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NOTES ON THE HABITS OF SOME PANAMANIAN
STINGLESS BEES (HYMENOPTERA,
APIDÆ)

By CHARLES D. MICHENER¹

ASSOCIATE CURATOR, AMERICAN MUSEUM OF NATURAL HISTORY

The purpose of this paper is to report some more or less miscellaneous observations on stingless bees (*Meliponini*) made during a fourteen-month period in Panama. A total of 169 nests of twelve species were examined.

OLD PANAMA

A particularly favorable locality for the study of these bees was found in the ruins of Old Panama, located on the Pacific coast of Panama a few miles east of Panama City. These ruins consist of more or less crumbling stone walls and buildings in which there are many crevices, holes, and openings of various sorts where stingless bees nest. A total of 141 meliponine nests were found among the ruins. This is obviously an incomplete count, especially for the *Meliponæ* whose nest openings are small and inconspicuous. Many nests of other species must also have been missed, especially where there are high walls still standing.

¹ The author is much indebted to Mr. Herbert F. Schwarz of the American Museum of Natural History for the opportunity to read a portion of his forthcoming treatise on the genus *Trigona*, and for identifying all the bees discussed in this paper. Thanks are due to Dr. Herbert C. Clark, Director of the Gorgas Memorial Laboratory, Panama City, R. P., for the use of facilities of that Laboratory. Many of the observations on the nests among the ruins of Old Panama were made and recorded by my wife, Mary H. Michener.

The ruins studied are all within an area of about one quarter of a square mile, but do not occupy the whole of a square of that size, being scattered, for the most part, along two sides of the square.

Most of the nests found were in the masonry walls erected several centuries ago. However, the single nest of *Trigona fulviventris*, two of the nests of *Trigona pachysoma*, and one of the nests of *Trigona jaty* were in the trunks of trees growing among the ruins.

The distribution of the various species among the ruins is by no means uniform. In order to show this, the ruins were divided into five areas (lettered A to E) each having approximately the same amount of wall space. The number of nests of the various species found in these areas are shown in Table I.

TABLE I

NUMBER OF NESTS OF VARIOUS SPECIES OF MELIPONINI FOUND IN FIVE AREAS AT OLD PANAMA

	A	B	C	D	E	Total
<i>Melipona favosa phenax</i>	3	4	0	3	1	11
<i>Melipona interrupta triplariidis</i>	1	1	0	0	0	2
<i>Trigona testaceicornis perilampoides</i>	26	20	1	2	0	49
<i>Trigona jaty</i>	6	3	3	11	6	29
<i>Trigona testacea</i> subsp.	11	6	0	19	0	36
<i>Trigona nigra paupera</i>	0	4	0	3	0	7
<i>Trigona pachysoma</i>	1	0	0	4	0	5
<i>Trigona fulviventris fulviventris</i>	0	0	0	1	0	1
<i>Trigona corvina</i>	0	0	0	1	0	1
	48	38	4	44	7	141

Areas A and B are adjacent to a rather large mangrove swamp, a small coconut grove, and a considerable area covered with brush and small trees. Area D contains a considerable number of trees and is adjacent to some partly wooded land. It is suspected that the sources of food thus provided explain the large number of nests in these areas. The other areas are largely surrounded by grasslands with few trees.

In addition to species considered below, several species of

Trigona have been collected on flowers at Old Panama, but since their nests were not found, they are not discussed here.

FLOWER VISITING HABITS

Perhaps because of the need by these colonial bees for a continuous food supply in a region where very few plants bloom continuously throughout the year, the species of meliponine bees are not oligolectic. However, among the flowers available at any one time, they do have very definite preferences. Furthermore, different species have different preferences. The following examples illustrate this point:

On March 15, 1945, a nest of *Melipona favosa phenax* was found at Old Panama within ten feet of a blooming *Solanum* bush and about 150 feet from a small tree of *Dalbergia brownii*, both of which attracted *Melipona interrupta triplaris* which was collecting pollen from the *Solanum*. Yet no *Melipona favosa phenax* were seen on these flowers. This species was flying 200 or more feet to flowers of an unidentified herbaceous plant. In January *Melipona favosa phenax* had been feeding chiefly on *Simsia grandiflora*, plants of which were dead in March.

In January, 1945, on Aneon Hill, Canal Zone, *Trigona testaceicornis perilampoides* was abundant on *Simsia grandiflora*. *Trigona fulviventris* was visiting flowers of *Mentzelia aspersa* a couple of feet away. *Trigona testacea* subsp. was visiting the *Mentzelia* as well as *Ipomoea triloba*, growing equally close to the other plants, but only rarely did it visit *Simsia*. The few *T. jaty* seen were on none of these plants but on flowers of a small weed growing about five feet away.

At Old Panama *T. fulviventris* was never seen visiting flowers of herbaceous plants growing near its nest, although these same plants were visited regularly by *T. jaty* and *T. nigra paupera*.

Also at Old Panama specimens of *Trigona nigra paupera* were seen visiting flowers of an herbaceous plant growing about four feet from a wall containing nests of *Trigona testaceicornis perilampoides*. The latter species was absent from these flowers, but was collecting from flowers of unidentified trees growing at the edge of a tidal swamp 200 feet away.

LONGEVITY OF COLONIES

It was impossible to make direct observations on the longevity of colonies of stingless bees during a period of only fourteen months since most colonies apparently live for several years. However, some observations were made which have some bearing on studies of longevity.

A number of nests of *Trigona testaccicornis perilampoides*, *T. jaty*, and *T. testacea* subsp., and one of *T. pachysoma* were found abandoned, the colonies evidently extinct, after having been earlier observed in an active condition. One nest of *T. t. perilampoides* was observed and found active on March 23, April 9, 20, and 23, and June 30, 1945. On September 28 no bees were seen at the nest entrance, and the entrance tube was weathered and broken. The colony was obviously extinct. On December 31 the same nest entrance was repaired, looked quite normal, and an active colony of the same species was present. Apparently the nest was reoccupied by another colony. This is good evidence that the observation of bees in a given nest at widely separated dates is not proof of continuous occupancy, nor do such observations necessarily shed light on the longevity of colonies.

Even more striking is the single *Trigona* nest which was observed almost daily. This nest of *T. jaty*, located in the Gorgas Memorial Laboratory building in Panama City, was occupied by three different colonies of this species in fourteen months! This was the only nest found in the vicinity. In December, 1944, large male swarms were around this nest. As they were present day after day beside the main entrance of the Laboratory, someone sprayed them with insecticide and then opened the small valve box in which the nest itself was located, and sprayed the bees and the nest. Later the nest, including the entrance tube, was removed from the valve box, but some of the wax remained.

For several months no bees were seen in the vicinity. However, about April 25, 1945, about one hundred *T. jaty* arrived at the old nest site. Two days later they had built a small entrance tube and some sheets of wax in the valve box (which could be opened slightly without seriously disturbing the bees). From May 2 to 8, males swarmed in front of the nest each day. Obviously these males had not been reared in this nest, which contained no brood

cells. Honey pots were being constructed on May 5, and on May 15 some honey was found in them. By May 20, a single small brood comb was being built. No queen was ever seen with this colony, and it became progressively smaller, until by July, 1945, it was extinct.

Again no bees were seen near this nest until about October 15, 1945, when a new and large colony suddenly appeared in the valve box and built a nest. In December, 1945, and January, 1946, this nest would not have been distinguishable from the nest in the same place in December, 1944. Male swarms were never seen about this last colony. A physogastric queen was noted in it in January.

It would be interesting to know why this same cavity (valve box) was selected repeatedly for a nest site, when there was an abundance of other, presumably suitable, similar cavities in the vicinity. Possibly a lingering nest odor attracted new occupants to this site.

Melipona favosa phenax Cockerell

Eleven nests of this species were found, all in the crumbling masonry walls of Old Panama. Nest openings were observed from 2 to 20 feet above ground. The openings are typically round, 6 to 7 mm. in diameter, but in one instance where the entrance was in a narrow crevice, the opening was 4 mm. in vertical diameter by 8 mm. in horizontal diameter. Inside the relatively small entrances the passage ways enlarge to 10 or 15 mm. in diameter if space between stones permits.

The entrances do not project in tubular fashion from the walls as with many of the species of *Trigona*, but are flush with the surfaces of the walls. In one nest the passage way extending from the entrance into the nest was exposed for the outer two inches, being attached to the upper surface of a large horizontal crevice.

The material of which the nest entrances are made looks like dried mud, often with some groups of short brown fibers scattered about. The mud-like substance is from 3 to 5 mm. or even more in thickness. Its origin has not been determined. It may come in part from old termite nests which are numerous within the walls. One *Melipona* nest was obviously built, at least in part,

in a small termite nest and the others might well reach termite nests and passages deep within the walls. Material to repair a damaged nest entrance was brought, as moistened pellets, from within the nest.

Bees pass in and out of the nests of this *Melipona* in rather small numbers. The impression is of very small colonies. The nest openings are quite constantly guarded during the day. The head of a worker bee is almost always to be seen blocking the nest entrance: At the approach of another *Melipona*, either from the outside or inside, the guard backs into the larger part of the passage behind the opening and allows the other bee to pass. One nest examined after dark was open and apparently unguarded.

Groups of from twenty-five to seventy males of this species were several times observed, either buzzing around or more often resting in a more or less dense mass on the walls at Old Panama. At no time was a nest opening discovered close to such a group. Male swarms² of this nature were observed on March 25 and 27 and December 20, 1945. One such swarm noted on March 25 at 2:00 P.M. was in the same location on March 27 at 9:45 A.M. The significance of this activity is not clear.

Melipona interrupta triplaridis Cockerell

Only two nests of this species were found, both in the walls of Old Panama. The nest entrances are distinguishable from those of *M. favosa phenax* only by slightly larger size (nearly 12 mm. in diameter). They are guarded in the same way as those of that species.

Trigona testaccicornis perilampoides Cresson

Fifty-two nests of this species were examined, forty-nine of them in the walls of Old Panama, three in the bases of large trees at Quarry Heights, Ancon Hill, Canal Zone. Nests were found from 1 to 20 feet above the ground. The entrance tube of each

² The term, swarm, in this paper is used for aggregations, commonly entirely of males but sometimes of workers, which are found most often in front of nest entrances. The individuals in such a swarm commonly remain in flight for long periods, sometimes giving an impression similar to that of a swarm of chironomids. Dispersal swarms such as occur in *Apis*, consisting of a queen and group of other individuals, are well known in the Meliponini but were not observed by me.

nest is made of a thin, rather soft and pliable brown wax or wax-like material, usually with some small holes toward the apex so that the wall of the entrance tube sometimes appears almost lace-like. The tubes project from 3 to 20 mm., the distance as measured on different sides of any one tube often varying greatly because of the irregularities of the rocks in the walls at Old Panama. The average of the measurements of the longest sides of 18 tubes was 10 mm. In diameter the tubes ranged from 5 to 15 mm., the mean of the maximum diameters of 19 tubes being 12 mm. Usually the entrance tubes are not quite circular, the maximum diameter commonly being 2 mm. greater than the minimum. One entrance having maximum and minimum diameters of 15 and 5 mm. was located in a crevice between two rocks. One tube was found which projected straight upward from the top of a wall instead of horizontally from the side as usual.

This is a timid bee. Throughout the day mouths of the entrance tubes are lined with bees facing outward in a guard-like manner, but at any rapid movement of an observer within several feet of the nest they quickly withdraw. Because of the small size of the bees in comparison to the nest opening, the "guards" do not nearly fill the entrance, as with several of the other species. They move to one side and inward to allow passage of other bees in and out of the nest, but do not back in out of sight.

Both at night and in the day time, a steady humming sound can usually be heard from any nest of this species. This seems to indicate that there are fanners inside the nest. The individuals visible around the nest entrance do not fan, however, as in the case of *Trigona fulviventris*. Salt (1929) has noted fanning in *T. capitata zezmeniae* Cockerell.

Trigona testaceicornis perilampoides is the only meliponine that I have observed to close its nest at night. Evening activities of eight nests were observed between March 17 and April 10, 1945. The pattern was the same in all cases. Sometime before 6:00 P.M. the regular diurnal foraging flights ceased. Considerable activity continued, however, bees flying from the nest opening for a few feet, apparently dropping waste of some sort, and then returning to the nest. At 6:25 or 6:30 P.M., these short flights stopped. The inner wall of the entrance tube, at the outer end,

was lined at this time with bees manipulating the edge of the entrance tube with their mandibles, gradually drawing it out, without the use of additional wax, into anastomosing processes and arms which by 6:50 or 7:00 P.M. formed a more or less lace-like covering at the apex of the entrance tube. At this time it was almost dark and the bees withdrew out of sight from the nest opening. The largest perforations in the "lace" were in the center, and sometimes a hole nearly one-third as large as the day-time diameter of the opening was allowed to remain.

Males have been seen swarming² in front of nests at all times of day, and at all seasons of the year. Perhaps because swarming usually occurs on sunny days, many more swarms were seen in the dry season (January to April) than during the wet season. On windy days some of the swarming males frequently cling to plants if there were any present in front of the nest. In the evening swarms disappear between 4:30 and 6:00 P.M. The swarms are often large, consisting of hundreds of individuals, and produce a surprisingly strong buzzing sound for such small bees. So far as has been observed, only a small percentage of the colonies swarm at any one time. Thus on March 25 there were swarms in front of only 3 out of 30 nests examined. A week later these three nests were quiet, but five others had swarms. Sometimes a nest with a large swarm will have a neighbor only a few feet away whose activities are apparently uninfluenced. A single nest has been observed with a swarm on ten different days during a year, and doubtless actually swarmed many more times. Other nests apparently produced swarms only rarely. While Salt (1929) records swarms of workers in another form of this species, workers were never found in swarms in Panama.

On one occasion a single worker was seen removing wax from the entrance tube of an abandoned nest. It worked with its mandibles removing small pieces of the material of which the tube is made. After a few minutes it flew away. Later the same or another worker was again removing material from the same abandoned nest.

The relation of this species to *Lestrimelitta limão* will be discussed under the latter species.

Trigona jaty Smith

Thirty-four nests of this species were observed. Of these, twenty-eight were in the stone walls of Old Panama; one in a tree trunk at the same place; one in a building in Panama City; two in tree trunks at Pacora, Panama Province; one in a large wooden fence post at Guayabalito, Colon Province; and one in the stone walls of the ruins of Fort San Lorenzo, Colon Province.

Nests were found from 1 to 22 feet from the ground. The entrances are tubular, as a rule more slender than those of *Trigona testaceicornis perilampoides* and are made of soft, light brown wax, about half of them tinged with yellow at the apices. The tubes usually have a few small holes in the sides toward the apices. They projected from 5 to 30 mm., the average of the lengths of the longest sides of nineteen tubes being 11 mm. The entrances are only roughly circular. A particularly large one had maximum and minimum diameters of 14 and 12 mm., but several had corresponding measurements of 6 and 5 mm., and the average of the maximum diameters of eighteen nest entrance tubes was only 7 mm.

The nest entrances of this species are not guarded by bees which stay in the entrance tubes, as with *T. testaceicornis perilampoides*. The only bees ordinarily seen in the entrance tube of a nest are those actually passing in or out. However, outside of the opening of almost any nest, and within a few inches or a foot of it, one to eight or ten worker bees hover and dance in the air, in a manner suggesting swarming males. These bees remain in the air for long periods without alighting. At the approach of an observer, they often disperse but soon return and resume their dancing. Since other workers passing in and out of the nest are not approached by the dancing individuals, it does not seem probable that they function as guards.

Numerous nests of this species observed at night were open, and the bees out of sight within.

Males swarm in front of the nests frequently, sometimes in immense numbers. Swarms have been observed at all times of the day on sunny days during the months from December to May. Unlike the swarms of other species studied, those of *T. jaty* quickly disperse if disturbed, but reassemble in a few minutes.

A few workers are often present in collections made from swarms. It is probable that these are the hovering workers previously discussed, which at times of swarming, become mixed with the males. At times most of the members of a swarm are gathered together in a more or less compact mass resting near the nest. This phenomenon was observed particularly when the nest entrance and vicinity, were in the shade. At Pacora a large swarm of workers was observed in front of a nest entrance in February.

Additional observations on *T. jaly* are described in the section on longevity of colonies.

Trigona nigra paupera Provancher

Seven nests of this species were observed, all in the walls of Old Panama. They were found from 2 to 12 feet above the ground. The entrances do not project in tubular fashion although in two cases a collar about 1 mm. high surrounded part of the opening. These collars and the linings of the openings consist of a somewhat shining, hard, dark brown or blackish material. The openings were circular, or one diameter was at most 1 mm. shorter than another. The maximum diameters of the seven nests ranged from 6 to 8 mm. Colonies of this species appear to be small, not more than two or three individuals usually being in sight at a time.

At most times during the day one or two bees can be seen partially filling the nest entrance and facing outward. One of these "guards" backs out of sight into the nest to allow the passage of other bees. Returning bees fly around near the nest opening as though seeking the hole, seldom plunging directly into it. At the approach of an observer the "guards" usually disappear into the nest, not reappearing for some time. The presence of an observer near the nest also interferes with the return of foraging bees, which hover at a distance from the nest or slowly work their way toward it.

One nest observed at night was not closed, nor were any bees visible at the entrance.

All individuals seen at the nests in Old Panama had black abdomens. However, all individuals collected for me by Dr. Harold Trapido from a nest between the walls of a house at Juan Mina,

Canal Zone, had the abdomen whitish above. Those having the latter coloration are commonly considered callows. However, it seems possible that there is a genetic basis for the color differences, some colonies consisting wholly of black specimens, some consisting wholly of individuals with white, and some colonies being mixed (Salt, 1929).

Trigona pachysoma Cockerell

Five nests of this species were studied at Old Panama. Three were in the stone walls, two in trunks of large trees. They ranged from two to thirty-five feet above the ground. The entrances in this species are tubular, 25 to nearly 100 mm. long, nearly 20 mm. in diameter, of thin, rather soft, gray, wax-like material.

Workers from one nest, which was disturbed, attacked after the manner of *T. corvina* and *T. testacea* subsp. The same nest observed at night was not closed, nor were any bees visible. This nest was observed as active several times from March to July, 1945. However, on November 10 the entrance was in poor repair and only two or three bees were seen going in and out. Two phorid flies were seen to enter the nest, suggesting that there was decomposing matter within. Two weeks later no sign of life was seen at this nest.

Trigona fulviventris fulviventris Guérin

Two nests of this species were observed. One was at ground level at the base of a large buttressed tree at Old Panama. The entrance tube, of an exceedingly hard dark brown material, was about 25 mm. in length with a vertical diameter of 40 mm., and a horizontal diameter of 50 mm. The other was about a foot above the ground in a tree at Pueblo Nuevo, near Panama City. The nest entrance was similar to that described above but somewhat smaller.

After the destruction of the entrance tube at the Old Panama nest, it was slowly rebuilt and did not reach its previous size for more than six weeks. The entrance tubes of other species studied, particularly those utilizing soft wax, are rebuilt in a very few days.

The colonies of this species which were observed were appar-

ently very large, many bees being visible at one time. In contrast to other species studied, the nest entrance is lined during the day with many bees constantly fanning the air with their wings. The noise from nests of *T. testaceicornis perilampoides* suggests that fanners may be present but they are not at the nest entrances. In *T. fulviventris* the fanners do not move to make way for bees returning to the nest, as the entrance is large enough that the latter can fly directly in. Many of the bees leaving the nest, however, fan as they move outward along the inner walls of the entrance tube. It is possible that all the fanners are merely individuals on the way out of the nest. Some, however, fan for long periods of time, others for only a moment before flying away, and still others fly without stopping to fan at all.

Regardless of how much their nest is disturbed, these bees do not attack. However, they tend to go about their activities in an apparently normal fashion in the presence of an observer, unlike some of the timid species.

This was the only species noted at Old Panama which remained active during a light rain. Some workers were leaving the nest, and others, many of them laden with pollen, were returning in spite of the rain.

Males were noted at both nests of this species, at one on February 22 and at the other on July 23. The swarms consisted of only twenty-five to fifty males, and of these only about half were flying about at any one time. The remainder were scattered about resting on leaves, twigs, and tree trunks within eighteen inches of the nest entrance.

Trigona testacea subsp.³

Forty-four nests of this bee were examined. Thirty-six of them were on the walls of Old Panama; four on the similar old walls of Fort San Lorenzo, Colon Province; and four at Juan Mina, Canal Zone.

Nests of this species, like those of *T. corvina*, are built more or less exposed, rather than completely enclosed in a cavity (except for the entrance tube) as with the other species discussed in this

³ Mr. Herbert F. Schwarz tells me that this is an undescribed variety of *T. testacea*. It is the form previously called *T. testacea cupira* Smith by Schwarz (1934).

paper. Unlike the nests of *T. corvina*, those of *T. testacea* are rather delicate and are usually not built where fully exposed to the weather. At Old Panama and Fort San Lorenzo a few nests were located in the open on the sides of walls, but most were under overhanging ledges or in holes, of which there are many, in the walls. At Juan Mina one was under the eaves of the dock, two were inside a chicken house, attached to the roof; and one was attached to small branches of a grapefruit tree. Orchid roots formed a dense mass on top of the latter nest, protecting it from the weather.

Nests were observed from 5 to 22 feet above the ground. The nests are irregularly shaped gray masses resembling certain termite nests* attached on one or two sides to stones or other surfaces. On one side of each nest, usually near the lowest part of the nest, is the broadly funnel-shaped entrance. The funnel and indeed the entire outer wall of the nest is made of a hard, slightly brittle material, dark gray in color. The flaring edges of the funnel are sometimes flush with the surface of the nest, but usually project 5 or 10 mm., and occasionally as much as 15 mm. The outer end of the funnel is from 25 to 40 mm. in diameter. It is ordinarily round except for small irregularities and sometimes many slender processes and projections on the margin. The opening in the throat of the funnel is small, 8 to 12 mm., in largest diameter, usually somewhat elongated in the horizontal diameter.

Two nests which were opened are described in greater detail. One from under the eaves of the river dock at Juan Mina was constructed as usual in this species, being very irregular and flattened against the surfaces to which it was attached. The main portion of the nest was on top of a more or less horizontal rafter. A smaller portion extended thence downward on the side of the rafter. The nest opening was near the lower end of this vertical portion. The vertical portion of the nest consisted mainly of passageways and honey pots. Many of the latter were represented by bulges visible from the outside. Some of the pots were full of solid pollen, others contained very thin, clear honey. The horizontal portion of the nest on top of the rafter contained no

* Nests of this species have often been described as being in termite nests. The bees themselves clearly built the nests studied by me.

pots. In its center was the brood chamber, containing five or six horizontal combs. The material used for the outside of the nest and for the passage ways was rather thin, hard, and brittle. That used for the brood combs and the honey and pollen pots was soft and pliable. The queen was found at the edge of the brood chambers.

Another nest, the largest that I have seen of this species, was irregularly spherical in shape and attached to two small branches of a grapefruit tree. These branches were about three inches from one another, and passed through the upper portion of the nest, so that the nest hung down beneath them. A twig from one of the branches passed through the center of the nest. A dense mass of orchids grew on top of the nest and their roots formed a mass an inch thick covering the entire top of the nest and protecting it from weathering. Many orchid roots extended down through the nest.

The nest was about eight inches in diameter. Its entrance was in the lower part of one side. Hanging down beneath the entrance was a nodulose mass consisting of a large number of empty chambers, connecting with one another and with the interior of the nest. The entire outer surface of the nest, but especially that of the lower half of the nest, was nodulose. Inside of each nodule was a chamber, connected with the interior, and empty except sometimes for a few bees. Pots, made of thin soft wax, were mostly located just outside of the brood chamber and contained either clear liquid honey or solid pollen. In the spherical brood chamber were thirteen horizontal combs. The types of wax used were the same as those found in other nests of this species.

The nest contained about 2900 bees (2876 by count, but a few escaped) and weighed four pounds.

When nests of this species are disturbed, workers swarm out in great numbers and attack the intruder. *Trigona pachysoma* and *T. corvina* are the only other species studied having similar behavior.

Throughout the day several bees can always be observed, facing outward, only their heads and forelegs visible, in the throat of the funnel-shaped entrance. When a foraging bee is leaving the nest or returning, one of the guards backs into the nest to make way for it.

This species is chiefly active in the morning and evening, continuing activity later than other species, or until about 6:45 P.M. (March). At midday, at least on hot days, no bees can be seen entering or leaving the nests. At night the nest entrances are not closed, nor are "guards" in evidence. However, if the nest is disturbed, bees will swarm out and attack as in the day time.

I have not seen males swarming in front of the nests of this species and suspect that they may not do so. On April 9, 1945, at 11:00 A.M. several males were found resting on the rocks within about 6 inches of a nest. When disturbed they buzzed about but did not attack as the workers do.

Trigona corvina Cockerell

Seven nests of this species were examined, one at Old Panama, one in Panama City, four at Juan Mina, Canal Zone, and one at Santa Rosa, Colon Province. All were built around, and supported by, branches of trees and were from eight to forty feet above the ground. In external features all agreed with the single nest which is described below.

This nest was cut down from a grapefruit tree at Juan Mina on April 27, 1945. It was ovoid, dark gray, twenty-two inches high and seventeen to eighteen inches in horizontal diameter, and weighed sixty-nine pounds. It was built around an approximately vertical branch about two inches in diameter which passed through the nest near its center and gave off several smaller branches which issued from the sides of the nest.

The entrance was about an inch in diameter and located near the lower end of the nest. Beneath the entrance was a beard of small gray filaments 2 to 4 mm. in diameter and 10 to 40 mm. long.

The outer layer of the nest was brittle, 1 or 2 or sometimes 3 mm. in thickness. This layer was supported by many small columns, sometimes irregular but often round in cross-section and 2 to 5 mm. in diameter. Thus there were extensive interconnecting passageways beneath this outermost layer. Inside of these subsurface passages the nest material was thick, not at all brittle, and required a hatchet and considerable prying to cut and remove large pieces. This thick wax was to some extent in distinct layers,

but the layers differed in number, thickness, and distinctness in different areas. Where distinct they were connected by irregular columns and the spaces between layers were connected by holes through the layers. The layers were one-fourth to three-fourths of an inch thick, or when not distinct formed a total thickness of two and one-half to three inches. Many holes penetrated the outermost layer of strong material to make connection with the space beneath the outer skin of brittle material.

This arrangement must serve a useful purpose for at the attack of an enemy (e.g., the author) the outer thin coating is promptly broken and bees can swarm out from many parts of the nest to attack the intruder. Yet because of the very thick and strong wax inside, the nest as a whole is very strong and would not be seriously damaged by storms.

Among the inner layers of hard wax was much yellowish solid material, apparently pollen, so that in cross-section some parts appeared stratified or laminated with it. This material was firm although not so strong as the wax, and some of it looked as though it had been in the nest for a long time. Inside of the layers of strong hard material were one to four (in different areas) irregular layers of honey pots, made of soft dark brown wax, and almost all sealed and completely full of dark-colored honey.

Inside of the honey pots was the brood chamber, an ovoid space about fourteen inches high and nine inches in horizontal diameter. This space was filled with horizontal combs of brood cells. These combs were irregular, so that no one completely crossed the chamber; some were very small, and many had holes in them. Thus there was ample opportunity for passage up and down among the combs. An imaginary vertical line through the brood chamber passed through about thirty combs. The margins of the combs were connected at various points with the walls of the brood chamber, and there were occasional vertical supports between combs. The cells of the combs were 3 mm. in diameter, 5 to 6 mm. high, and although round in cross-section, were arranged in definite regular rows as if the cells were six-sided. It was estimated that there were 82,000 brood cells in this nest.

Here and there in irregular portions of the combs, especially near the edges of the brood chamber, was a queen cell. These

were paler than other cells, 9 mm. long by 6.5 mm. wide, often somewhat irregular in shape.

A total of 6529 adult bees were taken from this nest. (The number that escaped is unknown.) Of the 5201 retained for study, two were virgin queens, 417 males, and 4782 workers.⁵ The physogastric queen, if present, was not found.

Trigona corvina is often a serious pest of citrus trees in Panama. The workers gather on the tender growing leaves and cut the margins with their mandibles. Then they apparently collect the liquid exuding from the damaged leaf margins. Such damage is sometimes so continuous as to almost prevent the growth of an orange tree.

This species and *T. testacea* subsp. are known as zagañas by the Panamanians.

Trigona pallida pallida Latreille

One nest of this species was found on the Rio Pescado arm of Gatun Lake, near Mendoza. It was in a dead log, thoroughly infested with termites, which was lying on the ground beneath some bushes. The nest entrance was a round tube about an inch in diameter, projecting about an inch from the log, and made of rather hard grayish black material.

Trigona latitarsis Friese

One nest was found at an altitude of 2000 feet on Cerro Campana, Panama Province. The bees' nest was in a large termite nest full of living termites, located about ten feet above the ground on a small tree. Male bees were swarming in great numbers in front of the nest opening when the nest was found on August 5, 1945, at about 3:00 P.M.

The nest entrance consisted of a tube of soft, delicate yellow wax projecting about 60 mm. from the wall of the termite nest, and enlarged near its base on the lower side to form a large pouch.

Trigona clavipes dorsalis Smith

One nest of this species was found about one foot above the ground level in the trunk of a tree on Barro Colorado Island, Canal Zone. Another was found about ten feet above the ground

⁵ These counts were made by Mr. Herbert F. Schwarz.

in a tree trunk near Juan Mina, Canal Zone. Nest entrances in both instances were quite long (in one about 75 mm. long), tubular, about 10 mm. in diameter, brown basally but soft and yellow apically. The walls were thin and provided with numerous small perforations toward the tip of the tube.

Lestrimelitta limão (Smith)

Although no nests of this species were found, some information concerning its nest-robbing activities at Old Panama seems worth recording. The species was observed on ten occasions (in the months of March, April, May, July, and December) in the mornings between 9:00 A.M. and 11:30 A.M., apparently robbing nests of *Trigona testaceicornis perilampoides*. It was not observed to molest any other species.

The arrival of a group of *L. limão* at a nest of *T. t. perilampoides* was never observed. On April 1, however, a group of workers estimated at 50 specimens was observed flying around a small area of wall and the base of an adjacent tree. It was suspected that this represented a group searching for a nest to rob.

On other occasions nests of the *Trigona* were observed as they were being robbed by *L. limão*. The entire process of robbing a nest of *T. t. perilampoides* evidently requires two or three hours. A nest being robbed is full of workers of *L. limão*. Only very rarely is a *Trigona* seen among them at the nest entrance. The *Lestrimelitta* workers line the entrance tube, much as the *Trigona* do normally, except that the individuals of *Lestrimelitta* chew at the wax of the entrance tube, so that by the time they have left, the tube is shortened and irregular. None were actually observed to fly away with wax. These individuals of *Lestrimelitta* also act as guards, keeping out returning *Trigona* workers. At the approach of a *Trigona*, one or more of the *Lestrimelitta* guards rears up and opens its mandibles in a threatening manner. The *Trigona* flies away and hovers near the nest, often trying several times, only very rarely successfully, to enter the nest. As a result, a considerable swarm of workers, many of them carrying pollen, usually develops outside of a nest being robbed. Such a swarm often has the appearance of a swarm of males.

During the period when the *Lestrimelitta* are in the *Trigona* nest, some individuals of the former can be seen going in and out.

During the last half hour that the robbers are there many more go out than come in. Although as many as thirty have been seen to leave in two minutes, there is no group or mass exodus. Finally only one *Lestrimelitta* is left in the nest entrance, keeping the *Trigona* from entering. At this stage the remaining *Lestrimelitta* spends almost its entire time lunging with open mandibles at *Trigonas* which are trying to get in their nest. When all the *Lestrimelitta* are gone, the *Trigonas* return quickly to seemingly normal activity, and within a day or two the entrance tube is rebuilt to normal size and shape.

Unfortunately the nature of the activity within the *Trigona* nest during robbing is unknown.

On one occasion two *Trigona* nests only about a foot apart were robbed at the same time. On all other occasions when observations were made, nests near the robbed nest were undisturbed. One nest was observed being robbed on March 26, and again the same nest was robbed on May 20.

There has been considerable discussion of the habits of *Lestrimelitta*. From the observations here recorded, combined with those of others, it seems probable that *L. limão* builds nests of its own, such as that recorded by Schwarz (1934). While it may be that under some conditions the *Lestrimelitta* usurp and live in nests of *Trigonas*, as recorded by Müller (1874) and Friese (1931), it is evident that much robbing is done without destroying the colonies of the species which are robbed. At least at Old Panama, it seems probable that the *Lestrimelitta* get most if not all of their food, and perhaps their wax, from the nests of *Trigona*. It is highly important evidence that while much collecting was done on flowers at Old Panama, not a single *Lestrimelitta* was ever found on a flower. This, combined with the absence of the usual pollen collecting structures in *Lestrimelitta*, strongly suggests that these bees are habitual if not obligate robbers.

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