri Forel ssp. *pallidum* Weber

A. pallidum was described as a variety in 1937 (Rev. Ent. 7:388-389) and raised to subspecific rank in 1938 (Rev. Ent. 9:168). The ants are paler than those of the typical *mayri* and the mesonotal and gastric carinae more distinct. One female and two workers were taken May 25, 1935 at the foot of the Northern Range north of Tunapuna. They were part of a colony nesting at the base of a bamboo clump in humus under a layer of dead leaves. Under this same cluster of bamboo also were found nests of three colonies of *A. urichi,* a much larger ant, so that the ecological niches in this case were identifical.

Apterostigma wasmanni Forel

Wasmanni was described in 1892 (Mitt. Schweiz. Ent. Ges. 8:345) from southern Brazil. In addition to the subspecies *icta* in Trinidad a subspecies *petiolatum* Weber has been described from Bolivia. The ants are comparatively stout, have a strongly carinate thorax and have two lobes in the meso epinotal impression.

Distribution. — The ants are doubtless widely distributed in Trinidad but I have found them chiefly in the foothills north of Tunapuna (29.VI; 5.VII; 24.VII; 1.VIII.35) and on San Fernando Hill (500 feet) in southern Trinidad (3.IV.35).

Nests. — The San Fernando nest was on a dry slope with a northwest exposure which was covered by a thin lastro or second growth forest. The soil was mostly disintegrated rock with little humus. In this apparently unsuitable location for a fungus grower the ants had their nest in a small hollow tree stump about 8 cm. in diameter. Entrance was by a hole about 2.5 cm. in diameter, the remainder of the stump opening being

filled with fine debris which doubtless conserved humidity. The fungus garden was not covered by a mycelial envelope and was of somewhat dry pellets of what seemed to be feces of a woody nature. These were covered by a scanty and thin growth of mycelium. The ants "feigned death" momentarily. The July 5 nest was under moist bamboo in lastro or second growth. The July 29 nest was also under bamboo, on the west side and exposed completely except on the bamboo side where it was not even heavily shaded here. The nest was on a slope under a loose layer of bamboo leaves three or four centimeters thick. The fungus garden was sessile, resting upon an open meshwork of fine bamboo leaves with very little vegetal detritus between. This basal part was dry. The garden was about 45×55 mm. and 20 mm. high, consisting of an open honeycomb of cells which were 5-9 mm. in diameter. It was sufficiently compact so that it could be removed intact. The fungus was grown on small pellets and slivers of wood, the substrate appearing a lighter and more variegated brown than in *Apterostigma* in general. The mycelium was whitish but with minute bromatia appearing somewhat buff in color and occurring thickly in some areas.

Observation Nests. — The colony from near the top of San Fernando Hill was placed in a container and the next afternoon placed in an observation nest. 24 hours later a queen and two males could be seen alive and one dead worker. By the following morning the ants had moved some of their woody fecal pellets of substrate to wet blotting paper. By April 8 a small fungus garden had developed on the pellets; a male was dead and another live male and a dealate female were seen. Two days later the garden was flourishing and had apparently grown on bread. A dealate female was on top of the garden and a male to one side. The same ants and workers were seen the next day and the garden was of such a nature that pieces of yellow sweet potato could be discerned as parts of it. The ants had manured the garden with their clear, amber fecal droplets. During the next few days the garden continued to flourish and was developed also on farine. A freshly dead worker was noticed April 26 and additional amber fecal droplets on the garden. By the end of the month the garden had started to wither. It regained its usual condition, however, and remained stable during most of May. At least one male and a queen continued alive. On May 21 a freshly dead dealate female and a worker were in the nest, the latter with a dead *Trachymyrmex urichi* grasping its leg.

Another dead *Trachymyrmex* with a dead *Myrmicocrypta buenzlii* grasping its leg were in the nest. These latter two species had been using the same arena and a colony of *Cyphomyrmex rimosus* had been living in harmony below the nest entrance. During June the colony deteriorated and by July 2 the only ant left alive was a male.

The colony collected July 29 in the foothills north of St. Augustine was placed in an observation nest where the ants developed a flourishing garden. By August 6, however, the ants had broken the garden up into a number of fragments and these had on August 7 a few dark amber fecal droplets.

A few workers were collected July 5 in the immediate vicinity of a nest of *mayri* and placed with the *mayri* colony in the same observation nest. Three of these were removed on July 8 to a separate nest. They probably had nothing to eat in the interval since they did not appear to mingle with the *mayri.* The next morning they were given a flourishing piece of the fungus garden of a *Sericomyrmex urichi* colony. Within a minute the two closest ants had slowly approached it and started to eat the mycelium. One worker also lapped the juice from a fresh bit of sweet potato which had a few hyphae. The third ant was 20 mm. away from the garden and did not discover it for six minutes. The two workers lapped more of the juices of the substrate than the mycelium. By two days later the ants had largely covered the garden in the course of their tunnellings and by the following morning it was completely buried. That afternoon a piece of the pileus and one of the stipe of the freshly collected sporophore of *Agaricus arvensis* (det. Dr. Briton-Jones) were placed in the nest and in front of a feeble ant. It immediately approached the pileus and lapped it in several places, then fed on a piece of gill, ingesting an area about equal to the dorsal surface of its own postpetiole. The other ants came up fairly quickly for *Apterostigma,* and started to lap both stipe and pileus pieces. One ant was seen to use its mandibles in pinching off fragments. Two ants were feeding at the end of seven minutes. July 15 one ant was dead, one only feebly alive and the other was dead. They were all dead the next day.

Biology. — The average colony of *wasmanni* probably consists of several score workers and possibly seldom as much as one hundred. Males were found in nests as early as April 3 and as late as July 29. The ants freely nest near other attines and in one place colonies of *Apterostigma mayri, urichi* and

wasmanni all occurred within a few centimeters of one another. A fourth species, *fitzgeraldi,* was taken nearby. Several nests were found in open situations on hillsides and the ants appear to tolerate comparatively dry places. The San Fernando nest was in a particularly dry place and the day on which it was found (April 3) was in the midst of the dry season.

Apterostigma wasmanni icta Weber

The subspecies *icta* is known only from the dealate female which I took January 3, 1935. It is distinctly smaller than the typical form and differs in details of sculpture. The ant was taken from the forest floor five miles south of Rio Claro at the Ortoire River in heavy rain forest. These ants will likely be found elsewhere on the island in similar habitats.

Apterostigma auriculatum Wheeler

Auriculatum was described in 1925 (Arkiv för Zool. 17A:49-50) from workers and three females taken by Prof. Roland Thaxter at Four-Roads Point, Port of Spain, Trinidad in an old log. "The worker of this species is very distinct and easily recognized by the peculiar ear-like lobes formed by the pair of short ridges on the mesoepinotal constriction, a character which does not occur in any of the other described species of the genus." This species has unfortunately not been recognized since but may be very close to *wasmanni.*

Apterostigma fitzgeraldi Weber

One of the smaller but distinctly sculptured species is *fitzgeraldi* which was described from a worker in 1937 (Rev. Ent. 7:393-4) from the foothills north of Tunapuna, Trinidad, June 29, 1935. It is easily distinguished by a pair of carinae or teeth in the meso-epinotal impression. The ant was among leaves under a clump of bamboo on the hillside in the same general situation where other attines were numerous, including *Apterostigma wasmanni, mayri* and *urichi.*

Apterostigma ierense Weber

Another of the smaller species is *ierense,* described in 1937 (Rev. Ent. 7:387-8, Fig. 4) from a colony taken near the Maracas Waterfall, Northern Range, Trinidad May 28, 1936. Other

specimens were taken in the foothills north of Tunapuna July 24, 1935. The workers have a strongly carinate thorax and coarse punctation.

Nests. — The Maracas nest was in a pocket in the ground but surrounded by leaf mold and not soil. The fungus garden was cellular and 20 mm. in diameter. There was no silk envelope. The foothills nest was hardly five cm. from the type nest of *Trachymyrmex ruthae,* and 17 cm. from a nest of *A. urichi.* The fungus garden was of typical *Apterostigma* appearance and consisted of pellets of substrate and slivers of wood with a mycelium appearing bluish white against the background. The nest was barely under the soil but covered by humus and dead leaves.

Biology. — The colony of *ierense* probably consists of a few score workers as the small size of the fungus garden would indicate. Males were present in the Maracas nest taken May 28. These ants "feign death" as do attines generally. The Maracas nest was under herbaceous vegetation on the west slope of a steep, wooded gorge in a place of high annual rainfall (about 120 inches) while the foothills nest was in a much more open situation on the south slope of the hills in a region with much less rainfall. An *Anochetus* colony was close to the Maracas nest and, as they appear to be predators, possibly the Apterostigmas might suffer.

A cockroach, apparently myrmecophilous, was present in this nest.

Sericomyrmex.

Literally meaning "silky ant", the members of this genus are noteworthy in their abundant pilosity which obscures the sculpturing and has a silky, usually coppery, sheen. Though ants of the genus *Apterostigma* also have numerous long hairs they are regularly dull gray or black. The latter ants are more slender as a rule while ants of the former are of stout habitus as in *Trachymyrmex.* The fungus gardens are similar to those of the latter.

Sericomyrmex urichi Forel

The only species of the genus known from Trinidad is *urichi.* Forel originally identified specimens from the island as *opacus* but in 1912 (Mem. Soc. Ent. Belg., 19:193-194) redescribed them as the new *urichi.* Under *opacus* Mr. Urich described the nesting habits of a member of this genus for the first time (1895).

He described the raised entrances or turrets commonly found above the nest and a small chamber about six inches below the surface of the ground. As the colony grows it forms another chamber near the first. A third chamber may be formed. The latter two chambers have a diameter of about 2-3 inches and contain the fungus gardens, the original chamber being then used only for substrate. Mr. Urich described the pendant gardens and the fungus in the form of hyphae with "Kohlrabi" clumps or bromatia. He found the colony to consist of never more than 200 individuals, the winged forms to occur in July, and the habitat always to be in clayey soil. In nature they used particles of fruit, flowers and leaves, preferably the former. In his observation nests they took orange, banana, rose petals and leaves, preferring the white part of orange rind. The ants were mostly diurnal.

Distribution. — Mr. Urich mentions only Port of Spain as a specific locality though he was aware of other places. I took the species along the Gasparillo River, Sta. Cruz, 29.XI.34; Botanical Gardens, Port of Spain, 10.V.35; Point Radix between Cocos and Mayaro Bay, 24.XI.34; Mayaro Bay, 16.VI.35; Imperial College of Tropical Agriculture, 22.III.35, 5.VI.35; Maracas Valley, 14.V.35, 28.V.36.

Nests. — An Imperial College nest, found originally March 22, 1935 back of the Hostel, was excavated again on June 5. In March the entrance was a mere hole in the ground about 5 mm. in diameter on the north side of a Hibiscus hedge in clay soil. Superficial digging failed to reveal the fungus garden although an empty chamber of a few centimeters in lateral diameter and 1-2 cm. high was exposed. The ants were cautious in movement, "feigning death" upon the slightest disturbance and moving with exceeding slowness. In June the nest was more completely excavated. At a depth of 20 cm. a chamber 18×15 cm. in lateral diameters by 8 cm. high was found. The fungus garden filled the chamber and was pendant on Hibiscus roots but also touching the floor. It was honeycombed but comparatively solid, crumbling in small fragments easily, however. The fungus was grown mostly on parts of Hibiscus and other flowers as well as other vegetal remains. The previous day they were seen carrying flower parts. *Solenopsis geminata* ants invaded the exposed nests and myrmecophiles apparently Thysanura, were present in the garden. These latter were timid and elusive.

A Mayaro Bay nest in sandy clay had a crater 180×150 mm.

in maximum extent which possessed two entrances, each about 5 mm in diameter. At a depth of 90 mm. two chambers were encountered, one 230×100 mm., the other fully as large. The chambers were filled with the fungus garden, which was suspended from coconut roots, 25 mm. below one chamber a third was excavated which was elliptical and much smaller (55×30 mm.). It contained a strand of fungus garden on roots.

This colony nested in a coconut grove under a fallen coconut trunk which was suspended above ground by resting on the stump. The trunk was beside a small stream bed in sandy soil about 100 meters from the sea. Running water was present in the stream bed probably only in part of the rainy season and never during the dry season.

Observation Nest. — The part collected by the March 22 nest was kept in an observation nest. The ants were unable to climb even a few millimeters of the glass sides. That afternoon workers were seen feeding on banana, on March 24 they ate sugar, the following day yellow sweet potato, banana and perhaps papaya and on March 26 orange and potato. They did not have any fungus garden. During the remainder of March they persisted in cutting up substrate (bread and potato) despite the lack of a garden. By April 11 all had died, those dead the longest having a fungus growth with yellow fruiting bodies on slender stalks like the fungus growing from the carcasses of *Trachymyrmex* and *Atta*.

The site of the above nest was revisited June 5 and further excavation revealed the fungus garden. This part of the colony with garden was placed in an observation nest and for a day the ants were busy carrying out used or damaged substrate and soil. The remainder of the garden was built up into a honeycomb which was attached to the glass ceiling. During the remainder of the month the colony flourished. They were found on July 3 to have manured their garden liberally with pale amber fecal droplets. The garden was flourishing only on the side facing a moist wall. The colony was of necessity ended August 7 and was in good shape with a healthy fungus garden, the latter developed mostly on orange and grapefruit rind. The bromatia and general appearance was that of an *Acromyrmex* colony except that the cells were smaller. A male was present and a number of male pupae. The chamber the ants had formed in the soil was 202×203×41 mm.

Twelve workers were taken from this colony July 7 and

placed in a container of moist sandy clay. Eight hours later they were given two small, dry pieces of the fungus garden of a *Myrmicocrypta buenzlii* colony which had been grown on farine. A *Myrmicocrypta* worker was accidentally included. Several workers came up and explored it briefly with their antennal tips but did not eat. They walked over the alien worker several times but no hostility was shown between the two species though they did open mandibles. The next morning the *Myrmicocrypta* was unharmed and in attendance on its garden. The other ants had apparently ignored both except that the garden had eight fecal droplets which appeared to be more than its own worker would deposit overnight. The *Sericomyrmex* continued to ignore the garden and on July 12 the ants were given pieces of the stipe and pileus of an *Agaricus arvensis* sporophore freshly gathered. A worker came up, manifested interest, appressed its mouthparts and tongue to a piece in several places but did not eat. It quickly explored the portion, then went off. The ants died several days later.

A colony from Mayaro Bay June 16 was placed in an observation nest and thrived for the remainder of the month. A worker was watched June 30 manipulating a piece of rose leaf. It rotated the piece in the mandibles, pinching it as does *Atta* and then packed it carefully in a septum of the fungus garden. It had evidentally defecated on the piece before I saw it. On July 3 the ants were seen to have liberally manured their flourishing garden with pale amber fecal droplets. There was a number of larvae which were covered to a variable extent with tufts of mycelia, few to none being on the ventral surface. June 20 a phorid fly was detected trying to get into the nest by running between the panes of glass on top of the chambers, and running about the sides.

Biology. — Though Mr. Urich declared the colony to consist of not more than 200 individuals a colony at the Imperial College had over 200 workers and in addition brood. Both larvae and pupae are swathed in mycelium but the larvae may at times be partially to completely naked. The ants use vegetal substrate, such as Hibiscus and *Mitracarpus* (*portoricensis* ?) flowers or fruit rind. They were also seen carrying bits of dead leaves and what seemed to be insect feces though the latter was not recognized in nests. Myrmecophiles like Thysanura may occur in the nests, the latter being timid and elusive. A phorid fly attempting to enter a nest is described above. An

ant-eater, *Tamandua longicauda* Wagner, had workers of this species in its stomach.

Sericomyrmex urichi ssp. *maracas* Weber

S. maracas was described in 1937 (Rev. Ent. 7:395-396, Fig. 7) from a colony in the Maracas Valley, Trinidad. The ants differ from the typical form "chiefly in smaller size, in having larger posterior mesonotal tubercles, deeper mesoepinotal depression, more appressed pilosity, and in paler and duller color". Only the original colony has been recognized.

The ants were nesting at the side of the trail leading to Maracas Waterfall where there was an open north exposure. A crater opening in the clay between the exposed roots at the base of a tree led by an oblique tunnel into the bank 8 cm. to the chamber. The chamber was spherical and about 6 cm. in diameter. This was damaged in discovering it and the little fungus garden remaining was pendant on roots. It was gray in color outside, brown inside as in the typical *urichi*. Males and alate females were present on this day, October 1.

Trachymyrmex

Ants of the genus *Trachymyrmex* are closely related to those of the genus *Acromyrmex* but are monomorphic and often of a size intermediate between the largest and the smallest workers of the latter. They are similarly spinous and usually with hooked hairs on the spines or tubercles. The fungus gardens are also smaller and the size of the colony much smaller.

Trachymyrmex urichi Forel

One of the species of Attini sent by Mr. F. W. Urich to Forel was given this name by him in 1893 (Ann. Soc. Ent. Belg. 37:601).

It is a striking species easily distinguished by its dark brown head and much paler ferruginous thorax. The gaster is ferruginous above, darker below. It is also the largest *Trachymyrmex* in Trinidad and the commonest.

Distribution. — Though described from Trinidad I have also found it in the Orinoco Delta at Barrancas and in a wooded ravine near Soledad, across from Ciudad Bolivar on the llanos, Venezuela. Mr. Pablo Anduze has sent me specimens from

Moitaco, Venezuela (18.IX.40). A Subspecies occur in Panama, Colombia and Brazil.

It occurs generally in Trinidad and I have taken it at Port of Spain, 10.V.35; St. Augustine, numerous times; Tucuragua River, 5.V.35; Maracas Valley, 1.X.35, 26.V.36; Foothills north of Tunapuna, Piarco Savannah, 24-31.III.35; Nariva Swamp, 5.XII.34, 9-10.III.35; Mayaro Bay, 24.XI.34, 6.XII. 34, 13.I.35, 9.III.35; Guayaguayare Bay, 23.XII.34; Rio Claro, 3.I.35; Guapo Bay, 4.IV.35; Gasparee Island, 1.VII.35. Wheeler (1922) records it from Ariopita Valley (Chipman); Gasparee Island (Thaxter), Botanical Gardens (Wheeler) and Trinidad (Urich).

N e s t s. — Externally the nest of *urichi* may be in the form of a simple crater or it may be in the form of a turret. An average crater was 82×120 mm. in diameter and was in sandy loam under coconuts. The entrance in this nest was 30 mm. to one side of the crater soil. An unusual nest had a twin turret, each chimney 65 mm. high, actually on the clay mound made by a large *Atta cephalotes* colony though not close to major *Atta* openings. Beneath the crater or turret opening is to be found one or more chambers, the largest number found being five. The uppermost chamber may be down from the soil level 30 mm. or deeper and the deepest found was at a depth of 165 mm. The chambers are elliptical in form, a small one being 38 mm. hig × 44 mm. a large chamber being 76 mm. high × 74 mm., another 51 mm. high × 120 mm. and a third 90 mm. × 90 mm. Several chambers may be at approximately the same horizontal level with short tunnels or merely windows separating them. The fungus garden occupies most of the space in the chamber and is pendant on roots piercing the ceiling or sides. Externally it appears dark gray, internally more brown.

The sexual forms have been taken in several chambers of the same nest as well as in but one chamber.

A nest on the Piarco Savannah contained four chambers and was surmounted by a turret 76 mm. high. It was 230 mm. from a small bush but was otherwise freely exposed. The first chamber was flush with the general soil surface but beneath the turret. It was 35 mm. high and 58 mm. wide. The second chamber was 70 mm. high × 102 mm.; the third 51 mm. high × 95 mm.; the fourth 77 mm. high × 70 mm.

A colony beside a house at Guapo Bay had a nest under orange trees which was particularly shallow, probably because

of the trampling of feet. Another colony in the gentleman's garden was also nesting shallowly.

Nesting in the Botanical Gardens of Port of Spain, the type locality for *T. cornetzi bivittatus (q. v.)* was this species. The entrances to the nest were simple holes, any crater probably having been washed away by a heavy downpour the preceding day. The nests themselves were in clay banks.

At Bombshell Bay, Gasparee Island, a pendant fungus garden was found a depth of 165 mm. in *dry*, crumbly red clay. The nest was on the hot southwest slope of a hill with withered, scanty bush vegetation. Other chambers were believed to lie still deeper. The fungus garden was relatively compact and I considered at the time that the only reason it could exist under the dry conditions was that the ants probably chewed up and manured the pieces of dryish leaves that they used.

Observation Nests. — Two colonies that were collected March 10 in separate localities on the south margin of the Nariva Swamp were placed in nests in the same arena and by March 13 had fused the soil of one having become too wet. Both had winged sexual forms. Colonies of *Mycetophylax littoralis* and *Cyphomyrmex rimosus* also had nests in the arena and were partially dispossessed by the activities of the *Trachymyrmex*. On March 14 at 2 p. m. a third colony was introduced into the arena when its nest was placed here and opened, with the following results:

Many winged forms came out of the nest of their own accord and wandered aimlessly about. Others were carried out by their own workers. When carried by workers the alates draw up their legs and curve their bodies so that the head and apex of gaster are as close together as possible. They remain motionless as they do when "feigning death". Workers grasp them by the ventral surface of the postpetiole next to the gaster and carry them gaster forward, dorsal side up and over the worker's back. Or the alates may be grasped at the ventral surface of the "neck" and carried head forward, ventrum down. Several males emerged and took short flights. The excitement was evidently communicated to the previously fused colonies for males emerged from this nest. A male attempted feebly to copulate with a worker, another attempted unsuccessfully with a female, a third attempted to copulate with both ends of a worker. The dealate females manifested no especial interest when the males attempted copulation though an alate female became slightly agitated.

The three colonies fused successfully overnight and formed a flourishing fungus garden. It was exposed to the air on one side to a large extent (70%) with holes on top and at the opposite side. The garden was sessile of necessity compared with the pendant condition in natural nests. Several males milled about, others attempted flight. Both *Trachymyrmex* and *Cyphomyrmex* workers were seen lapping sugar on moist paper. Dealate females aided in the construction of the new nest by carrying up soil. In excavating the workers removed pellets about the size of their heads, carrying them up one side of the glass wall and down the other to the bottom rather than dropping them overboard.

At 7:25 a. m. March 16 nearly all of the ants were milling about with several males and females *in copula*. In this position the male rode on the right side of the female with head forward. All of the sexual forms displayed great agitation and swarmed towards the light at the southeast corner and under the muslin covered part. A dealate female crawled towards the top of the nest and a second one with whom a male tried unsuccessfully to copulate. These latter appear not to be persistent in their efforts for any great length of time. The winged females appeared to seek the males to a certain extent. A worker carried a male upwards but they soon parted. At the opposite corner of the arena workers and one or two females were busy with the garden. Several males came here, one of whom attempted copulation with a worker unsuccessfully. Another was carried by its head for a moment by a worker. One male, more persistent than usual, tried to copulate with a dealate for several moments who seemed to be little more receptive than a worker. Winged females were found in greater numbers at the top of the arena, crawling agitatedly about. Males were seldom here and then for but a moment, often taking short flights. From 7:45 to 8:10 I was absent and upon my return all of the ants were at the bottom of the aquarium. One male was desperately attempting copulation with a willing female when another female came up and pushed the first one away. The male then turned his attention to this one but as she turned around and around in a clockwise manner on the side of the glass container copulation was impossible and he soon fell away. Five or six males were dead in the southeast corner as though they had dropped dead from exhaustion. At 9:15 at least one male was still alive but was walking about fairly quietly. No winged females were seen but the dealates were

aiding the workers in excavation. At 10:30 the situation was as before. Only dead males were visible at 5 p. m. The following morning at 8:30 males and alate females were wandering about the nest and a male was attempting copulation with a female. The workers were milling about. Another marriage flight may have occurred earlier. Later in the morning a diffuse fungus garden on moist sand could be seen. The garden was fully exposed and was in front of three small vials covered with black paper which I had inserted for any females desiring cells. All castes were clustered thickly under this paper.

On the afternoon of March 18 the old nest site of one of the colonies was examined and it was apparent that most of the fungus garden had been removed; the remainder had deteriorated. Six or seven males were dead in the southeast corner. No females were found dead though a number must have lost their wings to judge by the many wings about. A male was buzzing around. The fungus garden being used was in two adjacent compartments. The alates had concentrated under a piece of black paper over moist soil 80-100 mm. from the garden. No alates were swarming the next morning but workers were carrying males about. An alate female carried a dead male by its neck and perpendicularly for a few moments, then deposited it in a corner. The workers carried ants in various postures and gripped them in various places on the body with no one consistent method used. At 8 a. m. March 20 a few alates, mostly males, were wandering about. Workers were carrying dealate females and a male. Twelve males were dead in two corners. At the same time the next morning the situation was as before with four males. Four males and an alate female were dead at 8 a. m. March 22. Dealate females and workers were carrying quiescent females or workers, one by an antenna. Many dealate females were in the aquarium. That afternoon the ants were given a variety of substrate and a few minutes later were busily cutting off pieces of sweet potato to remove to the garden. They were carrying from the nest what appeared to be tough, fibrous white mycelium to deposit in a corner. Many dealate females were being carried by other females and workers, one dealate even carrying another quiescent female to which a worker clung on each side. During the next three days the ants continued to carry one another about as before. On March 25 an alate female, sixteen dealates, five workers and three males were dead. The workers very likely had been trying to get rid of the surplus of females by carrying them about but

had no place to leave them. Curiously enough the females behaved similarly and also carried substrate. For the remainder of March conditions had stabilized to a large extent. The ants maintained adequate fungus gardens. An occasional dead and an occasional live male would be seen. One or two females flew about in the nest on March 29 and 31.

At the start of April there were five small fungus gardens in various parts of the nest but none was flourishing and two females were buzzing about. At 7:20 a. m. April 3, a small marriage flight was occurring but with few males. Many workers were in the top corner where the sunlight was brightest. The flight had ended by 8:10 a. m. Alate males and females were still present April 13. Many males and dealate females as well as one alate female were dead in the nest April 16. The gardens were small and scattered. On May 14 several alate females, many dealates and many workers were left. They were transferred to another observation nest and a colony of *Cyphomyrmex rimosus* was also added because of lack of space. Confusion reigned for a time. A *Trachymyrmex,* coming up to the *Cyphomyrmex* area, was siezed by its antenna by a latter worker but as it backed away the *Cyphomyrmex* soon let go. Another *Trachymyrmex* came up, met a *Cyphomyrmex,* they "squared off", then the large ant made the first jump, grabbing the *Cyphomyrmex* by the pedicel. The latter was carried away but soon dropped.

On the following morning the ants were given a small piece of the fungus garden of another species, *corntezi bivittatus.* The ants became greatly excited and immediately pounced upon it, dealate females as well as workers. The colony had not had any fungus for several weeks. The ants broke the piece up into small bits and at most of it. In eating the mandibles remained closed, the terminal antennal segments are against the piece and the mouth parts busily lapped. The ants cherished one or two small pieces of the alien garden and, though they gave it much substrate, it did not flourish. Likely there were too many empty stomachs. By May 25, however, it had finally started to flourish and had attained a base about 20×10 mm. with a height of about 20 mm. in one place where it was attached to the glass ceiling. This was greatly larger than when the alien piece was first introduced. Females as well as workers cared for the garden. A winged female still remained. On May 30 a colony of *Apterostigma urichi* was introduced into a remote part of the observation nest. The *Trachymyrmex* were accustomed to forage here,

however, and battles immediately ensued, the dealate females taking part. Every time I looked in for the next five days battles were taking place, the *Trachymyrmex* being the aggressors. The Apterostigmas nevertheless built up a luxuriant garden. By June 12 most of the Apterostigmas had been killed and the garden of the latter disappeared. The remaining ants were mostly being carried about by the *Trachymyrmex*. At least one pupa was in a cell so that the females must have been laying eggs. On June 20 the ants had a luxuriant garden. Brood nearly filled a central chamber of the nest. During the night, unfortunately, a colony of large, black ponerine ants, *Pachycondyla crassinoda,* pulled out the cotton plug to the nest, entered and killed practically all of the fungus-growers. The latter must have battled valiantly for many had invaded the nest of the ponerines but the large jaws of the powerful ants could snip the smaller ones in two.

A colony from the dry Piarco Savannah March 24 was placed in an observation nest but by the next morning most of the fungus garden had withered. The remainder that survived had been placed by the ants on a moist strip of paper. The ants seemed unable to carry water to their nest in contrast to *Atta* and *Acromyrmex*. By the following morning the garden appeared more flourishing due to better moisture conditions. Males appeared to be more numerous than alate females. During the day the ants used yellow sweet potato for substrate but ignored bread. An alate female was placed in a container by herself but died five days later, still with her wings. The garden continued to flourish for the remainder of March and all of April. In addition to the potato the ants used farine and white bread. Males and alate females remained in the nest during this period. One male was found dead on April 16. The larvae on April 12 were noted as heavily coated with fungus. The garden became smaller during May and was attached to the ceiling. Late in May a part that was suspended from the ceiling was detached from the remainder like a stalactite. The ants manured it with a large number of tiny fecal droplets of a pale amber in color. The colony died during June, a contributing factor being the invasion of a colony of *Monomorium*.

Another colony from the Piarco Savannah collected March 31 was placed in an observation nest. The garden was sufficiently compact so that it could be removed largely intact and placed directly in an observation nest. It was the size of the local "Portugal" type of orange. This garden had large holes. Within

several days the ants had discarded much substrate, which appeared to be yellow, woody splinters. The garden gradually became reduced in size in consequence though the ants used bread and yellow sweet potato for substrate. A male was seen April 12. By April 14 the garden appeared very dry and by April 16 was deteriorating. Hardly more than about 15 cc. was left by April 20 and the colony was transferred to another nest. A few small larvae were present. The colony was kept for a few more days but nothing significant was noted.

A colony collected April 4 at Buapo Bay in a gentleman's garden was placed in small glass container of about 800 cc. capacity and half of a pillbox with a capacity of 10-15 c. c. placed in it. Many males and alate females were present. During the following week the ants placed their fungus garden in the pillbox and the winged forms crowded in. At 8:15 a. m. April 11 nearly all the males were out in the glass container and swarming agitatedly about. In this confined space the result indeed was a "tempest in a teapot". This was likely an abortive marriage flight. No females were out and very few were under the pillbox, which contained also a few males. There was no agitation here and had there been the garden would have been damaged. By May 25 most of the ants had died and the fungus garden gone. Three alate females, a few dealate females and a few workers remained. They were active when disturbed. They were transferred to another, more suitable container in which about one cubic centimeter of the fungus garden grown by a colony of *Myrmicocrypta buenzlii* was placed. The ants were much excited at being transferred but a number of all kinds explored the garden, though without lapping it. A few hours later they were given bread and yellow sweet potato for substrate. They immediately cut up pieces of the latter and carried them into the nest. By the next morning, however, the ants had cast out practically all of the garden and the substrate which they had cut up was not near the fungus. On May 28 they were given a piece of the fungus garden of a colony of *Acromyrmex octospinosus* which had on it several fecal droplets. The ants immediately ran to it, touched it for a few moments with their antennal tips, and felt it all over. Then they lapped up some of the mycelium, keeping the mandibles shut as usual. A worker and female cut off sections of the piece and carried them about, then put them down to one side. Three hours later the ants were still clustered about the garden, some lapping it from time

to time. An hour still later their actions were the same and in addition they appeared to be tending it. 24 hours later they had built up a healthy, normal-looking fungus garden, discarding nothing. It was in the form of a column with the apex attached to the glass ceiling. They had added the potato as substrate. The garden thrived throughout June. On June 12 five dealate females, two alate females and two workers constituted the entire population. The garden was on July 3 reduced in size but healthy and had several fecal droplets. Several eggs were imbedded in it and on one side was a male pupa with blackish eyes but otherwise white. The pupa could not have became a pupa earlier than May 28, indicating a duration of this stage of about one month or less. An alate female still had her wings. On July 28 only two dealate females and a worker remained alive. The ants had walled up the entrance to the nest with chewed up paper, leaving only a small, circular opening. They were transferred to a container with soil. About July 20 the garden disappeared. On July 29 they were given a piece of the fungus garden of a colony of *Cyphomyrmex rimosus* consisting of 8-10 bromatia, a small piece of farine and an amorphous black mass, possibly fecal. Within an hour the ants at various times walked by, waving an antenna occasionally in its direction but otherwise ignored the garden. The females at one time waved their antennae over it but otherwise did not investigate. The ants excavated soil near the garden and then removed the farine and bromatia from the amorphous substrate. They were then given a piece of the flourishing garden of a colony of *Mycetophylax littoralis* grown on farine. The worker soon came by and briefly explored it with both antennae, left for a few seconds, then returned to explore more thoroughly. The worker stayed over a minute but did not attempt to taste the piece. A female came up and hastily siezed it, carrying it away and dropping it to one side. Two days later the piece of garden was still alive, a part of it being in a cell the ants dug in the soil, the other part being half buried in another part of the nest. They were given pieces of the stipe, pileus and velum of a slimy *Phallus* sporophore, freshly collected. Within the next five minutes all of the ants explored it once or more with their antennae. Finally a female vigorously licked the velum for about a minute. The common ponerine ant, *Ectatomma ruidum* Roger, was also observed to lick this fungus as it grew on the grass that morning so that the *Trachymyrmex*

was not exhibiting any especially significant taste. The ants continued alive for sometime after August 7.

Another colony collected at Guapo Bay April 4 had been living in scanty grass of an orange grove. It contained many winged forms. The colony was placed in a nest somewhat too small for it. Within two days the ants had built up a good garden in the form of a series of perpindicular lamellae. Many males died by the end of the second day but many were left. During the week several males were seen in the arena but the alates remained by the garden mostly. No agitation of the males or marriage flight occured on April 11 at the time when the previously described colony was exhibiting this behavior. A few males died on each day in the second week. They were usually found dead at the point in the nest which was nearest a window, indicating perhaps that they were trying to fly away. Throughout April males died off gradually. The garden deteriorated until on April 26 only a tiny fragment remained. On April 30 six males were digging into boiled yellow sweet potato and were clearly eating it. They did not attempt to carry pieces away. Males were similarly feeding on May 2 and were also drinking water. Males continued to die, 42 being found dead May 2. By May 21 only a few ants remained, including several dealate females.

Biology. — In an endeavor to determine the manner of colony formation a total of 14 dealate and alate females were placed in separate cells from March 14 to July 10. These ants lived from 4 to 60 days, two living 40 and 60 days respectively. These two, however, fed on fungi of other genera. Disregarding the two above, the average number of days the isolated females lived was eight. None developed a fungus garden or was seen to have laid an egg. There was no relation between the time lived by ants when alate initially or when dealate. Several of the alates lost their wings, other retained them. Two alates lost three of their four wings in one place as though they had assisted in the removal rather than that the wings had merely dropped off. The marriage flight taking place in the laboratory is described under "Observation Nests"; males were found in the field on March 10, March 24 and April 4. Dimorphic males occurred in several colonies kept under observation.

The average colony consists of several hundred adults. 125 males were present in one colony and died in an observation nest over a period of a month.

This species nests in a variety of soils ranging from well-

drained sandy to heavy clay soils. Though commonly nesting in forest (lastro, rain forest, etc.) the ants nest in the open on the Piarco Savannah and were found on March 24 in the dry season to have a dry and brown fungus garden, quite different in consistency and color from the usual type. The used-up substrate was thrown out some distance from the nest entrance and resembled a patch of sawdust. These ants were smaller and darker so that a "splitter" might consider them to represent a different form. The ants use a variety of vegetal substrate including parts of flowers. An analysis of the soil of a Piarco nest appears in Table I. Although the soil here was acid, that of a nest on Gasparee was considered to be alkaline because of the limestone rock. The ants may nest under cacao but are probably of neutral importance since, at the most, they might cut a few flowers. In most places *urichi* appears to be an inconspicuous member of the ant fauna but on Gasparee Island it seemed to me to be the dominant terrestrial ant on July 1, 1935. The dominant arboreal ants were of the genera *Crematogaster* and *Pseudomyrma.* The common giant or marine toad *(Bufo marinus)* was found to have eaten these ants at the Imperial College March 22.

Trachymyrmex urichi ssp. *radicis* Weber

Radicis was described in 1938 (Rev. Ent. 9:197) from a few workers taken on Point Radix, separating Cocos and Mayaro Bays. These ants are strikingly smaller than the average *urichi,* have the median pronotal spine much reduced and tuberculate and have the second lateral pair shorter and more slender. The possibility that they may represent a first brood of a *urichi* female should be checked. Workers taken in the Nariva Swamp are slightly larger but otherwise resemble them. They were within a meter of a colony of *T. cornetzi bivittatus* which in turn was nesting close to an *Atta cephalotes* colony. The *urichi* workers were carrying a part of a leaf and also what appeared to be arthropod fecal material.

Trachymyrmex cornetzi Forel ssp. *bivittatus* Wheeler

Bivittatus was described as a variety of *cornetzi* in 1922 (Amer. Mus. Novitates No. 45, p. 13) from the worker "differing from the typical form from Colombia in having the pale-brownish

cloud on each side of the first gastric segment deplaced by a very definite dark-brown band, which reaches to the base of the segment and is continued as a band of the same color on the side of the postpetiole." There is no infuscation of the pronotum, but the antennal club, except the tip of its last joint, is dark brown. Dr. Wheeler took the type colony in the Botanical Garden, Port of Spain and at Coroni, "In both places the nests were in clay banks." I find, however, that the color characteristics given above are not reliable but that instead the workers may easily be recognized as follows:

The ants are about 3.6-3.8 mm. long with a thorax length of 1.3 mm. The postpetiole is bi-lobed behind with the lobes flaring upwards and backwards; it is about one-quarter wider than long. The ants have low spines and tubercles. The color is distinctive, being a generally pale ferruginous with a conspicuous dark brown spot on the vertex of the head. *

Distribution. — In addition to the Port of Spain and Coroni (Caroni?) records I have found these ants in the Aripo Valley, 1200 feet, 19.IV.35, and at the La Montserrat Estate, Maracas Valley, 26.V.36, in the Northern Range; Tucuragua R., tributary of Tacarigua River 300 ft., 5.V.35; Basin Hill Forest Reserve, 700 ft., 1.IV.35.

Nests. — The ants may or may not have a raised entrance to the nest. Entrance to one nest appeared to be a small hole under leaves, and pellets of soil had been carried to a pile some centimeters away. Another had a raised crater with a small opening. The single chamber found in one nest was about 50 mm. down, in another nest about 63 mm. The latter was about 50 mm. in diameter. Only sessile fungus gardens were found, resting on small stones between which the soil had been removed. The garden is gray in appearance.

Observation Nests. — The Basin Hill colony collected April 1 was placed in an observation nest immediately. When the colony was found workers were gathering bits of orange rind. By the following morning the fungus garden and

*) They are easily separated from the new subspecies which may be called *T. cornetzi* ssp. *brevispinosus*, ssp. nov. The worker is 3.6-3.7 mm. long with a thorax length of 1.3 mm. Antennal scapes exceed occipital angles by their distal diameters. Petiole bispinous above; postpetiole from above squarish, very little broader than long, rounded in front. Spines of thorax reduced; epinotal spines hardly bigger than the tubercles of the basal surface. Dark brown, tuberculous areas paler. Type colony No. 1043, collected July 31, 1938 at the El Hormiguero Mine, 3200 ft., Rio Porce, Colombia by myself.

brood were concentrated in one place and caterpillar or other excrement appeared to be used as substrate. This appeared to be less identifiable the next morning and more like the dark, spheroidal pellets used by an *Apterostigma urichi* colony from the same site. The ants appeared also to have cut off pieces of bread given them. Two days later they were using pieces of yam as substrate and the following week farine. Pupae that were first noted April 8 became callows April 17. On the latter date other pupae were rapidly maturing. Larvae were present April 30. For some time the garden had been drying but by May 9 the moisture of the nest had been increased. During May the garden was quite stable, resting upon small stones and attached to the ceiling in two places. The colony and garden continued to be stable during June and July. On August 4 they were given pure chemicals for substrate *(q. v.)* and by August 7 the garden appeared flourishing on some of this substrate. They had manured the garden with their deep brown to pale amber fecal droplets.

A colony collected under cacao in the Aripo Valley April 19 was placed overnight in a makeshift container and the next afternoon placed in an observation nest. The ants were active when disturbed. By the next morning they had built up a good fungus garden. Several males and brood were present. The ants brought in pieces of boiled yellow sweet potato. The colony was flourishing by April 26 and six males could be seen. The workers had used farine. Four had drowned in water furnished them. By April 30 the garden had become dry and withered. Males were present as usual as they were on May 5. On this date workers and one or two females were in a small bottle of water but not in the water itself. They may have gone there to collect moisture. On May 7 the ants were found to have moved the remaining small garden to this bottle which now contained nearly all of the ants as well. The bottle and the ants were moved to another nest and a few males but no alate females were seen. The males attempted flight when the cover of the nest was removed May 9 at 9 a. m. During most of the remainder of May the ants maintained their garden in the bottle, the males remaining here. A number of workers drowned in the water.

Biology. — The colony of these medium sized ants probably amounts to one hundred or less. Several collections were from under cacao and coffee but the ants probably are of neutral importance. One nest was under "lastro" of Heliconium,

bamboo, ceiba, etc. Workers were found gathering orange rind and carrying them slowly to the nest, others from another nest were gathering blue-black feces of a large snail. These ants are comparatively active.

Trachymyrmex relictus fitzgeraldi Weber

Trachymyrmex relictus was described by Father Borgmeier in 1934 (Arq. Inst. Biol. Veget., 1:107-108, Figs. 6-7) from Paramaribo, Surinam and the subspecies *fitzgeraldi* by myself in 1937 (Rev. Ent., 7:401-402) from Trinidad. The Trinidad ants suggest those of the genus *Sericomyrmex* but are much less silkily pilose. They have a long, acute pair of pronotal spines and similar epinotal spines.

Distribution. — The type locality is the Nariva Swamp (Lat. 10° 23'N. Long. 61° 3'W; 23.IV.35) and I have also taken in on the west of Morne LaCroix, 750 ft., 7.IV.35 and in the Basin Hill Forest Reserve, 700 .ft., 1.IV.35.

Biology. — Unfortunately nests were not found and only strays picked up. Those in the swamp were in high rain forest, wandering on the ground. Unusual dacetonine ants occurred here also. The Morne LaCroix ants were in high rain forest which contained *Myrmicocrypta buenzlii,* described originally from Surinam, and *Mycocepurus smithi trinidadensis.* The Basin Hill ant occurred with the latter species on a mound of *Atta cephalotes* in a place in the forest which contained mostly *Heliconium.*

Trachymyrmex humilis Wheeler

One of the smallest *Trachymyrmex* is *humilis* described in 1916 (Bull. Mus. Comp. Zool. 60:325-6) from two workers, one from Gasparee Island and one from Port of Spain, collected by Professor Roland Thaxter. It belongs to the group of small species which have a great reduction in thoracic spines and a large postpetiole. Two closely related species, *tucuché* and *carib,* sp. nov., occur in Trinidad and all appear to be rare ants. There is no further information on the species and it has not been recognized since.

Trachymyrmex tucuché Weber

One of the smaller species of the genus is *tucuché* which was described in 1938 (Rev. Ent., 9:197-8) from the slopes of El Tucuché, Trinidad and collected in December 15, 1934. Other

records are the foothills north of Tunapuna and the Arena Forest near Arena.

The Tucuché ants had erected a small turret in dense shade on a steep slope under an overhanging rock. The turret was of hard clay and stood 16 mm. above the soil level. The circular external orifice was 6 mm. in diameter but 13 mm. below the soil level the tunnel was constricted to a diameter of 3.5 mm.

Fig. 1. *Trachymyrmex tucuché,* turret entrance to nest as it appeared after removal and drying.

The turret had a maximum external diameter of 10 mm. This appears to be the smallest and most compact turret known in Attini though I found a similarly compact turret in British Guiana of *T. Phaleratus* Wheeler which was auriculate, spreading 38 mm., though only 14 mm. above the soil surface.

The Arena worker came from cut-over land which included such trees as *Carapa guianensis, Tabebuia serratifolia, Calophyllum antillanum* and *Vitex divaricata.* The foothills ant also came from cut-over land or lastro and was crawling over damp bamboo leaves. It appeared light red in life.

Trachymyrmex ruthae Weber

One of the largest species of *Trachymyrmex* in Trinidad is *ruthae* which did not become known until 1937 (Rev. Ent.

7:402-404). It is remarkable for having in the worker a glistening white bloom on the ventral surface of the prosternites in front of the legs. The ants are large, dark brown, and coarsely spinous. The species is known from the single colony collected July 24, 1935 in the foothills north of Tunapuna.

Nests. — The entrance to the nest was in the form of a collar of pieces of leaves and twigs with an orifice 20×10 mm. and a height of 70 mm. In this collar were entrances to three tunnels at depths of 3,7, and 10 mm. The tunnels led directly into a chamber 25 mm. high and 45 mm. in diameter. At a depth of 140 mm. the chamber containing the fungus garden was found. This was 51 mm. high and 115×90 mm. in diameters, being elliptical in shape. The garden was suspended mostly on horizontal roots. It was unusual in being in two colors, half appearing a light tan and half a dark gray. The paler half was covered in places with a dense, cottony, white mycelium while the dark half was more like an *Apterostigma* garden, having a substrate of dark balls with a grayish mycelium.

Observation Nest. — The colony was placed in an observation nest the day collected, July 24, and thrived for two weeks until I had to preserve it before leaving Trinidad for British Guiana. The ants used their original substrate and did not appear to use orange rind which was given them. The bromatia were small and irregular, appearing a step lower in development than those grown by *Atta* and *Acromyrmex*. The ants freely manured the garden with dark amber fecal droplets of varying sizes.

About 10 workers were removed to a separate container the night they were collected. July 28 they were given a piece of the garden of a colony of *Sericomyrmex urichi* which contained bromatia and a fecal droplet. The ants were somewhat enfeebled by their four day fast but several immediately went up to the piece and started tasting it without hesitation. Others soon followed and within two minutes all were feeding. One was seen to take up a bromatium and abrade it between the mandibles. Over an hour later several were still feeding, taking up *mycelia* in the mandibles. Fifteen hours later a worker was in attendance on the garden which was healthy in appearance. A worker came up to lap some of the fungus. By August 7 only one worker was alive and the garden disintegrated.

Other workers were also removed July 24 and fasted four days. These were then given a small piece of the fungus garden of a colony of *Apterostigma urichi* which was covered with a

luxuriant white mycelium. An ant immediately went up and touched it with the antennal tips but did not taste. Another worker did the same and six minutes later a third ant repeated the performance. When they were seen three hours later a worker was standing over the piece but under the binocular I could see that it had not disturbed the mycelium and it soon left. They were then given a piece of the garden of a colony of *Mycetophylax littoralis* grown on farine. It was placed close to a worker who immediately went over it carefully with the antennal tips. It did not appear to eat. Another came up, felt briefly with the antennae, then left. The ants otherwise ignored both pieces. They were then given a piece of the garden of an *Atta cephalotes* garden. The ants immediately clustered about, tasting and feeling it. Most of the ants went away as though disappointed or as if finding it not exactly right. Several ants stayed exploring it more throughly, then picked up bits of the mycelium or a bromatium and ate them. A worker was still in attendance 50 minutes later. On the next afternoon the piece of garden was found broken up into several fragments, one of which had luxuriant mycelium. The ants were not in attendance. By two days later these fragments had disintegrated. The ants were given pieces of the stipe, pileus and slimy velum of the sporophore of *Phallus* sp. which had just appeared on the savannah. The two nearest ants immediately went to the velum and started vigorously lapping the juice. Within three minutes all were avidly lapping. On defecated a clear, amber droplet upon the pileus upon which the velum was resting. The stipe was neglected. Within a week the ants were dead.

Biology. — The type colony contained 280 workers, 23 dealate females, 7 alate females and 23 males. Some of the dealate females may have lost their wings after the colony was collected alive so that the number of functional queens was undoubtedly less than 23.

The ants nested in lastro or second-growth scrub and were under bamboo. 65 mm. in front of the nest was a small shrub at whose base a *Pheidole* colony was tending aphids. *Apterostigma ierense* nested even closer to the *Trachymyrmex* nest, probably about 50 mm. away and was under the coin in the photograph. *A. urichi* and *Cyphomyrmex rimosus* colonies also occurred nearby.

Trachymyrmex carib, sp. nov.

Worker. — Length 3.1 mm. (of thorax including epinotum 1.1 mm.). Allied to the group of small species with reduced spinulation and large, inflated postpetiole. Occipital margin emarginate, less so than in *schomburgki* but more than in *abortivus;* antennal scapes exceed occipital angles by about twice their distal diameters; joints 2-6 of funiculus longer than broad, penultimate joint less than half as long as the terminal joint; frontal carinae with small, convex lobes in front and terminating behind in front of occipital angles; pre-orbital carinae end a short distance back of eyes; thorax from above with tubercles forming a truncate equilateral triangle whose pronotal base is 0.55 mm. broad; in side view convex. Basal surface of epinotum with two pair of tubercles variably developed, convex in profile; epinotal spines well developed, much longer than broad. Petiole above with an acute pair of spines. Postpetiole twice as broad as petiole, very slightly longer than broad, anteriorly produced above as an inflated convexity. Gaster about one-fifth longer than broad, somewhat marginate on the sides from a tendency of the lateral tubercles to be connected.

Tubercles of head numerous and low, each bearing a short, hooked hair; tubercles of thorax sparser and similarly setigerous; tubercles of gaster evenly distributed above, similarly setigerous. Finely and densely granulose. Evenly ferruginous except for brownish spot on vertex of head.

Cotypes: Two workers taken at an elevation of about 850 feet near the Mt. St. Benedict Monastery, Trinidad, November 27, 1934 by myself. The inconspicuous ants were picked up from the rain forest floor.

This species resembles two other closely related species found in Trinidad, *humilis* and *tucuché.* It differs from the former chiefly in having longer antennal scapes, longer funicular joints 2-6 with the penultimate joint less than half as long as the terminal joint, much longer epinotal spines, the postpetiole not more than twice as broad as the petiole and in differences of tubercles. It differs from *tucuché* in slightly larger size, in having much longer antennal scapes and funicular joints, lower thoracic tubercles, the postpetiole not broader than long and in other ways. The discovery of all castes of these rare ants will undoubtedly lead to the clarification of their status.

Acromyrmex.

One species of *Acromyrmex* occurs in Trinidad and this is typical of the genus. The workers are polymorphic with the extremes connected by a complete series of intermediates. The

large workers are much larger than those of the preceding genera while smaller sizes resemble *Trachymyrmex*. The polymorphism, however separates the two genera readily. The nests are much larger and the colonies more populous than in the preceding genera.

Acromyrmex octospinosus Reich

As mentioned above, the large workers cannot be confused with any of the preceding species and none of the latter has polymorphism of this caste. The ants are readily separated from those of *Atta cephalotes* by their duller integument in all sizes and by the lack of a distinct soldier, an extreme caste not connected by intermediates with the largest workers. The mature colonies are also much smaller. Both species cut leaves readily and are important pests to agriculture.

Distribution. — Some of my records are listed in Dr. Wheeler's book (1937). These and other specific records are as follows: Patos Island, 20.VII.35; Monos Island, 21.VII.35; Gasparee Island, 1.VII.35; 158 Charlotte St., Port of Spain, 3.VI.36; Botanical Gardens, 16.VII.36; Gasparillo River, Sta. Cruz, 29.XI.34; St. Augustine, numerous times; Foothills north of Tunapuna, 200 ft., 14.V.35, 100 ft., 18.VI.35, 29.VII.35; Tucuragua River, Tacarigua trib., 300 ft., 5.V.35, 18.VI.35; La Montserrat Est., Maracas Valley, 19.III.35, 14.IV.35, 28.V.36, 31.V.36; Mt. St. Benedict, 900 ft., 27.XI.34; Spring Hill Est., Arima, 1200 ft., 6.IV.35; W. of Morne Bleu, 1800 ft., 28.III.35; Rubber Est., Sangre Grande, Manzanilla Ward, 21.XI.34; Nariva Swamp, 10.III.35; Pt. Radix, 25.XI.34; Guayaguayare Bay, 25.XI.34; Galeota Pt., 22-23.XII.34; Trinity Hills Forest Res., 61°9'W., 10°8'N., 25.XII.34; Usine St. Madeleine, San Fernando, 3.IV.35; Pitch Lake, 22.VI.35; Ortoire River, Rio Claro, 3.I.35. The observed altitudinal range is sea level to 1800 feet.

Nests. — In Trinidad this species commonly nests in the soil with ordinary crater entrances but the ants will use other sites. Where the rainfall is inadequate to support moist humus and debris above the soil, such as on Gasparee Island, they nest of necessity in the soil. There may be one or several fungus gardens and there are much bigger than those of any smaller attines but much smaller than those of *Atta cephalotes* as well as less numerous. When resting on stony soil they may remove

the soil between the stones to insure adequate drainage as in other Attini.

Several nests were found in roadside banks, including the remarkable one with intersexes. In a roadside bank there may be crevices and these facilitate the entrance of the females when they attempt to found their colonies independently. Many such females were observed seeking entrance in this manner in the Maracas Valley (31.V.36) and several nests of mature colonies were found in this valley in banks. A nest in a clay roadside bank on the Usine St. Madeleine, San Fernando, was too deep to permit easy exposure. A nest along a road cut near Guayaguayare Bay was 50 cm. down from the top and 30 cm. into the side. In the main chamber was a fungus garden 18 cm. in diameter and 34 cm. high, attached at the ceiling to several roots but mostly resting on a loose mass of soil and dried grass stems. It was connected by irregular galleries leading down to the outside and about 45 cm. long. Leading off from the main gallery was a gallery 30 cm. long in which a tarantula was found as well as its cast skin.

A nest on Galeota Point was under a half rotted log and my photograph appears as the lower figure in Plate I of Wheeler's 1937 book. The fungus garden, 31 cm. long and 11.5 cm. in maximum diameter, was in the slight space left by irregular depressions on the under side of the log and the soil surface. The soil was well drained and sandy.

A colony in the Maracas Valley nested near the waterfall on top of a tree stump about 1.5 meters high. The stump stood in a slight clearing and the high rainfall and humidity prevented it from drying out. The ants were found here May 28, 1936 yet were not seen when I collected other ants from the top of the stump March 19, 1935 indicating that the colony may have been about a year old. Winged females were present. The garden was covered by debris, rotted wood, etc., which would conserve moisture very well.

Another unusual site was in a palm, *Attalea spectabilis* Mart., in the Port of Spain Botanical Gardens, July 16, 1935. The trunk of the palm was smooth for about 8 meters, then from 8 to 11 meters above ground was a mass of its leaves and crown as well as epiphytic vines and other plants. In the debris from all of these the ants had their nest. The workers gathered leaves and flowers from a *Cassia fistula* small tree nearly 8 meters away.

Ants from an "island" of Coccoloba, sedges and other plants on the asphalt Pitch Lake must have been nesting in this unusual site but the nest was not discovered in the limited time available. They could find a suitable site among the tangle of roots and humus in the shade of vegetation over the asphalt.

The largest nest observed in Trinidad occurred in an experimental banana plot at the Imperial College of Tropical Agriculture and, on May 17, 1935, extended over an area 75×65 cm. between banana stems. There were about six gardens in the soil at depths from 5 to 40 cm. They were of irregular shape but compact, light gray in color outside, light brown internally as in Attini generally.

Observation Nests. — Urich (1923, p. 2) refers to a queen kept in an observation nest for seven years during which time she "produced thousands of workers".

The colony kept longest in an observation nest by me was the remarkable colony on which the book by Dr. Wheeler (1937) was based. Many of my observations were not published and most of them bear on normal colonies as well.

This colony was collected in part May 5. The ants nested in the bank of a road near the Tucuragua River. The fungus garden was compact and about the size of a man's head. It contained many recently emerged males, fewer alate females and many pupae of the sexual forms. I noticed that there were scattered large workers which were much darker than the others and preserved them. These were some of the intersexes. The ruins of the garden, after collecting the portion I gathered, were watched for over half an hour without seeing any Phorid flies. There were tiny insects hovering over the ruins, then darting down and disappearing but these turned out to be Staphylinid beetles. No other myrmecophiles were seen. That evening the ants were placed in an observation nest.

By the next morning the ants had used most of the bread given them and were calmly carrying on in the arena as though they had been living there for weeks. The alates remained inside. The workers were bringing water to the nest as do *Atta* workers. By May 7 they had used more bread and all the boiled sweet potato which had been given them. During the next two days they used orange rind, leaves and blossoms as well as farine. At 8:15 a. m. May 14 an apparent female was in the arena and attempting copulation with workers as though it were a male. This ant was examined more carefully and found to be

an intersex with a head too large for a male but otherwise appearing to be this sex. The ant was very persistent in attempting copulation but there was no extrusion of genitalia. It was preserved for later study, and floated over a day in 80% alcohol indicating a lower specific gravity than workers would have. During the next day the usual few workers were out but at 2 p. m. I first noticed another intersex attempting copulation with a minima worker. It was nervously running about and trying to climb the glass sides of the container. It was preserved. A normal-appearing male was found dead on the refuse heap of the nest. May 16 a dead female freshly removed by the workers, another intersex with mouthparts and one antenna missing which was found dead on the refuse heap, and several alates dead several days were all preserved. May 17 an intersex and two females feebly alive on the refuse heap were preserved. May 21 four males were dead. A dealate female wandering in the arena May 21 was placed in a separate nest but died May 23. May 24 three females with pale, damaged wings were wandering feebly about on the refuse heap; two males and one intersex with its wings and antennal funiculi missing were dead here. On the following day the colony was carefully examined. All sexual forms had become adult but there were a few worker pupae and very few larvae present. A larva on its back was feeding on a dense piece of bromatium. It appeared to eat by abrading the surface and did not bite off pieces. The mandibles were used merely for revolving the bromatium at intervals and to hold it in place. While watching these and other species I became convinced that the large workers do not crop the fungus since they would need to stand on their heads because of the shape. The ants rather kept down the fungus and ate by abrasion by the mouthparts and lapping up the exuded juices. The pupae were covered densely with a white mycelium while the larvae were bare and glistening. No obvious intersexes were seen in the nest although there were many males and females. Many of the winged had crumpled wings and appeared to be females. No female appeared to be a functional queen as there was so little brood and no eggs. Bromatia were embedded flush with the mycelium and would therefore appear to be formations of the fungus without being caused by special manipulation of the ants. A male was out in the arena May 27 and died the next night. A dealate female was wandering about May 28 and when she was picked up she exuded a clear amber fecal droplet. A male was dead the next

day and yesterday's female, now missing her right hind tibia and tarsus, was only feebly alive. During the next few days females, mostly intersexes and with abnormal wings, were out in the arena at times. By June 4 two males and single alate and dealate females had died. During June and July the ants thrived. An occasional alate or dealate female would emerge temporarily into the arena but there was no general exodus of the sexual forms. On July 31 they were given pieces of the stipe, pileus and velum of a *Phallus* sporophore freshly collected. The ants immediately swarmed over them, lapping the slimy velum. They carefully examined the other pieces. Three hours later the ants were still lapping the slimy velum, now abraded to half its former size, and had cut up all of the pileus and nearly all of the stipe, carrying the fragments to the refuse pile for substrate and discarding them. Since I was leaving Trinidad for a time I had to regretfully chloroform the colony August 7. Throughout the three months in the observation nest the ants had maintained a vigorous colony and flourishing garden. One or more females must have oviposited since larvae and pupae were present, some of the latter covered with a white mycelium. The sexual forms had remained in the interior of the garden. This was also full of minima workers and worker brood. They had lately been given orange and grapefruit rind chiefly but nothing the past few days.

On June 18 the site of the original colony was revisited and the remainder of the colony was found to have moved 1.8 meters along the road. The ants and garden were collected and placed in an observation nest from which they could forage on the laboratory table in common with the preceding part of the colony. The colony had to be ended also on August 7. The fungus garden was much reduced and in several scattered fragments. The ants had started excavating in a flower pot on the table containing a Patos Island cactus. They had also foraged freely with the first part of the colony to be collected but only as they would with Attines in general.

Workers were taken from the May colony on June 19 and placed in a separate container. The next morning they were given a fragment of the garden of a *Trachymyrmex urichi* colony. The ants immediately pounced upon it as though it were there own. Some bit hastily with their mandibles but most of the ants lapped up the mycelium, as could be seen under the binocular. The hypopharynx was used as a tongue in lapping and the ants

did not confine themselves to aggregations of mycelia. The fragment had disappeared by the next morning and a pile of what appeared to be wet substrate was probably the remains. The ants were then given another fragment of the same *Trachymyrmex* garden. The ants repeated their performance. Farine was placed in the container and a worker defecated on a piece but otherwise left it alone. The ants soon ate nearly all of the mycelium. They were given no more food and died in several days.

Other workers were taken from the same colony on July 19 and placed separately. These were the minima and were removed with a small piece of their garden to an eight-inch tube of potato dextrose agar culture medium. By July 22 the surface of the medium was covered with bright carmine blotches of a viscous substance, probably bacterial. The fungus garden had on it a number of fecal droplets and was in fair condition with a few tufts of mycelium and the ants in attendance. The garden was overgrown with fungus and the ants dead by July 26, dying July 25.

An alate female found May 6 lost her wings May 8 and died May 9. Another found dealate May 6 died May 8. These had likely come from a marriage or dissemination flight.

A third female found dealate May 10 crawling on a cement walk about 1:30 p. m. was placed on boiled sand in a container plugged with cotton. By the next day she had pulled down much of the cotton but had no fungus or eggs visible. She was placed on boiled sand in another container covered with glass at 11:50 a. m. By 9 a. m. May 12 two eggs were scattered on the floor among the sand grains and at 4 p. m. she was taking up masses of sand grains from the floor and using them to build a cell, walling up one side to the ceiling. Two eggs were present on the floor May 13 and three on the next day. She tore up most of the paper given her. Only one egg was visible May 16 and no fungus garden. She was preserved some time later.

A dealate female found July 10 laid an egg several days later but died in a week or so.

Establishment of a Fungus Garden. — A female found dealate May 6 successfully established a fungus garden. She was taken while crawling along a drainage ditch and apparently was drinking water. Her marriage flight had evidently taken place after 10 p. m. of the night before. The ant was placed in a vial and no change was seen on cursory

examination until May 11. On this morning she was found to have a small fungus garden with 10 eggs embedded in it. The garden was placed on a small piece of paper sticking up from the moist boiled sand. The ant explored the garden and eggs carefully. Eleven eggs embedded in the garden appeared the following morning on one side. On another side she had embedded six or so grains of sand. A tunnel was excavated in the sand to a little more than her length. May 13 the garden had either fallen or was removed to the surface of the sand and had at least 11 eggs. Within six hours later she had placed the garden with 11 eggs back on the piece of paper. There were several brownish lumps that appeared like solid feces. Three eggs were left the next morning and the garden had deteriorated. On May 15 no garden was to be seen but the ant had constructed a spiral tunnel to the base of the container. She also tore down shreds of the cotton plug. The ant was taken out the next afternoon and placed with the sand and any remainder of the garden in another container. During the next 12 days she was unable to begin a new garden and no eggs were visible. Several small tunnels were excavated desultorily. May 28 she was given a flourishing piece about 15×5×5 mm. of the fungus garden of an *Atta cephalotes* colony. She was 90 mm. away and in a small tunnel but 30 seconds later she came quickly out and went directly to it. The ant explored it thoroughly with the antennal tips, then crawled over it, lapped the fungus and in general manifested the greatest interest. She lapped the mycelium without cutting with the mandibles. About ten minutes later she went to the opposite end of the container but returned immediately to continue eating for a few moments. She repeated the performance, going to the tunnel at the opposite end for a moment. During 100 minutes from the time the piece was introduced she ate nearly all of the fungus, leaving only the substrate. Overnight she had reworked this substrate, discarding over half of it including most of the part grown on yellow sweet potato but not any grown on rose leaves. A good mycelial growth was on the remainder May 29 and she had manured it with a few clear amber fecal droplets. The garden was flourishing the next day with the ant continually in attendance; the situation was unchanged the following two days. On the morning of June 2 she was at the opposite end of the container from the garden but in the afternoon was tending it as before. When I disturbed her while in attendance on the garden the next day she ran to the other

end and down a tunnel. The garden was healthy but not growing and there were no fecal droplets or eggs. June 4 in the morning the situation was unchanged but by the following morning she had moved the garden to a deeper part of the nest and incorporated it with grains of sand in the form of ridges. It had become much smaller. She was given shreds of farine and a few hours later was seen defecating on one. Most of the others had been similarly treated and had become golden brown. There appeared to be nothing else but scattered bits of used substrate in the container. During the next few days the container was accidentally flooded and the garden disappeared completely. June 11 she was moved to a new container since I could not follow her activities in the tunnels. June 12 she was given a piece of the fungus garden of a *Trachymyrmex urichi* colony. She immediately felt of it in different places, seemingly recoiling as though it did not exactly suit her. The palpi were not extended yet she appeared to be able to test it with the mouthparts retracted by placing them over the fungus. Then she bit off a piece and carried it about for three or four minutes. The ant put this piece down, returning to the main portion and hastily and momentarily exploring it with the antennal tips. An hour later she was wandering about, ignoring the garden mostly but occasionally returning to it for a moment. This piece of garden was flourishing the next morning but there did not appear to be any fecal droplets and it seemed to be ignored largely. By June 14, however, she had adopted it, frequently touching it with the antennal tips and otherwise exploring. There were no evident fecal droplets. By June 17 an egg had been deposited in a cell of the garden, now luxuriant. Within two days the egg had passed into the larval stage which had a dark gut and appeared to be feeding on the fungus. Its ventral surface was curved into the garden. The colony and garden were in good shape June 20 but by June 21 the ant died. The garden was luxuriant and an egg or larva appeared to be in a cell. The female had not at any time been observed to eat the fungus, although appearing to adopt it. The garden was left untouched until July 8 by which time it had become a brown, viscid mass, a fraction of the former size, with no hyphae. This is typical of the gardens of Attini when abandoned. They produce no fruiting bodies except sporophores of the common molds or else simply wither away.

Biology. — The colony of intersexes was otherwise a typical colony and contained 7166 workers, 186 females, 660

males and 163 intersexes, a total of 8175 adults, allowing for those which may have escaped it contained about 9000 adults at the height of the breeding season. Of the workers, 13.5 per cent were maxima, 30.3 per cent media and 56.2 per cent minima but it is my thought that the figures are high for the minima and low for the maxima. I have commonly observed that the minima are more freely produced in a laboratory nest than the maxima, perhaps because of crowding or insufficent nutrition. This is probably the only colony of an *Acromyrmex* to have been actually counted. The larvae and pupae are commonly swathed in a mycelium. Males were found in May and June while alate females were found as late as July 10.

These ants commonly nest in cacao plantations and may do some damage here in cutting flowers and leaves for their substrate. They do appreciable damage elsewhere to cultivated crops and exotic plants in general. At the Imperial College, workers were watched March 29 and 30, 1935 ascending papaya trees for ripe fruit and flowers which were 3.2 to 3.5 meters above the ground. Ants from three colonies were foraging on a small plot of papaya. How could the ants ascertain that ripe fruit was to be had beyond the range of their sight and small as it probably was? The ants worked most of the day from just after sunrise to past 9:30 p. m. Workers at the College also gathered flowers of leguminous plants, Hibiscus, etc. Elsewhere they were seen cutting flowers of *Mitracarpus (portoricensis?)*, flowers and leaves of *Cassia fistula* and leaves of a *Portulaca.*

The nest may contain myrmecophiles, such as Staphylinid beetles and Phorid flies, such as *Diploneura cornuta* Bigot. The Phorids at one nest which was being excavated did not attempt to oviposit on the workers but simply got out of their way. They sought entrances to within the pile of mixed soil and garden, evidently to oviposit on the brood or in the fungus garden. A colony collected December 22 was ended January 2 when only a few of the large workers remained feebly alive. At this time the mass of decayed brood, fungus and ants was alive with nematode worms. One feebly alive worker had spherical, unknown masses on the pedicel and worm-like structures in the gaster which may have been a parasitic nematode. A tarantula in a tunnel leading from an ant chamber is described above.

Predators were the large, silky anteater, *Tamandua longicauda* Wagner and the giant toad, *Bufo marinus*. The stomachs of these contained the *Acromyrmex*. A different relationship was

that between other ants. An army of *Eciton (E.) vagans* Olivier, which was robbing smaller ants in a drainage ditch of their broods, encountered a file of *Acromyrmex* in the ditch which was carrying fresh and withered leaves. The latter had to pass the Ecitons to get to their nest. The *Acromyrmex* boldly marched through the army, bearing their big loads of yellow flower parts, and made a picturesque sight. Many of the Ecitons threatened and even tried unsuccessfully to grasp the Attines but the ants kept on though a few were turned back. The common ponerine ants at the Imperial College. *Ectatomma ruidum* Roger, gathered about an entrance to the nest in the ground of one of the *Acromyrmex* colonies cutting papaya described above. The workers of the latter were bringing in papaya fruit in a continuous file. Every now and then a ponerine would jump at a laden Attine and, if successfull, would startle the other into dropping its fruit. The ponerine would then snatch the piece and run off. A ponerine and an Attine tugged on opposite ends of a long piece of fruit. For a moment they see sawed back and forth, the robber gradually drawing the other ant away from the path although both were of about equal size. Finally the fungus grower released its grip and the attacker made off with its booty.

There are several indications as to the range of a colony. Three colonies foraged together on the papaya plot and are described above. The colony described nesting up in a palm crown was foraging nearly eight meters away on a *Cassia* tree which would indicate a foraging area of at least 200 square meters. Ants of a colony on Galeota Point were cutting leaves of *Portulaca* at the base of a sea cliff and climbing aerial roots of *Clusia alba* to the top of the promontory with their loads, a distance of over 10 meters. One of these workers, incidentally, climbed half a meter or so up a root and was met by another ant without a load. The latter took the section of leaf from the first and started up the cliff while the other returned to the base. The first released its grip at exactly the right moment to the second ant, who swung the piece over its back and marched off.

Like other attines, these ants are nocturnal and crepuscular as well as diurnal. They were active on Patos Island at 10:30 p. m. and at 1200 feet in the Northern Range at a similar hour.

Atta.

The highest development of the fungus-growers is to be found in this genus. The species are so well known to the

inhabitants of the American tropics as to have been given vernacular nomes, "bachac" being the name used in Trinidad. The single species found in Trinidad is *cephalotes* and it is the only fungus-grower here with a soldier caste.

Atta cephalotes L.

The nests of *cephalotes* are often conspicuous on the landscape because of their large size. The long files of workers with an occasional giant of a soldier stalking along are also a familiar sight to all, especially when the workers are carrying sections of leaves or flowers. The colonies are hard to eradicate because of the considerable number and ramifications of their chambers. The ants are often exceedingly destructive and usually considered to be animals whose extermination is to be desired. According to recent evidence (Proc. Ent. Soc. Washington, 47:72, 1945) the well known insecticide DDT, Di-chloro-di-phenyl tri chloro ethane, has not proven effective in their control.

Perhaps the earliest account of a Trinidad fungus grower is that by Brent (1886) on this species. Wheeler (1907) summarizes Brent's account as follows:

"A good sized mango tree, at least as large as an average apple tree, I saw stripped of every leaf in one night, and greater feats than these are recorded by these "Fourmis Ciseaux", as they are called by the Creoles". Brent gives a diagram of the nest and describes a tunnel leading from the lowermost fungus-chamber to a still lower level. He "invariably found this lower tunnel wherever the inclination permitted its construction" and has "no doubt that it is constructed as a drain, and that the ants know as much about the advantage of thorough drainage as they have been proved to know, by many eminent observers, of those of other sanitary matters". Some of the chambers of the nest are described as three feet in diameter. He mentions Amphisbaenians as living in the nest and eating the ants..." The larvae are embedded in a soft woolly matter which proved to be the finely masticated parenchyma of the leaves. Thus a use was found for the leaves, although it reflects seriously upon the supposed sagacity of the ants that they should procure so many more than are required for the purpose".

Brent had no idea that the ants cut leaves in order to grow a fungus upon which they fed but believed that the leaves were the food. The supposed parenchyma of the leaves in which the larvae were embedded was the fungal mycelium.

A few years later Tanner (1892 a and b) followed in the study of this *Atta*. He seems to have been the first to use observation nests in which he observed the larvae and the chewing of the leaves. Tanner realized that the ants fed on fungus grown on leaves but erroneously believed the larvae to be fed on spores. What he interpreted as spores are now referred to as bromatia, spores not being formed under the conditions in the ant nest. He failed to observe the manuring of the chewed leaf particles or the manuring of the garden.

Urich (1895) added little to the previous observations and later (1923) refers to nests known by him to have existed for 10-20 years.

An earlier paper (Weber, 1937 b) describes the nesting habits of this ant and photographs of the nests in Trinidad, British Guiana and Venezuela, There have been various more extensive studies in other countries, such as Brazil and Surinam.

Distribution. — The ants are widespread in Trinidad and my personal records include: Santa Cruz, 29.XI.34; Maracas Valley, 19.III.35; Caura Valley, 10°41'30"N., 61°22'W., 20.XII. 34, 700 ft., 17.IV.35; Spring Hill Est., 1200 ft., 6.IV.35, W. of Morne Bleu, 1800 ft., 28.III.35, 23.VI.35; Tacarigua River, 1580 ft., 10°42'25" N., 61°23'W., 18.XI.34; Turure R., 200-300 ft., 10°39'N., 61°10'W., 9.IV.35; Aripo R., 700 ft., 9.IV.35; Manzanilla Bay, Mayaro Bay, 4.XII.34, 10.III.35, 16.VI.35; Nariva Swamp, 5.XII.34, 10°23'N., 61°4'W., 10.III.35, 10°23'N., 61°3'W.; Trinity Hills Forest Reserve, 10°5'10"N., 61°7'30"W., 24.XII.34; Basin Hill Forest Reserve, 700 ft., 1.IV.35; Ortoire R., Rio Claro, 3.I.35.

The observed altitudinal range is sea level to 1800 feet.

Mr. Desmond Vesey-FitzGerald brought me specimens (No. 4621) which he collected in 1935 on the nearby island of Tobago.

Nests. — The external indication of the nest is an irregular series of craters. Young colonies, of course, start with a single crater or in some cases a turret (Weber, 1937 b, Figs. 1, 2). A turret in a young nest December 20 was 110 mm. high with an opening 13 mm. in diameter and a distal external diameter of 60 mm. In the soil was a cavity 93 mm. in diameter which was nearly filled by the fungus garden. The queen found here was very sluggish, "feigned death" and did not attempt to scape. The colony was estimated to be six months to a year old and had very few soldiers. None of these was of maximum size. The

workers were busily bringing in leaf sections in the bright sunlight.

Another young colony had on April 9 a turret 120 mm. high and 60 mm. in maximum diameter which was tilted an angle of about 25° from the perpendicular. It was at 2:30 p. m. during a light rain, closed with exhausted substrate. The fungus garden was 100 mm. below the soil level and was 85 mm. high × 90 mm., sessile, and occupying nearly all of the chamber. The later was smoothly walled and symmetrical. Small Phorid flies were collected with the ants.

A colony of moderate size at Mayaro Bay had nine active openings at 8:30 a. m. separated by a maximum distance of 188 cm. The sea beach was only 4.5 meters away and high tide level an additional 5 meters.

The large colonies build nests of considerable size (*loc. cit.*, fig. 8) and may have single craters as high as 40 cm. An entrance to one such nest led into a vertical tunnel over a meter deep and there were other tunnels of similiar diameter and at different angles. These large nests require considerable labor in excavating and have been well pictured in Surinam and Brazil. The numerous fungus gardens are at various depths from a few centimeters down. A particularly shallow garden was 7.5 cm. below the surface and was connected by a tunnel 3.8 cm. in diameter to a second chamber 5 cm. below. The latter was 23 cm. high × 27 cm. diameter and empty except for a small pile of exhausted substrate containing Isopods, mites and similar scavengers. At another large colony the first garden encountered was at a depth of 23 cm. and about the size of a man's head. It had on April 17 sexual brood.

The entrances to the large nest may be in raised craters and shed rain very well but others may be flush with the general soil level and admit the water readily. During a torrential rain two streams of water were observed to flow down one entrance about three centimeters in diameter continuously for over five minutes. During this period a number of liters passed down the nest.

Observation Nests. — Part of a broken-up fungus garden containing no brood was collected with the ants in it and placed in an observation nest March 28. Within one or two hours the ants had started reconstructing their garden. Two days later it was flourishing. Soldiers stood near the entrance to the nest, one taking a position directly in front. The ants used bread and yellow sweet potato for substrate. A cockroach with full-sized

antennae was observed March 31 moving lively about. It had no fear of the ants and they ignored it or treated it as an ant. There were numerous bromatia, appearing as globular masses of white hyphae which were covered with minute, transparent, glistening droplets. The minima carried these about, sometimes in clumps, and removed them to the recesses of the nest. One ant was seen to manipulate such a mass round and round between its mandibles, then took it into the nest. The ants were busy that night at 8:30 taking water and bread into the nest. Soldiers were also out in the arena. This colony was chiefly nocturnal in habit, few ants being observed about the nest in the daylight on the day collected as well. Bromatia were visible in the side of the nest nearest the entrance April 5 and the cockroach flitting about. By April 8 the garden had become very dry but had abundant bromatia. Minima workers as well as larger sizes had been out in the arena. By the middle of April the garden appeared to be definitely deteriorating. On April 14 only a couple of workers were out gathering water. The cockroach was active and had previously been observed walking over the garden. The colony contrasted strongly with a vigorous colony maintained at the same time which contained the queen and brood. Clearly the contrast was due to the stimulus of the brood and queen upon the workers. Single soldiers died April 7 and 16. The dryness of the month of April also made it difficult to keep up the more exposed gardens. Only one soldier remained April 26 and he was very feeble. The garden had stabilized but was not flourishing. A nest of another colony was stacked on this nest April 27 so that both could use the same arena. No hostility was apparent between them or between them and a *Trachymyrmex urichi* colony also placed here. By May 3 the cockroach was not visible, the soldier remained alive and the garden was in poor condition.

Nine workers that phorid flies attacked when the above colony was exposed March 28 were placed in separate containers. They fed on sugar water but otherwise had no food. Single media workers died April 1 and 2, a minima April 6, two media April 8 and the remainder April 10. None was found to contain a recognizable parasite upon dissection and no phorids emerged from the carcasses within the next month. It would appear that phorids make many unsuccessful attempts at ovipositing and that even then the chances for survival are not high.

Four phorids collected at the same time were placed in a vial but only one survived the journey back to the laboratory.

This was given paper soaked with sugar water. The fly was highly phototropic. It died April 1.

A cockroach with very short antennae from the ruins of the same nest was placed alone in a small container with sugar-soaked blotting paper. The next morning it was on its back in the liquid but kicking. It was righted and three hours later placed with the portion of the ant garden which was collected. It seemed unable to keep on its feet and turned over, kicking. This attracted several minima ants who attacked it. The cockroach was then placed under a part of the garden.

A complete young colony was collected April 9 and placed in an observation nest. There were no large soldiers and the colony may have been six months to a year old. By the next morning the ants had thrown out damaged or exhausted substrate and had made a cell for the queen. Larvae and pupae were placed in two depressions on the garden. For two hours they ignored potato placed in the nest, then swarmed over it and cut it for substrate. They also cut orange rind. During the week the ants were out daily in large numbers, cutting substrate and building a flourishing garden. April 18 they were watched under the binocular. When the ants were given a piece of potato of about 6 cc. they immediately started cutting it up and had removed it piecemeal in slightly over two hours. When workers attempted to take in bodily a piece about 0.7 cc. they found the opening to the nest too small and cut it up also. The minima as well as the media were active in these procedures. A larva on its back was watched feeding on a bromatium. The workers in such cases rotate such a mass between their mandibles, then place it on the mouthparts of the pouting larvae. A larva was lying askew on its back feeding. It had a bromatium between its mandibles which went in and out with a somewhat piston-like motion and laterally, the labium being coördinated with these motions. Eating, as in the adults, seemed to be a process of attrition and lapping up of expressed juices. The larva handled the mass easily. Another larva had such a mass on one side of the mouth, the mouthparts working in and out without affecting the bromatium, when a media worker came up and regurgitated to it, working its own hypopharynx and palpi to the corner of the mouth opposite to that of the bromatium. It acted thus for 15-30 seconds when it passed on. The larva worked its mandibles for a moment later, then became quiet. A worker used the front tarsi and apices of the mandibles as well as the other mouthparts to assist in the

rotation of a bromatium and was obviously lapping the juices. Another worker assiduously lapped up juices among prostrate hyphae on a juicy bit of substrate, probably potato. The ant dug into the substrate, putting the antennal tips directly into it and beside the apices of the mandibles. The antennal tips were unquestionably bathed in liquid as were the tarsi. Several times a hypha came loose and was worked into the mouthparts. The hypha would be removed by passing the tarsi and antennae through the mouthparts. The hyphae were not swallowed.

Many workers were carrying water April 20; up to April 26 the brood was kept mostly in the center of the nest on the most flourishing part of the garden. The queen was to one side in a cell. She was resting that day on the right dorso-lateral part of the body with one hind leg attached to the garden and mostly holding her in place. By April 30 the ants had moved nearly all of the brood (consisting of tiny pupae, larvae and eggs) to the bottom of the nest under the garden except one large pupa, one large larva and one much smaller larva. The garden continued to flourish. The situation was on May 1 as above when the ants were moved to a new nest. The next day the garden appeared much as before with the queen on top towards the center and the large larva and pupa in separate open cells attended by many ants. It was clear for some days that these large larva and pupa had been getting much more attention than the remainder of the brood, either from more workers or from workers more times. On May 9 the ants appeared very sluggish, not aggressive and the garden attenuated with the lamellae solid-looking. There was a strong odor of pitch from this new wood and glass nest. They were removed to an older nest and during the next few days slowly came back to normal. By May 20 most of the surviving workers appeared to be the media, many ants not recovering. Scattered eggs and other brood were scattered on the glass floor under the garden. The garden was decreasing in size by June 13, with the queen resting on her left side though moving when the nest cover was tapped. She was upright the next two days and on a part of the garden. The colony was transferred again to another nest July 3 when it was reduced to the queen, many minima and a few media workers but no garden. After several hours the queen was found to have taken a position on her side with appendages retracted. The ants were given a large piece of the fungus garden of an *Acromyrmex octospinosus* colony containing at least one egg. The ants immediately swarmed over

it and under the binocular could be seen to lap up the hyphae and, to a slight extent, the juicy substrate. There was no hesitation whatever. The piece was exhausted within several days and they were given another portion, about 20×14×8 mm., of the same *Acromyrmex* garden July 7. The ants swarmed over it as before. Seven hours later they were still clustered about and the queen was beside it. This portion, too, was exhausted in several days. On July 12 the ants were given over half of the pileus and the basal part of the stipe of an *Agaricus arvensis* (det. Briton-Jones) sporophore, freshly gathered. The ants immediately came up and started feeding on both parts but mostly the pileus. They acted as though it were an ordinary garden. July 16 they were again given a piece of the garden of the *Acromyrmex* colony and ate it as before. Even the queen eagerly ate it. Some of this piece remained the next day with the queen and workers in attendance. Observations were concluded after 3¼ months in captivity of this colony which survived so many vicissitudes.

A few workers of the above colony were removed June 19 and placed separately. The next day they were given a piece of the garden of the *Acromyrmex* colony alluded to above. The ants immediately pounced on it as though it were there own and lapped the fungus greedily. Some even took up masses of the fungus and squeezed them with their mandibles as they lapped up the juices. By the following day the ants had deposited about a dozen fecal droplets on the piece which still was in good shape. One fecal droplet was present June 27 and none June 30. The ants used farine and potato for substrate. Three workers survived to July 7 but the garden had, through insufficient care probably, grown wildly. By July 9 the ants were dead and the garden luxuriant but abnormal in appearance.

A part of one fungus garden of a large, mature colony was collected April 17 and placed in an observation nest. With the garden were huge sexual larvae. The nest was placed in an arena which was occupied by a *Trachymyrmex urichi* colony. When the *Atta* nest was opened the ants swarmed out and were met by the other ants, both workers and dealate females, who came with antennae outstretched horizontally. When they made contact the latter ants recoiled immediately and retreated. The minima Attas did also mostly but the maxima ignored the *Trachymyrmex* or paid them little attention. There was no positive animosity or attempt to battle on either side. By April 20 the ants had removed

much exhausted substrate and several sexual larvae which had shrivelled as a result of the ants lapping the cut and damaged integument. One intact sexual larva remained. The others had been too thoroughly defended when the nest was opened and had been cut by the mandibles of the workers. The nest was placed on top of another *Atta* nest with openings turned in opposite directions. This other colony was mostly nocturnal and showed no interest. The larva pupated May 1 or 2 (not May 3, W h e e l e r, 1937, p. 49). A soldier became callow a few days later and was the only soldier left. On May 20 the pupa had become an opaque, grayish white and the gaster had a faint mid-dorsal darker streak.

On May 24, when observed under the binocular, the ants became a little disturbed under the light but soon relapsed into normal behavior. The pupa could easily be determined as a female and the mandibles had become a dark brown. The ants had been given rose leaves the day before but had been ignored until nightfall when several pieces were taken into the nest. Two medium-small workers were working over an irregular mass of rose leaf about equivalent in bulk to one of the ants. It had turned brown in color. The ants were rotating it about slowly between the tips of their mandibles with mouthparts retracted. The triturating produced by their needle-sharp mandibular tips caused bruises of irregular shape, rather than striae as stated by Moeller (see W h e e l e r, 1907, p. 684). The bruises caused the mass to be covered with the cytoplasm of the broken cells. Then one worker placed itself astride the mass, while the other maintained its grip, and emitted a clear amber fecal droplet upon the leaf. Contrary to T a n n e r *(loc. cit.)* the pellets were not of regular size and not made smooth since this would afford less support for the fungus. This and other masses of leaves so treated were embedded in the ridges of the honeycombed garden. The fungus was in the form of fluffy masses of mycelium sprouting from a narrower base of substrate. The minima and media workers doubtless perform this labor because their small size would be less likely to disturb the structure of the garden. The leaf fragments comminuted in this manner were not too thick to be used by the minima. The fragments planted in the garden were not planted at regular intervals and were larger than the size of a mustard seed to a dust shot as reported by Tanner, sometimes being longer than the head of the minima. A media worker was watched manipulating a leaf section, still a fresh

green, when a minima came up and during this process deliberately though rapidly defecated a clear, amber droplet on three places on the leaf surface. The minima then went away. There was no brood in the nest except the female pupa, now a grayish brown in color with the mid-dorsal gastric streak still darker. The soldier which emerged several weeks ago was still not fully mature in color. On the under surface of the garden were scattered bromatia, some of which the workers were carrying about and eating.

The nest was photographed May 27, showing the brownish, maturing female with the soldier standing guard as it has done for days. The wing pads of the female showed white and were folded on the ventral surface. This soldier had been cleaned from time to time by the minima which often crawled over it. They were about as long as the soldier's head was wide! The female emerged from the pupal state May 31. When discovered at 2:30 p. m. she was on her back with the damp wings crumpled but just out of the case. The workers were in attendance. The wings had not straightened the next morning and she was lying on her left side against the garden, motionless except for a slight waving of the left antenna. The right funiculus was gone, indicating too much assistance from the workers. A slight tremor was seen which might have been used to force air into the wing veins. Her color was honey brown and much paler than that of a mature female in a nearby nest. June 2 she was upright with her wings bent, and kept motionless except for slight movements when the nest was jarred. June 3 she was still upright and several centimeters from the garden but was clearly very feeble. The wings remained bent. The body rested on the floor and she appeared able to move the antennae and legs only slightly. The soldier remained facing her. June 4 the situation was as above. Minima workers constantly worked over her as they have been doing. By June 6 her color had darkened and she moved the antennae and legs slowly. The next morning she was standing still as usual but in the ofternoon showed more life, walking a trifle and unsteadily. She would open the mandibles in order for the minima to either clean the mouthparts or feed her. This day and yesterday the soldier ceased to guard her and was generally near the nest entrance. The female was at this entrance June 8 but it was too small for her to pass. The soldier as well as maxima workers were in attendance. If she was instinctively preparing for the marriage flight the hour was overcast and

Fig. 1. *Cyphomyrmex rimosus,* bromatia stuck to the under side of the glass plate forming the ceiling to the observation nest. Absorbent paper introduced to supply moisture.

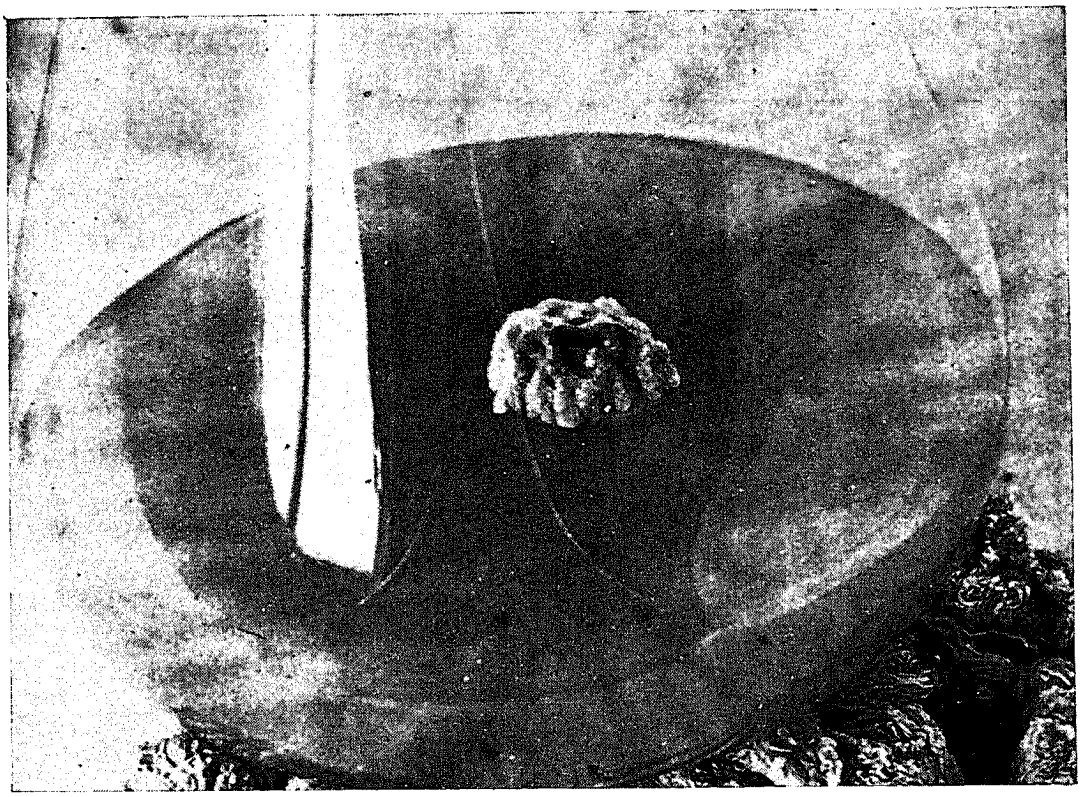

Fig. 2. *Cyphomyrmex rimosus,* fungus growing on sterile medium in Erlenmeyer flask.

Rev. de Entomologia, vol. 16, fasc. 1/2

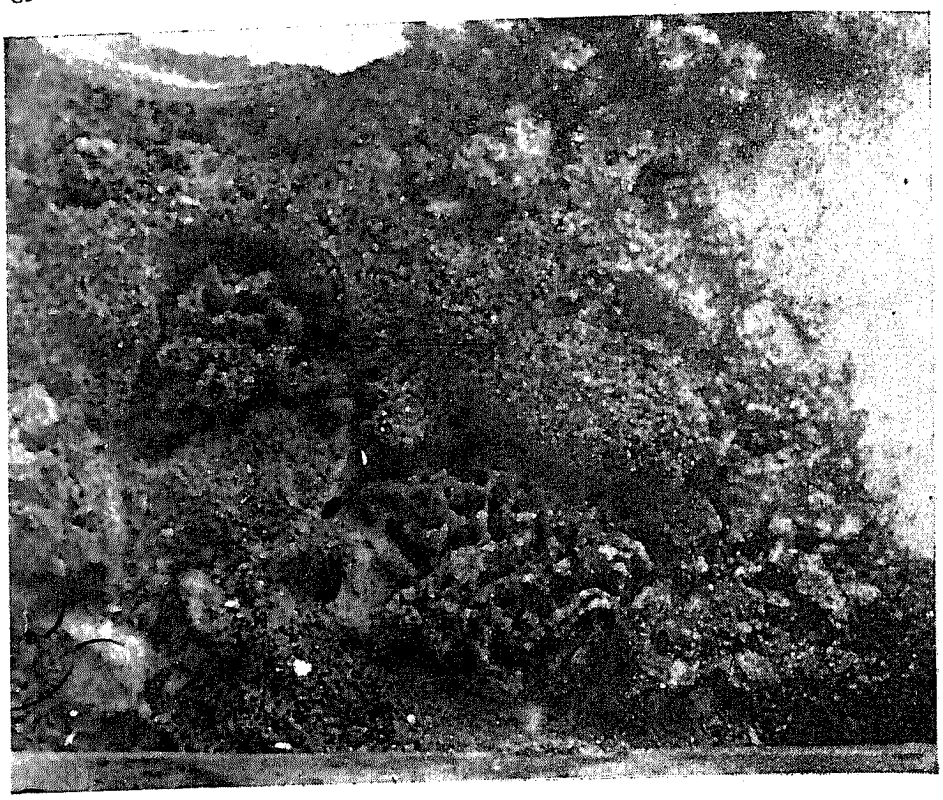

Fig. 1. *Mycocepurus smithi trinidadensis,* fungus garden in an observation nest. The fungus was grown on natural substrate.

Fig. 2. *Myrmicocrypta buenzlii,* fungus garden in an observation nest. The fungus grew on farine (cassava).

Fig. 1. *Myrmicocrypta urichi,* type nest explosed in sand. The fungus garden was attached to coconut roots. Ruler marked in inches.

Fig. 2. *Myrmicocrypta urichi,* type colony in a Petri dish used for an observation nest. The ants developed a scattered fungus garden.

Fig. 1. *Mycetophylax brittoni littoralis,* type nest exposed in the sandy beach of the seashore. The fungus garden was developed on sections of grass. Ruler marked in inches.

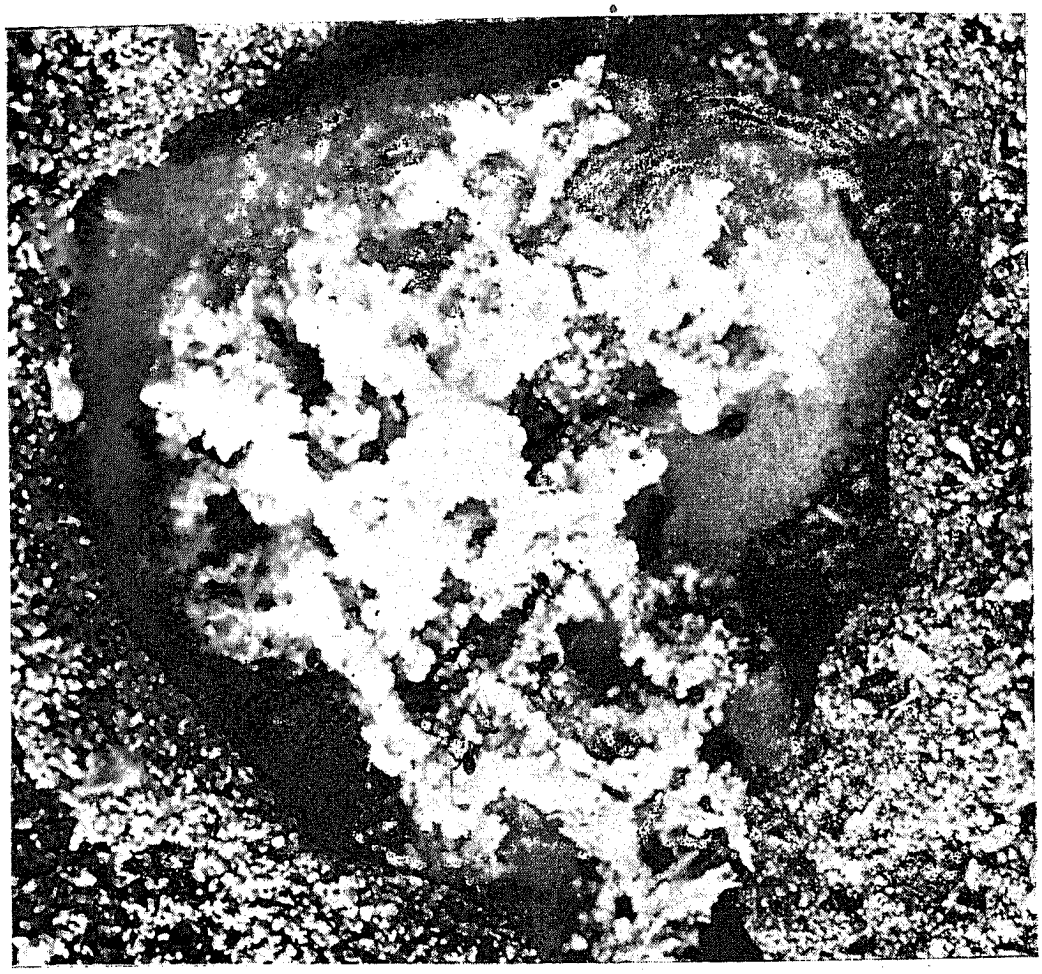

Fig. 2. *Mycetophylax brittoni littoralis,* fungus garden in an observation nest. The fungus grew on farine (cassava).

Rev. de Entomologia, vol. 16, fasc. 1/2
Plate 5

Fig. 1. *Apterostigma urichi*, fungus garden suspended under leaves from a buried twig. The garden was enclosed in an envelope of mycelium. British half-crown coin at left.

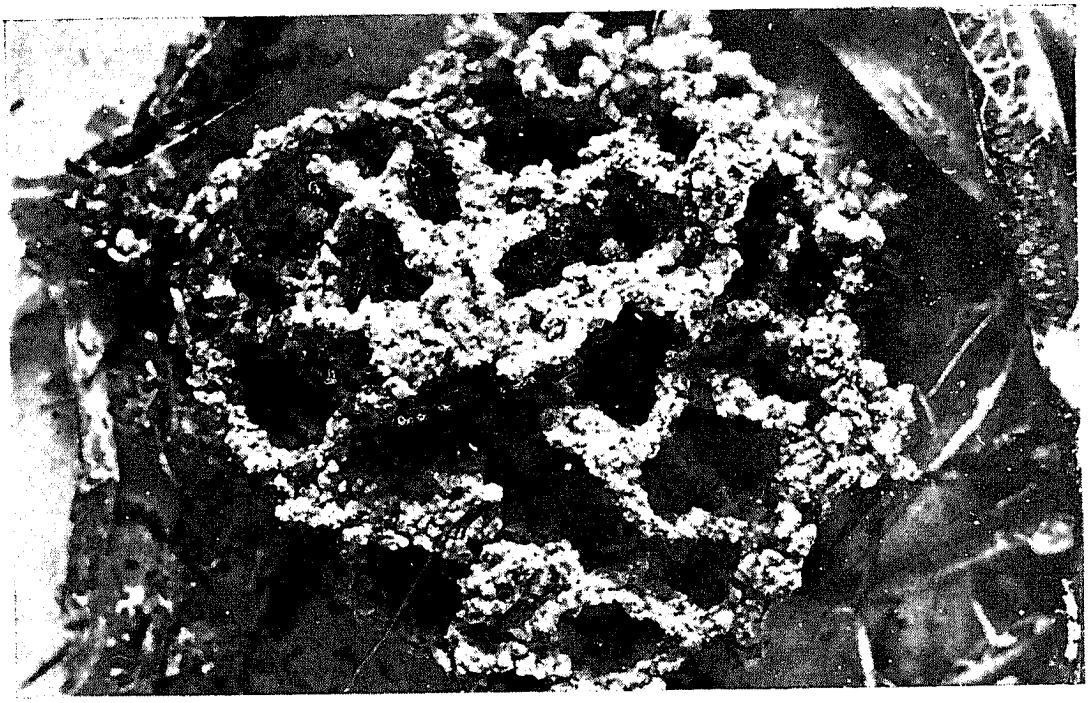

Fig. 2. *Apterostigma wasmanni*, fungus garden in an observation nest. The ants used their natural substrate of insect feces and vegetal debris.

Fig. 1. *Sericomyrmex urichi,* nest under coconuts. The crater appears to the left of the knife handle and above. Under the crater appear two small chambers and to the right of the knife blade appears a large fungus garden through which roots run. Knife 10 inches (25 cm.) long.

Fig. 2. *Sericomyrmex urichi,* fungus garden in an observation nest. Coconut roots collected with the colony are still used in part for support of the garden. Farine (cassava) and yam used principally for substrate.

Rev. de Entomologia, vol. 16, fasc. 1/2
Plate 7

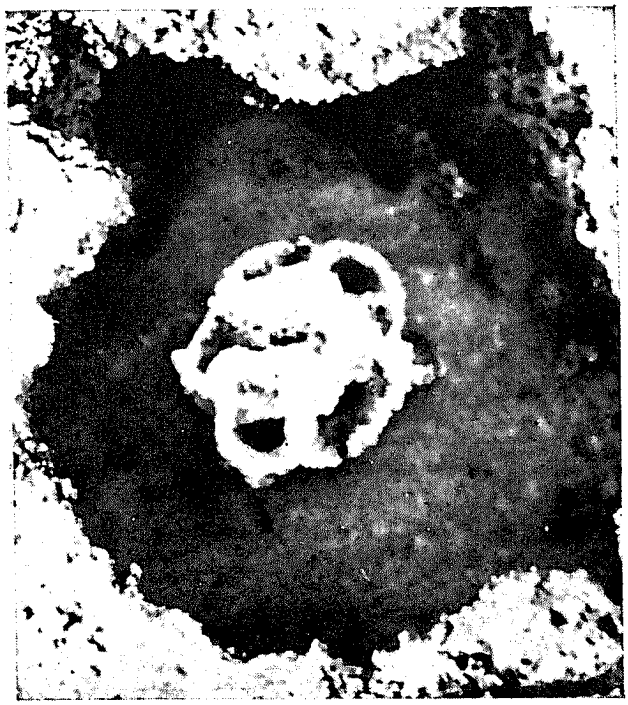

Fig. 1. *Trachymyrmex cornetzi bivittatus,* small fungus garden in an observation nest. The ants removed all soil from the vicinity of the garden.

Fig. 2. *Trachymyrmex ruthae,* type nest entrance in the form of a collar of twigs and leaves. British shilling coin at left.

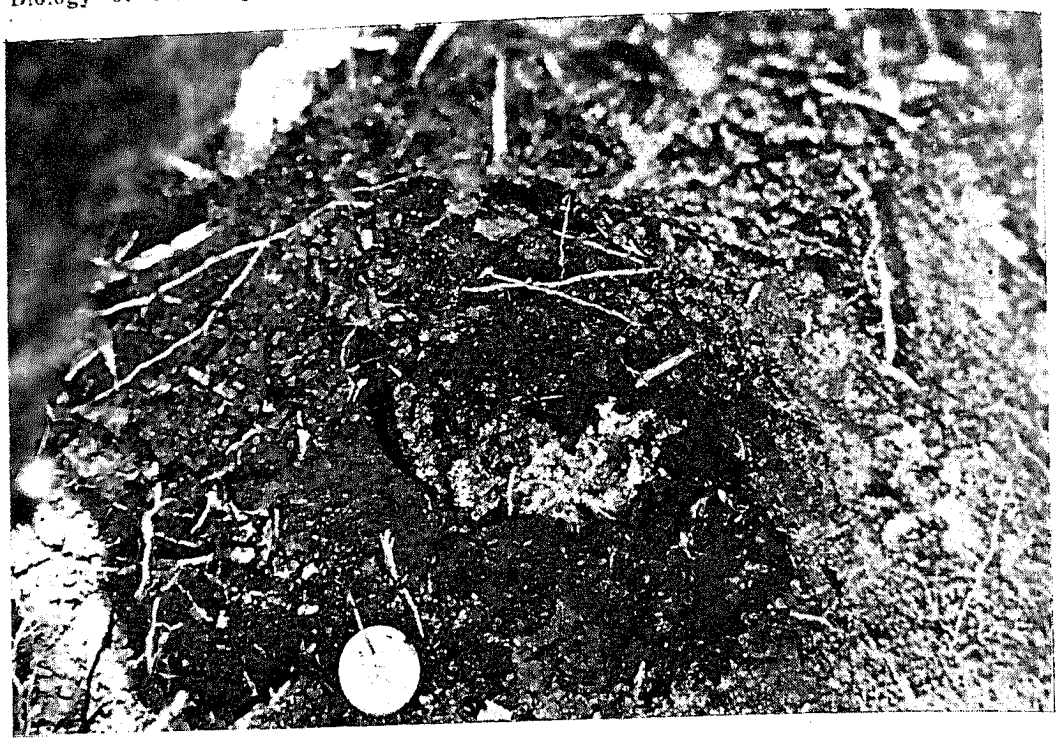

Fig. 1. *Trachymyrmex ruthae*, type nest. The ants nested under bamboo and formed a fungus garden whose left and right halves appear different. British shilling coin at left.

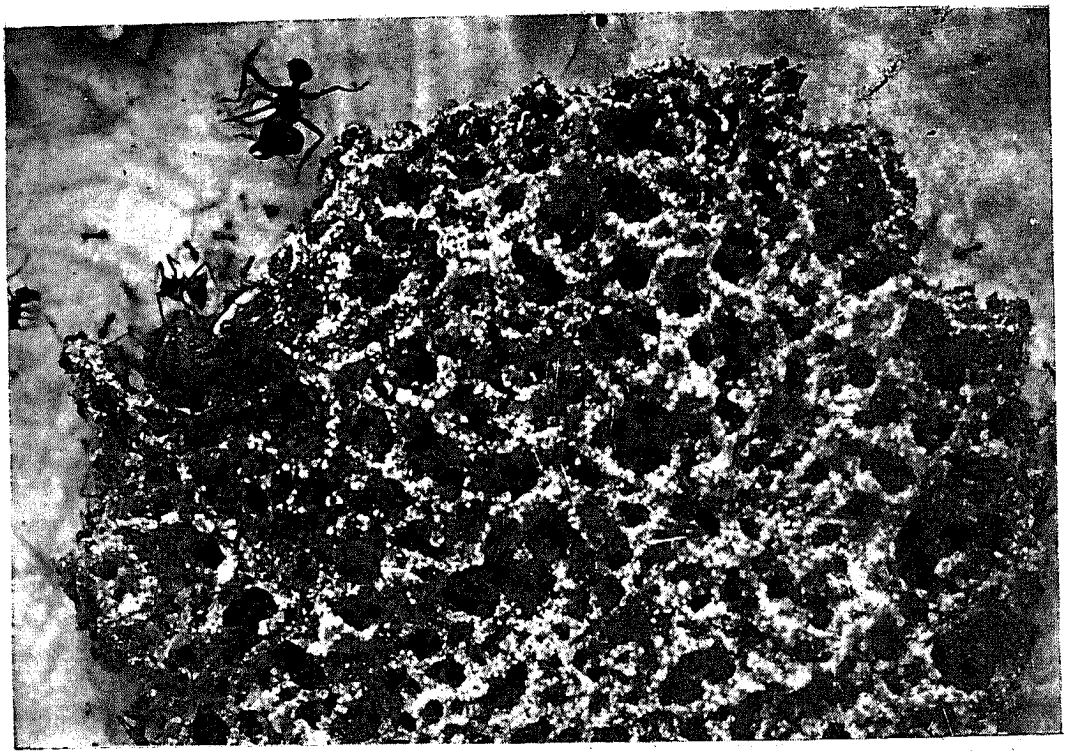

Fig. 2. *Acromyrmex octospinosus*, colony in observation nest. The soldier, reared in the nest, maintained constant guard over the female pupa at the upper left margin of the fungus garden.

with a fitful breeze. Her antennae and legs moved occasionally. By June 10 she appeared foebler, scarcely moving an appendage, and was at one side of the garden. The soldier did not face her. By June 10 she appeared feebler, scarcely moving an appendage, above her the soldier immediately came up to her. The minima workers swarmed over her as they did normally. The only sign of life was a slight movement of one of her legs. By June 14 she was lying on one side, seemingly helpless, with the legs moving feebly. I uprighted her. She was, on June 15, lying on one side away from the garden and was placed on top of the garden, whereupon she moved a leg feebly. The soldier and soldier maintained guard. She died the next day and was on June 17 still with workers in attendance and immaculately clean. Few ants were left in the nest June 28 and the garden much deteriorated. They were removed to another nest. The ants died within a few days, however.

A colony originally examined March 28 near Morne Bleu was revisited June 23 and a part collected. A number of winged females were present. The ants were placed in an observation nest and were on July 31 given pieces of the stipe, pileus, and slimy brownish gray velum of a sporophore of *Phallus* sp., freshly gathered. The ants immediately swarmed over them. A soldier as well as workers lapped the slimy velum. Three hours later the ants had broken up and carried away most of the velum and pileus and were still crawling over the stipe. They were given grapefruit rind, whereupon they swarmed over the part soaked in the acid juice, rather than the dry pith, and eagerly lapped the juice.

A nest in the Nariva Swamp originally partially excavated March 10 was revisited June 25 when numerous males and an alate female were removed. Within two days most of the males died. June 27 a fly was seen feeding on one dead male and under the binocular it continued to feed. It was a phorid with black thoracic dorsum and yellowish white abdomen with two conspicuous transverse black bands, a species collected before with ants. The fly extended its mouthparts fully and took in juices from various parts of the ant but oviposition was not seen.

A male from this colony was placed with an alate female from the above Morne Bleu colony June 27. The female stridulated and attempted to bite my fingers. Neither paid any attention to the other ant. The female lapped up a little sugar ten minutes later, left, then returned to lap sugar for a number of minutes

while the male persisted in trying to escape from the container. The male was dead the next day while the female lived for ten days before been killed while faintly alive.

Two other females from the Morne Bleu colony were removed from their observation nest June 27 and placed separately. Since the males in the other colony had been extruding a white liquid of gluey consistency from the cloaca as they died, it was thought that one of the females could possibly be artificially inseminated with this liquid which may have been semen. Some of the liquid was placed on the point of a No. 2 insect pin and placed in the slightly opened cloaca of a female but the results were uncertain from this crude method. The wings of the two females were cut off with scissors several hours later and the ants placed on wet sand in a jar. The next morning both were excavating a single chamber, taking turns. One would wait for the other to come out of the tunnel, whereupon it would immediately go down for a load of sand grains. There was no animosity but impatience shown as they figuratively crowded on the heels of one another. They were resting together June 30. By July 6 one female had been buried in their tunnel by the survivor who packed sand grains firmly about and over the dead ant. The dead ant was fresh-looking and probably died the previous night. The survivor died July 21 without forming a garden or brood although in July she did gather a packet of grains on the smooth floor as though it was a garden.

Another Morne Bleu female was removed from the parental nest and placed separately June 27. She formed a small cell, walling up the walls and corners of her container. She died July 14 without developing garden or brood.

A female and a few workers from the same Morne Bleu nest were removed to a separate container June 28 with a small piece of their own garden. This disappeared in several days and the ants were removed to another, better nest July 9, at which time the wings of the female were removed with scissors. The next day the ants were given a piece of the garden of a *Sericomyrmex urichi* colony which had on it one or two fecal droplets. Two workers immediately ran up and started tasting it. They tasted only momentarily and in a number of places as though it did not quite suit them. The female soon came up, feeling ahead with her antennae. She touched the piece with her antennal tips several times, then ate a little bit, working her mouthparts vigorously as though it did not taste just right. Ten minutes later

she was back exploring and tasting it briefly while the workers ate on other places of this small piece of garden. July 12 they were given an entire sporophore of *Agaricus arvensis* (det. Briton-Jones), freshly collected. 24 hours later they had eaten nearly completly around the rim of the pileus and one or two millimeters in. The female was lying feebly on her side although the workers were all dead. By July 17 the female still remained feebly alive. Her head was removed and the gaster examined, finding it full of eggs.

Another Morne Bleu female was removed from the observation nest and separately placed July 15. Her wings were cut off with scissors at this time. Under the lens her mouthparts appeared empty. The next day she was given a piece of an *Acromyrmex octospinosus* garden about in bulk equal to her head and thorax. It contained two small fecal droplets. The garden was placed to one side of her and she immediately wheeled about with antennae extended. She explored it thoroughly and tasted it in various places. 11 minutes later she was still feeding vigorously and 21 additional minutes still later was feeding, tearing off small bits, scattering them about. July 17 the ant was in good shape and had scattered the garden bits in various places. After exploring a small bit she was seen to place it on the largest bit remaining. She had taken mud and sealed up the rim of her glass dish. By the following day she had gathered together the remnants of the garden into one pile and it was in flourishing condition. The garden, however, disappeared within several days although she had been given suitable substrate. July 27 she was given a much larger piece of the same *Acromyrmex* garden which also had four minima workers. These were about as long as one of her mandibles and were hostile but she ignored them and they remained attached to the garden. The female immediately went up, feeling and tasting the garden in several places and biting off small pieces. She remained several days in attendance on the garden but died July 31. It was difficult to see why she should die since the garden appeared suitable. A female removed at the same time for control died July 25 without being given any food.

A small piece of an *Atta* garden with a few minima workers was placed in a tube of potato dextrose agar medium July 19. By July 22 practically no mycelium remained and the substrate reduced to a light brown, juicy mass. One worker had died. July 24 conditions were as before but by July 26 all ants were dead and the garden disintegrated.

Biology. — The populations of the large *cephalotes* colonies in Trinidad and other countries have only been estimated. The labor required in collecting all of the ants from a colony would be prodigious. If an *Acromyrmex octospinosus* colony consisted of 9000 adults, a *cephalotes* colony would undoubtedly consist of hundreds of thousands. Though these large nests must have a number of queens 10 gardens were once examined thoroughly without finding more than one female. Each, however, contained several or a few males. Males and alate females appear in the nests in May and June. The much more numerous gardens would necessitate a great number workers to care for them. The larvae and pupae are often swathed in mycelium. The feeding and care of them is described above from observation nests.

There is a marked division of labor in this polymorphic species. The smallest minima commonly remain in the fungus gardens and assist in the care of the fungus and brood. Slightly larger minima or small media may ride on the leaf sections carried by maxima workers and may also assist in the excavation of soil. It was this size that was chiefly excavating one night at Mayaro with only an occasional media worker. The media carry leaves at night as well as during the day. Both this size and the maxima cut leaves and are the chief gatherers of substrate. The soldiers usually remain in the nest and come forth at any disturbance to attack the intruder. They may also occasionally accompany the workers on their foraging expeditions but do not cut leaves.

Although the bachac was primarily a forest species it is commonly found on plantations in open situations. The ants usually nest in clay and only firm soil would withstand their excavations without collapsing. The bachac is both diurnal and nocturnal. Colonies, however, show individual variation in this habit. A Mayaro Bay colony that was active at 9 p. m. in bright moonlight carrying back leaves was found at 5:30 a. m., at dawn, to be just starting out, all workers going away from the nest without burdens. The ants had evidently worked only the first part of the night.

Predators include the large, silky ant-eater, *Tamandua longicauda* Wagner, and the giant toad, *Bufo marinus* L. It is probably this ant-eater that Urich (1923, p. 4) refers to as having these ants in its stomach. Spiders may also be predators as described below.

The most important enemies of the bachac, however, are

flies of the family Phoridae which are parasites. The names of those described in this paper, here and in observation nests above, are unfortunately not available. The flies are in the hands of Professor C. T. Brues for determination. Whenever a bachac nest is exposed the flies are found hovering over the ruins of the gardens. They also are to be found about the entrances of undisturbed nests and running about exhausted substrate.

A phorid was watched at an opening to a large Mayaro Bay nest on an overcast morning. The fly was hovering over medium-small workers which were bringing up soil from below. It persistently darted down to attempt oviposition on five or six of these workers. The ants did not rear up on their legs and seemingly paid no attention to it. Several other flies were resting near the opening and a small spider was captured as it attacked a small worker.

At a nest at an elevation of 1800 ft. near Morne Bleu a large phorid appeared to oviposit on three medium-sized workers in succession and started to attack another when I disturbed it by picking up the third ant. Smaller phorids were attacking smaller workers. The ants acted deathly afraid of the flies, rearing upon their legs with mandibles outspread and antennae waving when the flies came near. The flies chose their time well, hovering over until a quietly moving ant of the right size presented an opportunity. Then the flies would dart in quickly. The first phorids I watched darted at the apex of the ant's gaster. The ants savagely turned around. The majority of the ants and all of the later ones appeared to be attacked on the head or "neck". The ants would then rear up as though agonized, with the head turned back over the thorax. In doing this several ants lost their grip on the clay sides and fell down. All acted as though parasitized and it was a striking sight to watch.

At a Nariva Swamp nest being excavated, there were no phorids present at first. Then an occasional fly of one or two sizes appeared and attempted oviposition in the shade on ants. A tiny black and white phorid attached itself to a soldier dorsally between the petiole and the epinotum.

Phorids hovered about a Basin Hill nest and attempted oviposition on the heads of the soldiers, above where it joined the thorax, but the ants did not show ill effects. As a rule the large phorids attacked the maxima and soldiers while the small phorids attacked the media. Two recently dead *Pachycondyla crassinoda* ants were collected here April 1 and placed in a vial.

On April 9 fully 10 phorid fly larvae were found to have pupated in the cotton plug, where most became dessicated. By April 26 a dead and damaged adult phorid and a large live one appeared.

A large passalid beetle was found freshly dead by an *Atta* colony April 22 and was placed in a container. By April 29 a number of phorid pupae had appeared and one adult fly. 16 phorids emerged by May 11, four more in the next two days and by May 16, 23 adult flies had emerged. There were two sizes, presumably representing the sexes. Three flies were placed in each of three vials containing *Atta, Acromyrmex* and a live passalid beetle, respectively. One phorid survived to May 27 but the others and all of the ants died. None of the ants or the beetle appeared to have been parasitized under these abnormal conditions.

The refuse heaps of dead ants and exhausted substrate often have phorid flies, staphylinid beetles, spiders and other arthropods. When this refuse is placed in a closed container phorids, staphylinids, collembola, mites and spiders appear. One species of fly was noted as being black with silver bands on the abdomen.

Mites are also found on the ants in nature as is customary generally. These live on all sizes of workers.

Observations on the activities of lepismids and cockroaches often found in the nests are described under Observation Nests.

Other animals take advantage of these large nests but are mostly commensals or of neutral importance. Numerous species of ants are regularly found nesting in the soil thrown out by the bachacs or nesting in the soil about the fungus gardens. Other species of fungus-growers like those of the genera *Trachymyrmex* and *Mycocepurus* are described above. A small species of *Pheidole* nested a few centimeters down from the center of the surface of an *Atta* nest and a similar distance above a big fungus garden. The ants had to pass the bachacs as they foraged but were tolerated. A tarantula in one nest is also described above and another was seen running down a tunnel which was vertical for nearly one meter. A pupal cicada wich could move its legs was buried in the damp clay directly beneath a fungus garden. Large larvae locally known as "grugru" also may be found in the clay of nest. Wasps are sometimes seen hovering over the nest, probably for the purpose of gathering the fresh moist clay; *Eumenes* wasps were taken hovering about

three nest in the Nariva Swamp on April 21 and 22. The ants tolerate termites that may be eating wood buried in the nests or may have tunnels in the soil.

Table I.

Analyses of the soil about attine nests submitted by the author and made by the Imperial College of Tropical Agriculture.

Ant	No.	Moisture % *		Texture			Reaction pH	
		(1)	(2)	M. P. S. %	Sand %	Index of Texture	Norm:	Exch:
Mycocepurus trinidadensis	103	19.8	24.6	36.5	21.4	32	4.0	3.8
Myrmicocrypta buenzlii	105	24.7	32.8	32.3	31.5	26	4.8	4.2
Apterostigma urichi	107	72.5	262.5	Plant Material			4.0	3.4
Trachymyrmex urichi	87	10.4	11.8	21.9	34.0	15	4.7	3.9
Atta cephalotes	82	29.4	41.6	38.1	19.6	34	4.2	3.8
Atta cephalotes	112	8.4	9.2	23.9	48.0	14	7.8	7.6
Atta cephalotes	122	44.2	79.2	28.2	39.5	20	6.2	5.7
Acropyga berwicki**	145	—	—	40.1	30.7	34	6.0	5.6

*) Moisture (1) calculated as per cent. fresh sample.
Moisture (2) calculated as per cent. oven-dried sample.
**) A coccid-tending ant.

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