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PSYCHE

A Journal of Entomology

Volume 72

1965

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Published Quarterly by the Cambridge Entomological Club
Editorial Office: Biological Laboratories
16 Divinity Ave.
Cambridge, Mass., U. S. A.

The numbers of PSYCHE issued during the past year were mailed on the following dates:

Vol. 71, no. 4, Dec., 1964: March 6, 1965

Vol. 72, no. 1, March, 1965: June 25, 1965

Vol. 72, no. 2, June, 1965: September 25, 1965

Vol. 72, no. 3, Sept., 1965: January 18, 1966

PSYCHE

A JOURNAL OF ENTOMOLOGY

Vol. 72 March, 1965 No. 1

W. M. Wheeler Memorial Issue

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PSYCHE is published quarterly by the Cambridge Entomological Club, the issues appearing in March, June, September and December. Subscription price, per year, payable in advance: $4.50 to Club members, $5.00 to all other subscribers. Single copies, $1.25.

Checks and remittances should be addressed to Treasurer, Cambridge Entomological Club, 16 Divinity Avenue, Cambridge, Mass.

Orders for back volumes, missing numbers, notices of change of address, etc., should be sent to the Editorial Office of Psyche, Biological Laboratories, Harvard University, Cambridge, Mass.

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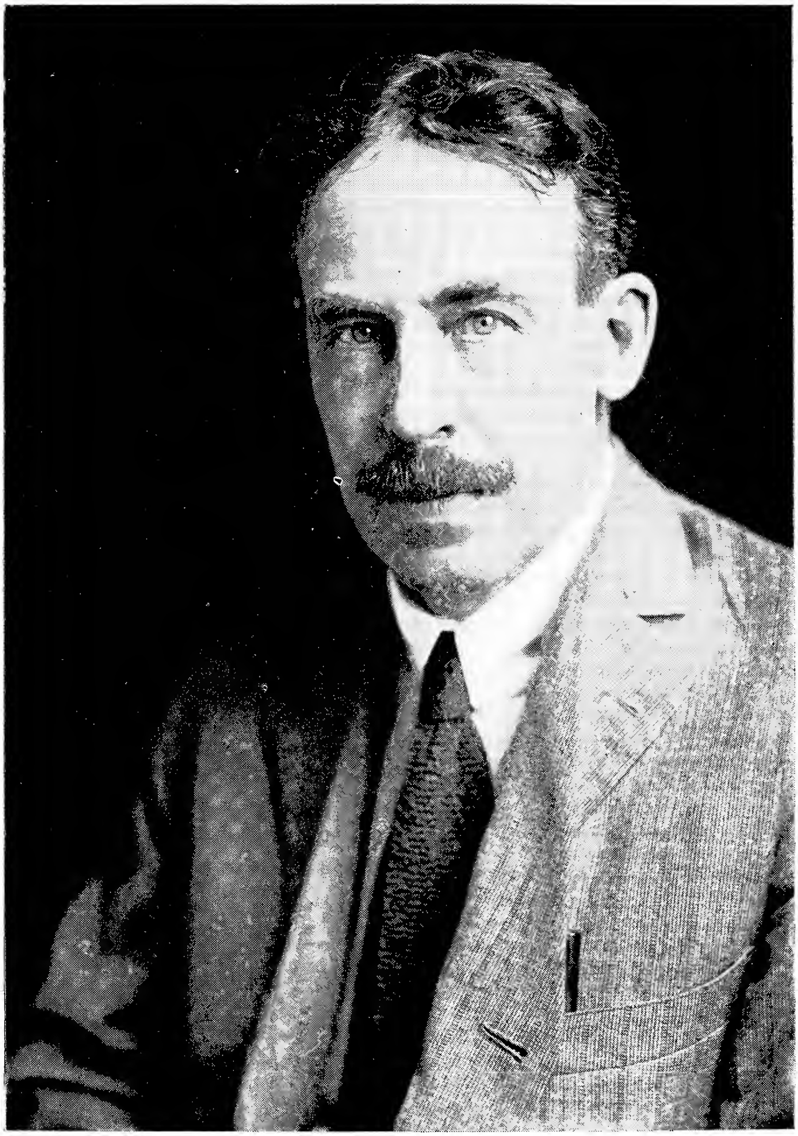
Reprints of articles may be secured by authors, if they are ordered at the time proofs are received for corrections. A statement of their cost will be furnished by the Editor on application.

The December, 1964 Psyche (Vol. 71, no. 4) was mailed March 6, 1965.

THE LEXINGTON PRESS. INC., LEXINGTON, MASSACHUSETTS



WILLIAM MORTON WHEELER
MARCH 19, 1865 — APRIL 19, 1937

PROFESSOR OF ENTOMOLOGY, HARVARD UNIVERSITY
1908-1937

PSYCHE

Vol. 72 March, 1965 No. 1

WILLIAM MORTON WHEELER MEMORIAL ISSUE

March 19, 1965, is the centennial of the birth of William Morton Wheeler, Professor of Entomology at Harvard University from 1908-1937 and an active member of the Cambridge Entomological Club for that period. The Editorial Board of Psyche has designated the present number of the journal as the *William Morton Wheeler Memorial Issue* and has arranged to include in it articles on ants and other social or subsocial insects. No attempt has been made to obtain contributions by all of Professor Wheeler's former students; most of the papers published here were already in the editorial office before plans for the memorial issue were definitely made. Included are contributions by three generations of students whose interest in social insects can clearly be traced to Professor Wheeler. We are indebted to Professor W. L. Brown, Jr., of Cornell University for the use of the accompanying photograph, which was taken about five years after Professor Wheeler was appointed at Harvard University.

A biographical account of Professor Wheeler, with a complete list of his publications, was published in Psyche, Volume 44, No. 3., 1937.

F. M. Carpenter, *Editor*

SMITHSONIAN INSTITUTION JUL 6 1965

TRAIL SHARING IN ANTS

By Edward O. Wilson
Biological Laboratories, Harvard University

INTRODUCTION: THE KINDS OF TRAIL SHARING

A very few cases have been recorded of ant workers regularly utilizing the trails of other ant species. Forel (1898) designated as "parabiosis" the following complex behavior that includes trail sharing. Colonies of the Neotropical rain forest species *Crematogaster limata parabiotica* Forel and *Monacis debilis* (Emery) [=*Dolichoderus debilis* var. *parabiotica* Forel] commonly nest in close association, with the nest chambers kept separate but interconnected by passable openings; while the workers forage along common odor trails. Wheeler (1921) confirmed the phenomenon and showed that, in the one instance where he observed food gathering, the two species were attending membracids together. Wheeler also discovered a similar association between *Crematogaster parabiotica* and *Camponotus femoratus* (Fabricius). Both species were observed utilizing common trails and gathering honeydew from jassids and membracids on the same plants, as well as nectar from the same extrafloral nectaries of *Inga*. Not only were the *Crematogaster* and *Camponotus* workers tolerant of each other in this potentially competitive situation, they were on quite intimate terms. They "greeted" each other with calm antennation on the trails, and on three occasions Wheeler observed *Camponotus* actually regurgitating to *Crematogaster*.

It has not been established whether parabiosis is mutualistic or parasitic in nature. The distinction must be a subtle one in such a complicated relationship. The form *"parabiotica"* of *Crematogaster limata* is evidently always associated with other ants. If future taxonomic studies prove it to be a species distinct from *limata,* it is a likely parasite. It would then be shown to be dependent on its associates, while the latter species often nest and forage by themselves. But the *prima facie* case for mutualism seems even stronger. The broods are never mixed, and as Weber (1943) points out on the basis of his own studies, all of the parabiotic species participate vigorously together in nest defense. There is no evidence that the presence of the *Crematogaster* harms the other species, except possibly by competition for the same food resources. On the contrary, *Camponotus femoratus*

Manuscript received by the editor January 5, 1965.

maintains flourishing populations in localities where virtually every colony lives in parabiosis with *Crematogaster.*

While the Neotropical parabionts are doubtfully mutualistic, the relationship of the European *Camponotus lateralis* (Olivier) and *Crematogaster scutellaris* (Olivier) can be classified as weakly parasitic. Goetsch (1953) and Kaudewitz (1955) have described instances in which *Camponotus* workers followed the *Crematogaster* trails in large numbers to the *Crematogaster* feeding grounds and exploited the same food resources during the same time of day. The *Crematogaster* were hostile to the *Camponotus,* which assumed a crouching, conciliatory "Wartestellung" on meeting the host workers. Unlike the Neotropical parabionts, the two species nest separately. Moreover, the relationship is not obligatory on the *Camponotus lateralis,* since the colonies of that species are often found far removed from *Crematogaster* colonies.

I will now describe a third example of trail sharing which I recently discovered between the dolichoderine *Azteca chartifex* Forel and formicine *Camponotus beebei* Wheeler. This case is of additional interest in that it seems to illustrate a close approach to the third or neutral class of symbiosis, namely commensalism.

AZTECA CHARTIFEX AND CAMPONOTUS BEEBEI

During a trip to Trinidad, West Indies, in 1961, my attention was drawn to *Camponotus beebei,* a formicine ant previously known from only several specimens collected in Trinidad and British Guiana. On each of three occasions on which the species was encountered, twice at Spring Hill, Arima Valley, and once near Cumuto Village on the Aripo Savanna, workers were found running over tree trunks along the odor trails of the much more abundant and aggressive dolichoderine *Azteca chartifex.* The *Camponotus* were never found away from the *Azteca* trails. Extended observations at Spring Hill revealed that the *Camponotus* always followed the *Azteca* trails for long distances with fidelity equal to that maintained by the *Azteca* themselves. That this was true trail symbiosis was further evidenced by the fact that no other alien species remotely approximated such behavior. Workers of several other arboreal species occasionally blundered into the same *Azteca* files but ran abruptly away without tracing the main route of the files.

One of the Spring Hill *Camponotus* nests was located. It was in a dead, hard branch of a mango tree that had fallen and lodged in the crown of a three-meter-tall grapefruit tree in a citrus plantation. The *Camponotus* workers were seen to emerge from their nest holes, run

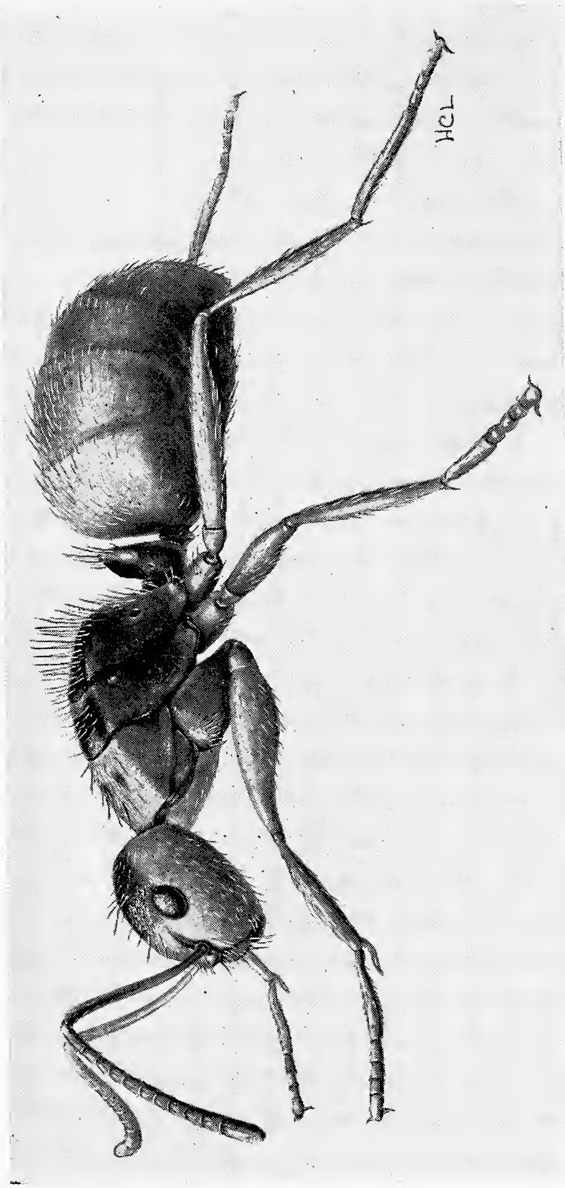


Fig. 1. Minor worker of *Camponotus beebei* Wheeler from Spring Hill, Trinidad.

down the mango branch to the branches of the grapefruit tree, which held an *Azteca* colony, and follow the *Azteca* trails to the ground. The *Azteca* workers seldom ventured up to the *Camponotus* nest. The *Camponotus* occupied scattered flat galleries in the mango branch. When cut apart the nest yielded 2 winged queens, 16 males, 6 major workers, 36 minor workers, and several larvae and pupae in various stages of development. The mango tree, from which the *Camponotus* colony fragment had evidently recently fallen, was also occupied by *Azteca chartifex*. In a second locality at Spring Hill, *Camponotus* workers were tracked up into the foliage of a tonka bean tree (*Dipteryx* sp.) beyond a large *Azteca* nest, but the *Camponotus* nest was not found. Nevertheless, it was evidently separate from the *Azteca* nest.

Both the *Azteca* and *Camponotus* followed the *Azteca* trails to the bases of the nest trees. Presumably both foraged extensively on the herbaceous ground vegetation, but their diets were not determined. Regardless of the nature of the diets, competition between the two species was reduced by the existence of opposite diel schedules. The *Camponotus* foraged apparently exclusively during the day, at the time the *Azteca* files were at their lowest ebb. In the early evening the number of *Azteca* workers on the trails were seen to increase by as much as a hundred-fold, but not a single *Camponotus* worker was found through several hours of searching during this time.

The *Camponotus* workers, then, "borrow" the *Azteca* trails when the owners put them to minimal use. The *Azteca* workers on the Spring Hill trails were hostile to the *Camponotus* workers and attacked them on the rare occasions when the latter slowed in their running, but the *Camponotus* were larger and faster and usually easily avoided their hosts without causing any visible disturbance. The *Camponotus* were never observed to interfere with the *Azteca* in any other way.

On the basis of the first observations it could still be legitimately asked whether the *Camponotus* were merely using the same visual or tactile "landmarks" on the tree trunks as the *Azteca,* rather than following their odor trails. This possibility was eliminated by the following experimental result. A freshly killed insect was pinned to the trunk of a tree one meter beneath the trail along which both species were running but within the range of occasional *Azteca* scouts. Within ten minutes, two *Azteca* workers had found the insect and laid odor trails from it back to the main trail. In the next five minutes over 100 *Azteca* workers moved back and forth along the new trail to the insect. In the same interval three *Camponotus* workers, a major and two minors, approached along the main trail and, on reaching the junctures of the new trails, departed down them for various distances. The major went all the way to the insect and prowled around it for several minutes before returning to the main trail. In two subsequent replications of the experiment, two of thirteen and one of five *Camponotus* workers passing along the main trail were deflected onto the *Azteca* side trails during the period of peak *Azteca* response to the baits. Such deviations from the main trail were never observed except at this time. It was concluded that the *Camponotus* respond to the *Azteca* communication.

The following observation led to the further conclusion that the *Camponotus* were tracking the *Azteca* olfactorially rather than visually. Occasionally around midday the *Azteca* were unusually scarce on the main trail, while the *Camponotus* remained moderately common. Stretches of 30 to 50 cm. of the trail were often bare of *Azteca,* but many individual *Camponotus* followed the established track just as well. On close examination I found no alterations in the surface structure of the main trail, other than the postulated chemical one, that could have supplied the *Camponotus* with a clue.

Although the *Camponotus beebei* utilize Azteca trails extensively, the following observation shows that they have maintained their own, private trail system. On a single occasion in February a line of seven *Camponotus* were seen moving along the main *Azteca* trail. Four of the workers ran in a tight group directly behind the leader, frequently advancing enough to touch the abdomen of the ant ahead. When the leader was touched, it dashed forward at a faster pace over a short distance. This part of the behavior was typical of communication by "tandem running", which I have described earlier in a paper on the genera *Cardicondyla* and *Camponotus* (Wilson, 1959). The remaining two workers followed at a greater distance, tracing each twist and turn taken by the leader. During the next 15 minutes several other *Camponotus* workers passed the same way, again tracing parts of the route of the leader with close fidelity. After that time, new Camponotus workers continued to run on the *Azteca* trail but ignored the *Camponotus* trail. There could be no doubt that the lead ant had secreted an odor trail of the recruitment type (see Wilson, 1963). It was laid on top of the *Azteca* trunk trail, which for most of its length was about 10 centimeters wide. Equally interesting was the fact that only the *Camponotus* responded to it. The *Azteca* workers continued to pass along their own trail during the episode but failed to orient to the inner track followed so closely by the *Camponotus*. Thus the *Camponotus* workers appear to respond to two odor trails, while the host *Azteca* respond only to one.

ACKNOWLEDGEMENTS

This study was supported by a grant from the National Science Foundation. The figure was prepared by Mrs. H. C. Lyman.

ABSTRACT

Trail sharing is a rare event in ants. Of two previously described cases, one is interpreted as part of a relationship that is either mutualistic or weakly parasitic, probably the former, and the other as part of a weakly parasitic relationship.

A third, new case has been discovered which appears to be commensalistic. On Trinidad, West Indies, workers of the rather scarce formicine *Camponotus beebei* utilize the arboreal odor trails of the abundant dolichoderine, *Azteca chartifex*. The *Camponotus* "borrow" the latter's trails during the day, when *Azteca* foraging is at a low ebb. The *Camponotus* workers are treated hostilely by the *Azteca* workers but are too swift and agile to be caught; their presence does not disturb the *Azteca* seriously. On a single occasion *Camponotus* workers were observed to lay their own private recruitment odor trail on top of the *Azteca* trails. The *Camponotus* trail lasted for about fifteen minutes and had no visible effect on the *Azteca*.

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SIMULTANEOUS CARE OF MORE THAN ONE NEST BY *AMMOPHILA AZTECA* CAMERON (HYMENOPTERA, SPHECIDAE)[1]

By Howard E. Evans
Museum of Comparative Zoology

In attempting to trace the origin of social behavior among wasps, in his *Social Life Among the Insects* (1923), William Morton Wheeler selected *Ammophila* as "a paradigm of the whole group of Sphecoids and solitary Vespoids". Were he alive today, and able to utilize all the considerable knowledge of this genus gained in the last three decades, it seems likely that he would embrace *Ammophila* even more enthusiastically as a paradigm not only of the solitary wasps but of several preliminary stages in the origin of sociality.

It has been shown by Evans (1958, 1959) and by Powell (1964) that the North American species of this genus which have been studied can be arranged in series as follows: (1) strictly solitary species which utilize a single large caterpillar per nest, (2) species which mass-provision with two to several small caterpillars, (3) species in which provisioning is commonly "delayed" such that the last prey is brought in after the egg has hatched, and (4) species employing progressive provisioning regularly. Several other aspects of behavior are roughly correlated with this progression: for example, species using smaller caterpillars usually carry the prey in flight, and these same species generally carry the soil of excavation away from the nest in flight. Also, most records of gregarious nesting pertain to species employing progressive provisioning.

It is apparent that the European species can be arranged in a very similar series (Adriaanse, 1947; Teschner, 1959). One European species, *A. pubescens* Curtis, illustrates still a fifth stage in this ethocline: the female maintains two or three nests at one time, remembering the location of each of them accurately and behaving in accordance with the status of the egg or larva in each nest as determined during frequent inspections (Baerends, 1941). Simultaneous care of more than one nest is otherwise virtually unknown among digger wasps, although a few species of Bembicini which make more than one cell per nest are reputed to begin provisioning a second cell

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[1] **Supported by a grant from the National Science Foundation, no. G17497. Most of the studies reported here were conducted at the Jackson Hole Biological Research Station, Moran, Wyoming.**

Manuscript received by the editor January 5, 1965

before the previous cell is fully stocked (Janvier, 1928; Tsuneki, 1956).

Powell (1964) suggested that studies with marked wasps might well reveal that some of our North American *Ammophila* maintain more than one nest simultaneously. By coincidence, during the same week that Powell's paper appeared, I was able to establish that this is, in fact, the case. Working along the Snake River in Jackson Hole, Wyoming, I found that *Ammophila azteca* Cameron behaves in a manner strikingly like *pubescens* in almost every detail relating to provisioning. My studies were relatively brief and leave a number of questions unanswered, but they seem worth putting on record at this time with the thought that others may be able to extend our knowledge of this widely distributed species before I am able to do so.

Ammophila azteca has been the subject of three published notes, all of them brief. Hicks (1935) observed several wasps digging and closing nests near Boulder, Colorado (identified as *aculeatus* Fernald, a synonym). Evans (1963) reported on a single nest found in Yellowstone Park, Wyoming, and Powell (1964) presented prey records from California and Baja California. The last two authors both identified the species as *pilosa* Fernald, a name now regarded as a junior synonym of *azteca* Cameron.[2] I also found one female of this species nesting at Great Sand Dunes National Monument, Colorado (elevation 7800 feet), in August 1964, and have included this record below. This is chiefly a montane species; Powell's records are from 6000 feet elevation in Baja California and over 10000 feet in California; the Jackson Hole and Yellowstone localities where I have worked are both at about 6800 feet. However, Menke *(in litt.)* reports the species from near sea level in California and various places in Canada.

General aspects of ecology and behavior. — Most of my studies were conducted in a small area of flat, bare soil along the Snake River at the Cattlemen's Bridge, about one kilometer east of the Jackson Hole Biological Research Station, Moran, Wyoming. The first observations were made on July 18, 1964, the last observations on August 14. My impression is that this species became active only a few days before my initial observations and that it had nearly completed its nesting season by August 14. In this area, where the active season for most wasps is no more than 4-6 weeks, progressive

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[2] This is a new synonymy, and should be credited to Arnold Menke, who is currently revising the genus *Ammophila* and who has studied Cameron's type. I am indebted to Dr. Menke for identifying the specimens collected in the course of these studies and for critical reading of the manuscript.

provisioning would seem uneconomical unless the wasp is able to maintain two or more nests simultaneously. However, two progressive provisioners which maintain only one nest at a time nested in some abundance in the same area; these were *Bembix spinolae* and *Steniolia obliqua.* The only other species of *Ammophila* found here was a single female *A. macra* Cresson which nested on the edge of the bare soil on August 14; I have presented a few notes on this wasp below, as it presented a striking contrast to *azteca.*

In Jackson Hole, *A. azteca* appeared to be strictly confined to patches of bare, moderately firm, sandy loam along the river; none were seen or taken in general collecting in other habitats. The major nesting area was about 20 meters long and varied from 5 to 8 meters in width, paralleling the river and separated from it only by a narrow, oblique bank which was not used for nesting. Parts of this area were covered with grass and herbs, chiefly around several trees, but these places were not utilized by the *Ammophila.* Also, the *Ammophila* did not nest in a small plot of very loose sand which was occupied by a colony of *Bembix spinolae.* The area was surrounded on the three sides away from the river by open woodland in which the dominant tree was lodgepole pine *(Pinus contorta latifolia);* near the river there were also narrow-leaved cottonwoods *(Populus angustifolia)* and willows (*Salix* spp.). I estimated that there were about 50 females scattered about the nesting area. My notes cover 20 females, but only a few of these were marked, and only four of the marked individuals were followed over a period of days. The most complete observations pertain to no. 2030, which was marked with a red spot on the second day of study (July 19) and followed until August first, including one complete day of observation (July 31) and observations for several hours on five other days.

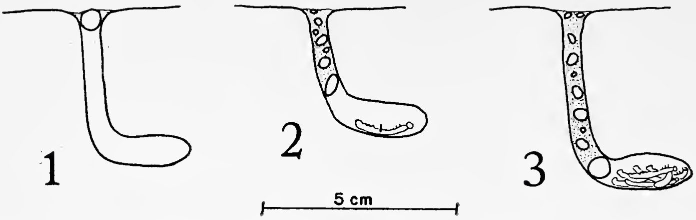
That it was impossible to make continuous records of more than a very few females was a consequence of the fact that females spaced themselves widely, each maintaining a small nesting arena, no more than 30 cm. in diameter, where all her nests were prepared (Figs. 6, 7). These arenas were separated, for the most part, by half a meter or more. On one occasion an unmarked female shared a circumscribed area with a marked female (no. 2028C), the nests of the two being more or less intermingled, but this was exceptional. I observed no aggression among females provisioning their nests, but females digging in proximity would sometimes attack one another. It seems possible that there is a measure of territoriality among females of this species, but since the wasps spend only a small portion of their time in the nesting arenas, contacts between neighboring females are few.

Both males and females were seen frequently on the flowers of *Solidago* and *Erigeron* growing in and near the nesting area, and it is probable that they obtain nourishment throughout the season from this source. Early in the season males were observed in considerable numbers flying close to the ground in the nesting area. On one occasion three males were seen digging intermittently and trying to enter a vertical hole, presumably in anticipation of the emergence of a female. I did not observe mating, chiefly because most of my studies were made a week or more after nesting had begun, when most mating had probably ceased and the males were declining in numbers. Mating in several species of *Ammophila* has been well described (e.g., Baerends, 1941; Olberg, 1959).

As compared to other wasps in this area, *Ammophila azteca* made its appearance rather early each morning (0830-0900) and was active until late in the afternoon (1630). Active wasps were often noted in partial shade or during periods of partial cloudiness, but they invariably disappeared when the sun was heavily obscured for more than a few minutes. I did not discover where they went during these inactive periods or at night. Hicks (1935) found a female of this species "sleeping" on a stem in late afternoon, presumably solitarily. The wasp held her body at nearly a right angle to the stem, grasping the support with her mandibles and some of her legs. A number of species of *Ammophila* are known to sleep in somewhat this manner, often more or less gregariously (e.g., Evans and Linsley, 1960).

Digging the nest. — Nests appear to be started at any time of day, but more especially in the mid-morning hours or late in the afternoon. Digging females periodically produce a "chirping" sound as they break through the soil with their mandibles. One female starting a new nest dug 1 cm in 13 minutes, the second cm in another 7 minutes; she completed the burrow and cell in a total of 58 minutes. This female had previously been digging at another point 10 cm away, but she abandoned this nest after apparently striking a stone; the abandoned burrow was left open.

When the wasp has loosened a small lump of earth, she holds it between her mouthparts and front legs, backs from the burrow, rises into the air a short distance, and with a slight jerk flings it onto the ground. She may fly in any direction from the entrance, but most wasps make the majority of flights on the same side, such that the earth comes to form a diffuse but discernible mound in the form of a small arc. The mound is rarely more than 0.5 cm deep, and varies from 2 to 4 cm wide by at least twice that long, although its borders are ill-defined. In some nests no mound can be seen, as the female



Figs. 1-3. Typical nests of *Ammophila azteca* (all from Jackson Hole, Wyo.) showing the three types of closures. Fig. 1. No. 2018, an empty nest closed with a single pebble and a small amount of sand. Fig. 2. No. 1993, a nest with a single caterpillar bearing the egg, showing a typical temporary closure. Fig. 3. No. 1996, a fully provisioned nest which had received the final closure.

scatters the soil rather widely. In any case it weathers away in a few days, and some of the soil may be used in closures.

There appears to be considerable variation in the distance the female flies with the soil, and consequently the distance from the nest entrance the mound accumulates. In Jackson Hole, most mounds were only a few cm from the entrance (2-6, rarely up to 20). Hicks (1935) observed very similar digging behavior in Colorado, but he found that the soil was carried a considerable distance from the nest, in one case four feet (1.2 m). Hicks timed several females and found that they carried from five to seven loads per minute. "One load", he reports, "was so large and heavy that the wasp was not able to fly with it after a typical and normal fashion and only reached the refuse spot by short flights and hops." Great variation in the distance the soil is carried was noted by Hicks (1932) in another species, *A. aberti.*

Burrow diameter in *A. azteca* is about 5 mm; the terminal cell is horizontal and has a diameter of about 10 mm, a length of 20-25 mm. All burrows at Jackson Hole were vertical or very nearly so; they varied in length from 3 to 6 cm, nearly all of them measuring between 4 and 5 cm (Figs. 1-4). The single nest excavated at the Great Sand Dunes, Colorado, was very similar, having a vertical burrow 3.2 cm long reaching a horizontal cell 2.2 cm long. The nest from Yellowstone was very similar in size but was dug into the sloping of a footpath and had an oblique burrow (Fig. 5 in Evans, 1963).

Closure of the nest. — As in many species of this genus, three types of closure can be distinguished: initial closure of the empty nest, temporary closures during provisioning, and final closure of the fully provisioned nest. The initial closure consists of a single pebble or hard lump of earth which is placed in the burrow entrance with the mandibles, often after "trying for size" several such lumps and rejecting each of them until one is found which fits the mouth of the burrow (Fig. 1). A small amount of sand is often scraped over this closure, but no pounding occurs. The wasp normally returns to this nest within a few hours or early the next day with the first prey, on which the egg is laid. The single nest studied at the Great Sand Dunes, Colorado, was like the many observed at Jackson Hole: the female removed a single small stone from the entrance before introducing the first caterpillar and laying an egg upon it.

Following oviposition, and after supplying each additional caterpillar, a very different type of closure is made (Fig. 2). Again, various lumps and pebbles are "tried for size", but this time the initial lump is placed well down in the burrow, at least half way down and often near the bottom; the object selected must lodge perfectly in the burrow so that material may be packed above it (this is the *hauptverschlussklümpchen* of Baerends and other European workers). When the initial lump is in place, the wasp scrapes sand into the nest with her front legs, facing of course away from the hole. She may utilize some of the soil of the mound if this is close by; or if loose soil is not available she may loosen some by biting the ground around the entrance. Periodically small pebbles or bits or earth are picked up and placed in the burrow with the mandibles. From time to time the wasp remains with her head down in the burrow and moves her body up and down, packing the soil in place with blows of the antero-ventral surface of the head in the usual manner of wasps of this genus. When the burrow is full, additional packing occurs, the wasp sometimes retaining her grasp on a small pebble while so doing ("using a tool") and then leaving the pebble in place in the fill (Fig. 8). Finally, sand is scraped in various directions over the top, resulting in thorough concealment of the entrance. The closure is prepared very rapidly and requires only a minute or two; one wasp completed a typical temporary closure in only thirty seconds. It is probable that the same pebbles and lumps of earth serve in successive closures, so one would expect a reduction in the length of time required after the first temporary closure.

Final closure may be indistinguishable from temporary closure unless one follows the provisioning of the nest to determine that this is, in fact, the final closure. My limited data suggest that in the final closure (1) the initial lump is always placed at or near the bottom of the burrow (Fig. 3), and (2) packing with the head is relatively prolonged and some packing while holding a pebble in the mandibles always occurs toward the end of the closure (Fig. 8).

Further studies will be needed to quantify these factors and to determine if there is a real difference between temporary and final closure. The closure observed by Hicks (1935) in Colorado was presumably temporary, since no "tool using" was noted. The wasp studied by Hicks used "an old hackberry seed to close the upper end of the shaft. Sand was scraped in over this, and some score or more of objects were brought to further cover and conceal the nest site".

Provisioning the nest. — Females were observed on several occasions flying closely about low branches of willows and cottonwoods, apparently searching for prey. On one occasion a wasp seized a caterpillar on a willow branch, but the latter thrashed violently and the wasp left without stinging it; this was a considerably larger caterpillar than was ever found in the nests of the wasp. The 44 prey taken from various nests were all of roughly the same size (slender, 12-18 mm in length); all were "naked" larvae, and all were green in color except for a few gray or reddish geometers. Specific identification of the prey was not possible, but many (perhaps all) belonged to groups which feed upon broadleafed trees rather than upon conifers. The following were recovered from the various nests dug out:

Hymenoptera [det. B.D. Burks]	
Tenthredinidae: Nematinae: *Nematus (Pteronidia)* sp. and *Amauronematus* sp.	28
Lepidoptera [det. D.M. Weisman]	
Geometridae (four spp.)	7
Gelechiidae (apparently all one sp.)	8
Sphingidae: *Smerinthus* sp. (early instar)	1

The use of sawfly larvae in considerable numbers is of interest, since Adriaanse (1947) found that *A. pubescens* restricts itself to caterpillars, the closely related *A. campestris* to sawflies. In the population of *A. azteca* studied, several nests contained nothing but sawfly larvae, a few nothing but moth larvae, and a very few (e.g., no. 2012) both sawfly and moth larvae. Individual wasps tended to stock successive nests wholly with sawfly larvae (rarely wholly with caterpillars), but there were numerous exceptions. I noted no shift in type of prey concordant with the progress of the season.

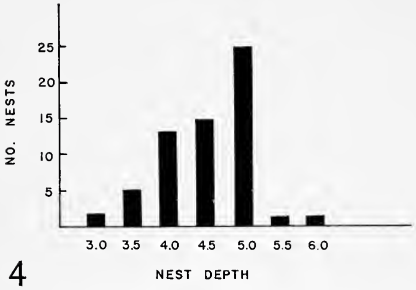
Prey records from other parts of the range of this species indicate use of lepidopterous larvae of several different groups, including relatively hairy forms, but there are no further records of use of sawfly larvae. The single female studied at the Great Sand Dunes brought in a gelechiid larva very similar to those used in Jackson Hole. The nest studied at Yellowstone contained one noctuid, one geometer, and five larvae of lycaenid butterflies (Evans, 1963).

Powell (1964) found a lycaenid larva to be used in Baja California, while in Mono County, California, a larva of the moth family Pterophoridae was employed. As Powell points out, lycaenid larvae are covered with short, secondary setae, while pterophorid larvae have tufts of elongate setae. The caterpillars taken by Powell measured 14 and 15.5 mm in length, while those taken from the nest in Yellowstone measured from 8 to 15 mm in length. Thus it appears that size of the prey is of critical importance, but not its vestiture or taxonomic affinities.

Powell reported that the lycaenid larva was carried in flight, about a meter above the ground. I observed prey carriage in flight once in Colorado and many times at Jackson Hole; in no case did I observe prey carriage over the ground. The female straddles the caterpillar, grasping it with her mandibles a short distance behind the head and during flight embracing the body of the caterpillar with her legs, the prey being venter-up. She lands a short distance from the nest and walks to the entrance, usually without circling or hesitation, then drops the caterpillar at the threshold while she removes the closure. At Jackson Hole, I experienced much difficulty approaching females closely for photography at this time; they would very readily take flight with their prey, often disappearing for several minutes.

Removal of the closure occurs very rapidly, taking only a few seconds if it is an initial closure, generally less than 30 seconds in any case. Soil particles and objects removed from the burrow are deposited within a few cm of the entrance and may be reused when the closure is restored. When the burrow is clear, the wasp grasps the anterior end of the prey with her mandibles and backs into the nest with it. The entire process (arriving with prey — clearing entrance — drawing in prey — reclosing entrance) occurs with remarkable speed, some individuals requiring less than a minute. When it is considered that only from one to four prey are introduced per day, it will be appreciated that even prolonged periods of observation afford one only fleeting opportunities to study this behavior.

In addition to entry with prey, each nest is entered periodically when the wasp is without prey. There are presumably "inspections" which function to impress upon the wasp the size and food requirements of the larva, as Baerends (1941) found to be true in *A. pubescens*. Inspections may occur at any time of day, but most characteristically occur early in the morning (0830-1030). In fact, the first act of each *Ammophila* arriving in the morning consists in entering the nest and closing it again. I did not observe any one female inspect more than one nest at this time; apparently when there



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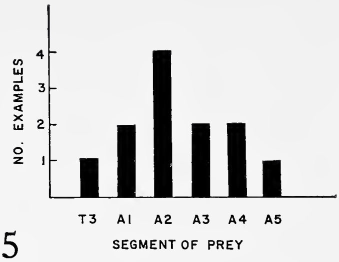

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Fig. 4. Number of nests of *Ammophila azteca* (all Jackson Hole, Wyo.) exhibiting various depths (in centimeters). In each case the measurement was rounded off to the nearest half cm in the field. Fig. 5. Number of examples of oviposition on various segments of the prey (all Jackson Hole, Wyo.). T3 = third thoracic segment; A1 . . . = various abdominal segments.

is more than one active nest, she inspects the one containing a larger larva (see detailed data on no. 2030, below). However, other inspections may occur later in the day (see also below). The entry and reclosure resemble closely the behavior occurring when the wasp is bringing prey.

The maximum number of prey found in any nest at Jackson Hole was six (2030D), but the nest studied in Yellowstone contained seven (Evans, 1963). It appears that about two days are required for hatching of the egg, about five days for larval feeding. Apparently females bring in the last prey and make the final closure when the larva is in the last instar and at two-thirds its full size; thus final closure usually occurs six or seven days after the nest is dug.

Oviposition. — The egg is laid on the first prey placed in the cell. It is glued firmly by the anterior end to the side of the caterpillar, in a more or less vertical position (Fig. 9, lower figure). As in many species of *Ammophila,* there is much variation in the placement of the egg. At Jackson Hole, one egg was found on the third thoracic segment, others on each of the first five abdominal segments, but more on the second abdominal segment than elsewhere (Fig. 5). The single nest studied in Colorado contained a caterpillar bearing an egg on the fourth abdominal segment.

Successive nests of individual females. — As mentioned earlier, it became apparent in the course of studies at Jackson Hole that each female prepares all of her nests in a small nesting arena. It also became apparent that each female prepares an unusual number of nests. For example, when I dug out the nest of no. 2013, an unmarked female studied early in the season, I found not one nest but six, all in an area measuring 8 × 14 cm. This was on July 27, and I could not believe that females had been nesting for more than two weeks (I began collecting in this area July 4, and took the first *A. azteca,* a male, on July 7). But if it takes six or seven days to rear a larva, this female should have started nesting at least 30 days earlier (one nest was still unprovisioned). This example and several similar ones made it apparent that some overlapping of successive nests must occur. I therefore marked several individuals and attempted to follow them over several days. Since my observations were not absolutely continuous, and since during the one complete day of observation I could keep only two wasps under full surveillance, because of the wide spacing mentioned earlier, my notes are not entirely convincing except in two cases. The arrangement of successive nests of these two individuals is shown in Figs. 6 and 7, and I here present, in abbreviated form, my field notes concerning one of them, no. 2030, which I painted with a red spot on July 19.

July 19. Brought prey at 1100 hrs to site A (Fig. 6).
July 20. Working on a nest at B.
July 23. Prey to B at 1530.
July 25. Prey to nest C at 1630.
July 29. Inspection followed by final closure at C.
July 31. Complete day of observation. Arrived in area at 0815.
0845: Wasp appeared at site D and made inspection, followed by temporary closure.
1022: Prey to D, followed by what appeared to be a final enclosure, including "use of tool" and scraping of sand over top for several minutes. Left at 1036.
1037: Reappeared at same site, walked about, flew off.
1047: Reappeared at same site, walked over old nest and around area until 1050.
1053: Back again, walking over nesting arena with her abdomen held high; off at 1055.
1113: Reappeared and began to remove closure at E. This appeared to be a rather thorough temporary closure. After a brief "inspection" she made a hasty temporary closure and left at 1120.
1237: Back to E with a sawfly larva; opened nest and drew it in within one minute of arrival. At closure three pebbles were "tried for size" before finding one which fit the bore of the burrow properly. Left at 1240.
1355: Back to E with another sawfly larva. After introducing

the prey made a fairly prolonged closure which I took to be a final closure but which proved not to be (see Aug. 1). During this she drove away two chrysidids (see below, under "parasites").

1400, 1409, 1414, 1445: Each time she reappeared in the nesting arena, walked about for a few seconds to a minute, then flew off.

1450: Started digging at G.

1457: Stopped digging, leaving hole open, and is now walking about the nesting arena.

1502: Digging at G^1.

1600: Closed burrow with a single pebble, scraped a small amount of sand over top, and flew off.

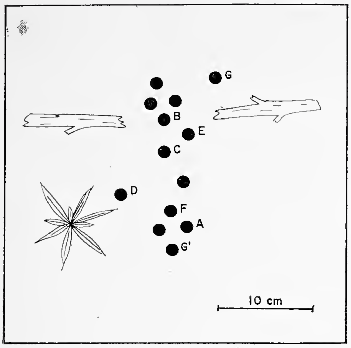
1632: Landed at nest, then flew to a *Solidago* in blossom two meters away, remained for a few minutes, then was not seen again today.

August 1. 1020: Landed at G^1, remained two minutes and flew off. This is a cool, partly cloudy morning.

1040: Now cloudy and windy (began to rain at 1100). I dug out the nesting arena, eventually finding 12 nests and one incompleted burrow (G) (see Fig. 6). Eight of these had cocoons, one was an empty nest (G^1), one had a single caterpillar with an egg (F), and two had wasp larvae (D and E, closed yesterday, E apparently temporarily, since the wasp larva was small and there were only 3 sawfly larvae in the cell).

Apparently nest F had been initiated on July 30 and was not visited on July 31 (the wasp presumably remembering that it contained an egg and did not require additional prey). Thus we can say that this wasp very definitely maintained two nests simultaneously (D and E), very probably three (if we include F), and that she was associated with three nests in the course of one day (D, E, G^1) while presumably retaining a fourth in her memory. Clearly this calls for a much more detailed study, but it would appear that the models provided by Baerends (1941) for *A. pubescens* apply very well to this species.

Some unexplained features of behavior. — On two different occasions I dug out a series of nests in a single nesting arena and found that all or most of the nests contained eggs. In one case there were six nests, five of them containing a single prey with an egg, the remaining one being empty. In another case there were four nests, all of them containing only one prey; in three cases the prey bore an egg, in the



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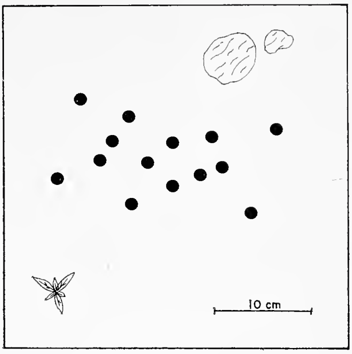

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Fig. 6. Arrangement of successive nests of no. 2030. Nests A-G[1] were prepared in that order (see text); unlettered nests were not seen to be dug or provisioned and were presumably completed before the beginning of intensive observations (at least in part). Fig. 7. Arrangement of nests of no. 2031, which nested about 2 meters from the preceding at Jackson Hole.

fourth case a small larva. Unfortunately in both instances the wasp associated with the nesting arena was unmarked, and I did not observe the site for a long enough time to be certain that only one female was responsible for each set of nests. As mentioned earlier, I did find one case in which an unmarked female shared a nesting arena with a marked female. If the above two cases did involve a single female each, then that female must have prepared several nests on the same day, or over no more than two or three days, and laid several eggs in rather rapid succession. When the larvae in these nests approached maturity, the female would have to obtain many prey in order to provision all of these nests. Whether truly synchronous nesting (as opposed to the overlapping of successive nests) occurs in this species remains to be determined.

On one occasion (2007D) I dug out a nesting arena and found three nests, one of which contained one caterpillar, the other two two sawflies each: but none of the nests contained an egg. This suggests that these might have been storage burrows, the prey to be exhumed later and used for oviposition or for feeding a larva. If in fact this species does at times maintain several nests synchronously, then the maintenance of storage nests would seem of great adaptive value, since it would spread out the requisite hunting over a greater number of days. It is possible that the maintenance of storage burrows is not a rare phenomenon in *Ammophila*. Hartman (1905) found two

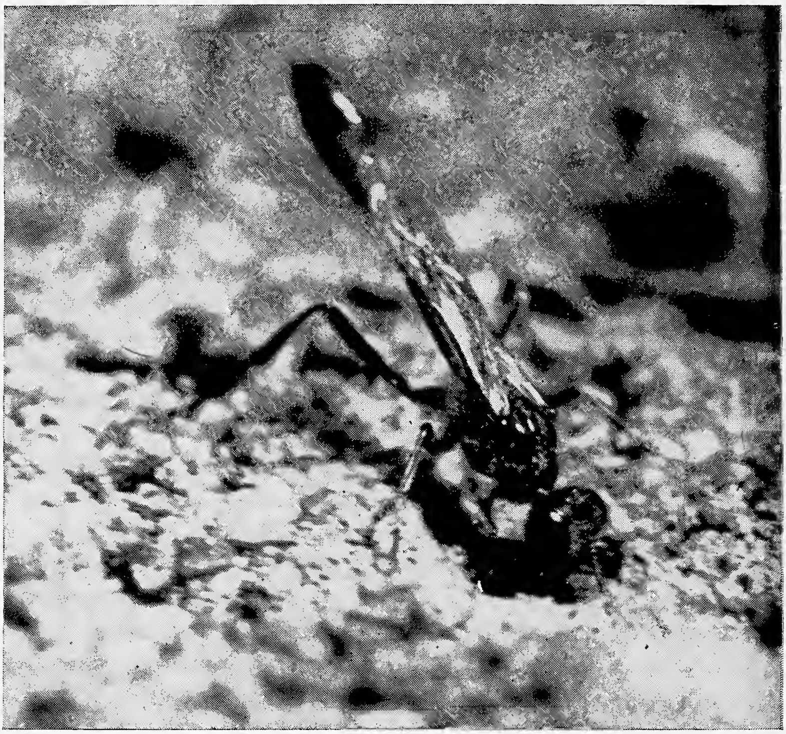

Fig. 8. Female *Ammophila azteca* at final closure of her nest. A small pebble is being held in the mandibles and used for packing soil in the filled burrow.

nests of *A. procera* in Texas which did not contain eggs, Tilden (1953) had the same experience with this species in California, and Criddle (1924) observed a female of this same species in Manitoba place a caterpillar in a nest one day and then dig it out the next day, return it to the nest, and lay an egg upon it This is an aspect of behavior requiring much further study.

Parasites. — Chrysidid wasps (*Ceratochrysis perpulchra* Cresson) were observed commonly in the nesting area of *A. azteca* at Jackson Hole, but I am unable to state definitely that they were parasitizing the *Ammophila.* The chrysidids would often land on the soil near *Ammophila* nests, and on several occasions they were seen to enter nests either partially dug or partially closed, in which case they were normally driven away by the *Ammophila.* On one occasion a chrysidid returned after the *Ammophila* had completed her closure and spent several minutes around the nest, but I did not see her dig into it.

Notes on Ammophila macra. — As noted earlier, a single female of the large species *A. macra* Cresson was found nesting on the periphery of the *azteca* nesting area at Jackson Hole. She was seen digging her nest at 1100 on August 14. The soil was taken from the burrow in lumps much as in *azteca,* but it was carried over the ground and deposited in a diffuse pile 6-14 cm from the hole. At 1115 the wasp selected a large stone and placed it in the burrow (which was fully 1 cm in diameter). She then dropped in several small pebbles and proceeded to scrape in sand, from time to time turning around and packing the sand in place with her head while making a loud buzzing sound. When the burrow was nearly full, she added several more stones, pressing each into place. Finally, she dug soil from a small, semicircular hole 3 cm from the entrance, making a shallow quarry or "false burrow", and scraping this soil into the nest entrance. This was packed into place by holding a stone in her mandibles and pounding, finally leaving the stone in place. The wasp then picked up a stick 4 cm long and dragged it over the top of the covered nest entrance, then added a second stick 7 cm long. She completed the closure at 1135 and was not seen again. The nest was dug out two days later and found to contain a single large sphingid larva (*Smerinthus geminatus* Say) bearing an egg on the side of the fourth abdominal segment (Fig. 9, upper figure). The burrow was vertical, 6 cm long, the cell horizontal and 5 cm long.

Thus this species differs from *azteca* in several important features: the soil is carried from the nest on the ground (and the prey doubtless carried on the ground); some of the soil for closure is obtained from a quarry and various objects are placed on top of the closed nest; and the nest is stocked with a single large caterpillar, thus eliminating the possibility of progressive provisioning or of the overlappng of provisioning of successive nests. *A. macra* bears a close resemblance to the well-studied species *procera* Dahlbom, and the behavior is similar to that species, although *procera* more commonly flies with the soil when digging.

Summary. — *Ammophila azteca* differs from other known North American species of its genus in that several nests are maintained simultaneously; in this respect it bears a close resemblance to the European species *pubescens.* Data indicate that at least two and at times probably three or more nests in various stages are maintained at one time, the female remembering the precise location of each and inspecting each nest, or at least most nests, each day before provisioning. The total duration of each nest is six or seven days.

The prey consists of caterpillars and sawfly larva of many diverse

Fig. 9. Above, larva of sphingid bearing the egg of *Ammophila macra*. Below, larva of a geometrid bearing the egg of *A. azteca.* These were extracted from nests in close proximity at Jackson Hole.

groups, all of them diurnal leaf-feeders of about the same size (8 to 18 mm, usually 12 to 16 mm). The egg is laid on the first prey in each nest and shows much variation with respect to the segment on which it is laid. Up to seven prey are provided per nest.

Soil is carried from the burrow in flight, and the prey is carried to the nest in flight.

Initial closure of the nest consists of a single object placed at the top of the burrow. Temporary closures after oviposition consist of a large object blocking the lumen of the burrow on top of which loose soil and smaller objects are packed, with or without "use of a tool". At final closure, a "tool" is apparently always employed.

Fragmentary data suggest the possibility that some females maintain storage burrows, this perhaps being correlated with maintenance of synchronous nests, all at about the same stage, by some females. More data on these and many other points are needed.

Brief observations on one female *A. macra* nesting in the same area revealed several important differences between this species and *azteca.*

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THE ANT LARVAE OF THE SUBFAMILY LEPTANILLINAE (HYMENOPTERA, FORMICIDAE)

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The Leptanillinae are a small subfamily comprising 14 species in 3 genera: *Leptanilla* Emery, 11 species; *Leptomesites* Kutter, 1 species; *Phaulomyrma* G. C. & E. W. Wheeler, 2 species.

This subfamily has been recorded only from the warmer parts of the Old World: Corsica, Sardinia, North Africa, India, Malaya, Java, Queensland, Western Australia and Japan. Seemingly it is rare, but the paucity of the records may be due to minute size and hypogeic habits. As W. M. Wheeler optimistically remarked (1932, p. 54): "We should expect careful collecting with the Berlese funnel to bring additional forms to light in South Africa, Madagascar, Asia Minor and India, or even, perhaps, in the warmer parts of the New World." Brown (1954, p. 28) noted: "The habits of the species are such as to render their discovery highly fortuitous under present collecting methods." In the 30 years since Wheeler wrote, only two species have been discovered (one in India and one in Japan), which would rather support another statement by Wheeler in the same article (p. 57-58): "The Leptanillinae . . . must be very ancient, like many other components of the microgenton. . . . *L. swani* is particularly interesting in this connection, because the extreme south-western corner of Australia, in which it was taken, is known to possess the oldest and least disturbed fauna of any portion of the continent." Antiquity is compatible with a disjunct distribution and with rarity.

The genus *Leptanilla* was established by Emery in 1870 and then for half a century was kicked about over the taxonomic table. Originally Emery placed it in the "Dorylidae" near *Typhlopone.* Mayr, however, in a letter to Emery (date not given — see Emery 1904) dissented, maintaining that it belonged with the Myrmicinae. Emery was evidently convinced, for in 1875 he removed it to the "Mirmicidei" in the neighborhood of *Stenamma* and *Liomyrmex.* In 1877 he moved it to the vicinity of *Monomorium* and *Leptothorax* in the "Myrmicidei genuini" but marked it with a query to signify uncertain position. In 1881 Ern. André had it in the first tribe, "Myrmicidae verae," of the "Myrmicidae" but mentioned its affinities with the "Dorylides."

Forel in 1893 did not mention the genus but might have meant

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to include it in the subfamily Myrmicinae, when he said that the fourth tribe ("Myrmicii") included "les autres genres de la sous-famille des Myrmicinae." And later (1901) he excluded it from the Dorylinae when he says, "Donc, je maintiens la sous-famille *Dorylinae* limitée aux genres *Dorylus, Aenictus, Eciton* et *Cheliomyrmex.*" In Dalla Torre's "Catalogus" (1893) it was still in the Myrmicinae but near *Trigonogaster* and *Pheidologeton.* In 1895 Emery was still of the opinion that it belonged in the subfamily "Myrmicini" in the second tribe ("Myrmicii") near *Huberia* and *Phacota.* But nine years later (1904), after describing the female of *L. revelierei,* he returned it to its original subfamily (Dorylinae). In the following year in Ashmead's skeleton it stood between *"?Liomyrmex"* and *Epipheidole* in the tribe Stenammini, subfamily Myrmicinae, family "Myrmicidae." In 1907 Santschi described males of 3 species, which he referred to the genus *Leptanilla* and claimed that their doryline affinities justified Emery's original allocation of the genus. It should be noted, however, that males of *Leptanilla* have never been taken with females or workers; hence it is not certain that those described by Santschi belong to this genus. In the "Genera Insectorum" Emery (1910) established for the genus a separate tribe (Leptanillini) in the subfamily Dorylinae, where it seemed destined to abide in isolation: Wheeler (1910), Forel (1917 and 1923), and Wheeler (1922) did not disturb it. Wheeler (1923, p. 335) suggested that even further isolation might be necessary: "I believe that the tribe Leptanillini, which Emery includes among the Dorylinae, will have to be separated out as a distinct subfamily (Leptanillinae). Dr. George C. Wheeler finds that the larva of Leptanilla is very aberrant, and the characters of the adult are either quite unlike those of other Dorylinae or only superficially similar and due to convergence, or similarity of subterranean habits." By 1932 (p. 57) the separation had been effected: "Emery, as is well known, regarded the Leptanillinae as constituting a special tribe of the Dorylinae, but Dr. G. C. Wheeler and I have raised the group to subfamily rank." Bernard (1951) raised the taxon to family rank.

Brown and Nutting (1950, p. 124) in their study of the wing venation for the family Formicidae wrote: "The position of the leptanillines is debatable. They are usually treated as a subfamily by modern authors, and the venation is so highly reduced in the forms we have seen that little may be deduced from them concerning relationships to the other subfamilies." Brown was apparently still puzzled in 1954 (p. 28) for he wrote: "This little subfamily has suffered such drastic anatomical reduction in most of the usually valuable phylogenetic characters that it is doubtful whether we shall ever be certain of its true affinities. . . . It is possible that forms as yet unknown will reveal their ancestry more clearly. Until that time, however, subfamily rank for the *Leptanillinae* may as well be maintained. Present opinion seems to favor relating this group to the *Dorylinae*."

The larvae of the Leptanillinae do bear certain resemblances to the known doryline larvae *(Dorylus, Aenictus, Eciton, Cheliomyrmex):* the long slender body and the small feebly sclerotized mandibles. On the other hand, they differ in the constriction at the metathorax, the long hairs on the abdomen, the absence of hairs on the head and the shape of the head. But these differences become trivial and insignificant beside the three which not only differentiate them from the Dorylinae, but also from all other known formicid larvae (160 genera): (1) the peculiar projection from the ventral surface of the prothorax; (2) the reduction of the spiracles from the normal ten pairs to a single pair, which is located on abdominal somite III; and (3) the shape and stance of the mandibles.

Subfamily LEPTANILLINAE Emery

Elongate and very slender; slightly constricted at the metathorax; anterior end curved ventrally; remainder of body straight and clavate. With a curious complex structure projecting anteroventrally from the ventral surface of the prothorax. Only one pair of spiracles, located on abdominal somite III; each spiracle opening eccentrically on a naked circular area. Body hairs simple; the minute hairs very abundant and uniformly distributed; a few conspicuous long hairs sparsely scattered. Head naked and elongate. Antennae small, slightly raised, each with two sensilla. Labrum slightly broader than long, with the ventral border semicircular; posterior surface spinulose, with the spinules in rows. Mandibles apparently turned laterally (instead of medially, as is usual with ant larvae); feebly sclerotized; each with a rather long slender sharp-pointed apical tooth, which curves laterally; lateral (=outer) border furnished with several long slender sharp-pointed teeth; anterior surface with rows of spinules. Labium thin, flap-like and narrowed basally; lateral surfaces sclerotized; each palp a low ventrolateral projection bearing five sensilla.

Of all the ant larvae studied we have found the Leptanillinae the most difficult to process partly because of their small size but chiefly because of their extreme slenderness. A slender larva is more apt to collapse than a stout one. Furthermore the constriction at the metathorax aggravates the difficulty of cleaning and predisposes to breakage in that region. As a result processing has often left us only fragments to mount on slides. Fragments are all right — in fact, necessary for some parts — if none is lost and if they can be correctly oriented.

References. — W. M. Wheeler (1923, p. 335) used larval characters in establishing the subfamily (quoted above and also by G. C. Wheeler, 1928, p. 88-89 and referred to by G. C. and E. Wheeler, 1930, p. 198).

G. C. Wheeler (1928, p. 89) justified W. M. Wheeler's establishment of the subfamily. (Repeated G. C. and E. Wheeler, 1930, p. 199.)

Kutter 1948 p. 294: "Alle bis jetzt bekannt gewordenen Larven der Leptanillinae haben den teilweise chitinisierten, ventralen Thorakalanhang gemein, wie offenbar auch die Senkrechtstellung der Mandibeln, während der Besitz des als Tympanalorgan bezeichneten Organs noch nicht als typisch für alle Larven der Unterfamilie bezeichnet werden darf."

Bernard, 1951, p. 1041: "Larves eucéphales, carnivores; nourries par les ouvrières."

Genus *Leptanilla* Emery

We are unable to separate *Leptanilla* generically from *Leptomesites:* the difference between the larvae of the two known species of the former are as great as the difference between either species and the larva of the latter. Therefore the subfamilial description will suffice for the genus.

Bernard (1951, p. 1017) described primitive larvae and mentioned the larva of *Leptanilla* as an example.

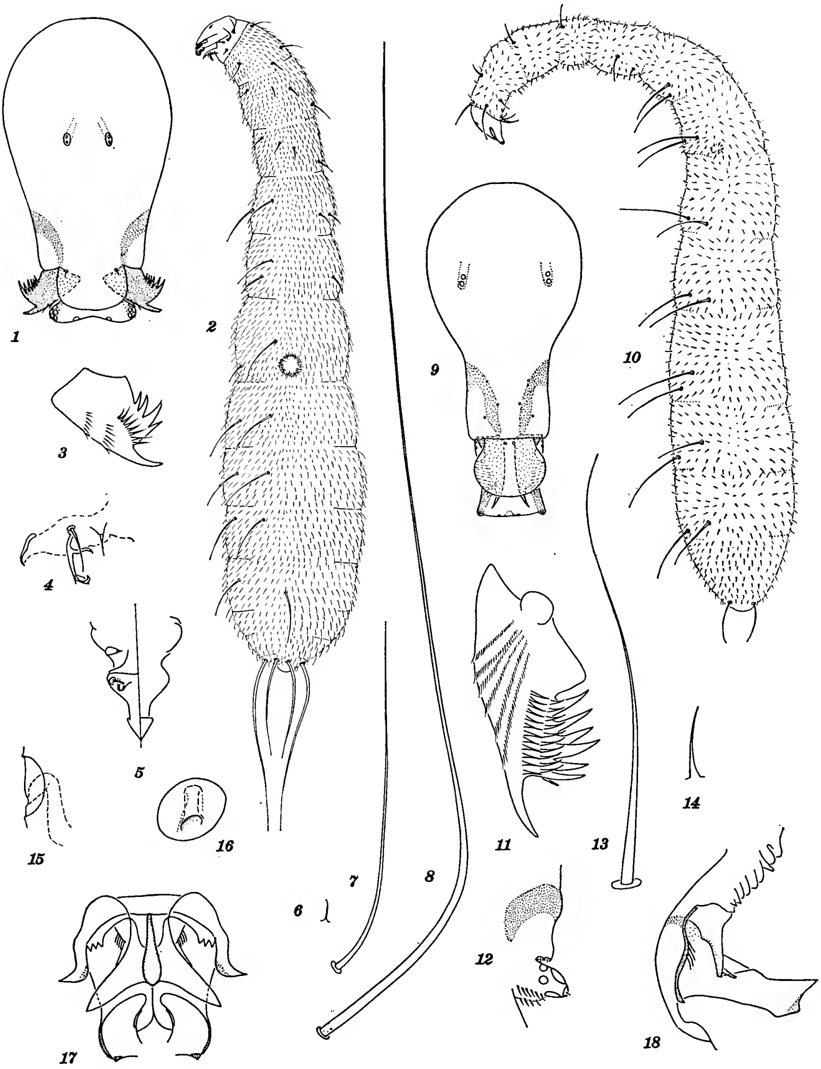
Kutter (1948, p. 292) differentiated the two genera by the absence of the naked area around the spiracle ("tympanum") and the structure of the ventral prothoracic projection. As we show below, this distinction is no longer tenable.

The two species of *Leptanilla* differ with respect to the following characters: size and shape of terminal boss; complexity of ventral prothoracic projection; size and arrangement of long body hairs; shape of head; number of teeth and spinules on the mandibles; and the sclerotized band bordering the spiracular area.

Leptanilla revelierei sardoa Emery

(Fig. 1-8)

Length approximately 1.3 mm. Body elongate and slender; thorax slightly curved ventrally, slightly constricted at the metathorax; abdomen straight and clavate, the diameter increasing gradually to abdominal somite V and decreasing to the posterior end which is



WHEELER — ANT LARVAE

rounded and terminates in a small naked hemispherical boss. With a complex structure projecting anteroventrally from the ventral surface of the prothorax (see Fig. 4-5). With only one pair of spiracles, located on the third abdominal somite near the posterior border; each spiracle opening eccentrically on a naked circular area, which is bordered by a narrow heavily sclerotized band. Body hairs simple. Of three types: (1) numerous, increasing in length from 0.005 mm on the thorax to 0.02 mm at the posterior end, without alveolus and articular membrane, uniformly distributed but lacking from the anterior portion of the prothorax, the circumspiracular area and the terminal boss; (2) 0.01-0.15 mm long (shortest on the prothorax), few, conspicuous, the longest attenuated and flexible distally, with alveolus and articular membrane, absent from the dorsal surface of abdominal somites III-IX; (3) about 0.3 mm long, with attenuated flexible tip, two (one dorsal and one ventral) on the posterior end near the terminal boss. Head naked; elongate; widest above the antennal level; cranium subpyriform in anterior view. Antennae small; slightly raised; each with two sensilla, each of which bears a spinule. Labrum slightly broader than long; the ventral border semicircular; posterior surface spinulose, the spinules in long rows, the rows concentric with the ventral border. Mandibles with the toothed border directed laterally; feebly sclerotized; each with a rather long slender sharp-pointed apical tooth, which is curved laterally; lateral border with four long slender sharp-pointed teeth; a few rows of rather large spinules on the anterior surface. Maxillae adnate to the labium; palp a stalked hemispherical knob directed laterally and bearing five sensilla; no galea seen. Labium a thin flap, narrowed basally; lateral surfaces sclerotized; each palp a low ventrolateral projection bearing five sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a transverse impression on the anterior surface.

EXPLANATION OF PLATE 2

Figs. 1-8. *Leptanilla revelierei sardoa.* 1, head in anterior view, ×417; 2, larva in side view, ×76; 3, left mandible in anterior view, ×847; 4, ventral prothoracic structure in side view, ×423; 5, ventral prothoracic structure: left half in posterior view, right half in anterior view, ×423; 6-8, three body hairs, ×500.

Figs. 9-18. *Leptanilla swani.* 9, head in anterior view, ×417; 10, larva in side view, ×76; 11, left mandible in anterior view, ×1333; 12, left maxilla in anterior view, ×847; 13 and 14, two body hairs, ×500; 15 and 16, spiracle and circumspiracular area in side and surface phantom views (hairs omitted) ×333; 17 and 18, ventral prothoracic structure in anterior view and in side view, ×667.

Material Studied. — Three larvae labeled "Sardegna: Golfo Aranci. I. 1909 A. Dodero." These are the specimens studied by G. C. Wheeler (1928). We studied them first with a phase microscope; then they were dismounted, stained lightly, remounted and studied under both phase and light microscopes.

Literature. The description and figures by G. C. Wheeler (1928, p. 85-87) have been completely revised for this article. Bernard, 1951, Fig. 949 C, D after G. C. Wheeler, 1928.

Leptanilla swani Wheeler

(Fig. 9-18)

Length about 1.4 mm. Body elongate and very slender; anterior end curved ventrally, slightly constricted at the metathorax; remainder of body straight and clavate; diameter increasing gradually to abdominal somite VII and diminishing to the posterior end, which is round-pointed and terminates in a small naked boss. With a complex structure projecting anteroventrally from the ventral surface of the prothorax (see Fig. 17-18). With only one pair of spiracles, located near the posterior border of abdominal somite III; each spiracle opening eccentrically on a naked circular area. Body hairs simple. Of two types: (1) abundant and uniformly distributed (except on the terminal boss and the circumspiracular area), minute (0.005-0.024 mm long), longest near the posterior end, without alveolus and articular membrane; (2) long (0.084-0.23 mm), slender, with the apical portion fine and flexible, with alveolus and articular membrane, few, conspicuous, absent from the dorsal surface of the abdomen. Head naked; elongate; widest at the level of the antennae; cranium subpyriform in anterior view. Antennae small and slightly raised; each with two sensilla, each of which bears a spinule. Labrum slightly broader than long, with the ventral border semicircular; posterior surface spinulose, the spinules rather numerous and long, arranged in rows concentric with the ventral border. Mandibles with the toothed border directed laterally; feebly sclerotized; each with a rather long slender sharp-pointed apical tooth, which curves laterally; lateral border with six long slender sharp-pointed teeth; anterior surface spinulose, the spinules numerous, rather long and arranged in rows; posterior surface with one row of long spinules. Maxillae adnate to the labium; palp an irregular knob projecting laterally and bearing five sensilla; no galea seen. Labium a thin flap, narrowed basally; lateral surfaces sclerotized; each palp a low ventrolateral projection bearing five sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a transverse slit on the ventral border.

Material Studied. — Three larvae from Chittering, Western Australia collected by D. C. Swan. These are the specimens referred to by W. M. Wheeler in 1932 (p. 56-57). We studied them first with a phase microscope; then they were dismounted, stained lightly, remounted and studied under both phase and light microscopes.

In 1963 Rev. B. B. Lowery of St. Ignatius College (Sydney, Australia) generously sent us 40 larvae of this species, which he had collected at Cunningham's Gap in southern Queensland. The two best specimens have been kept in alcohol. Many others were processed according to our standard technique (1960) and studied under both phase and light microscopes.

Literature. W. M. Wheeler (1932, p. 56-57) compared the larva of *L. swani* with that of *L. sardoa* by quoting from a letter from G. C. Wheeler to whom he had sent the larvae for study.

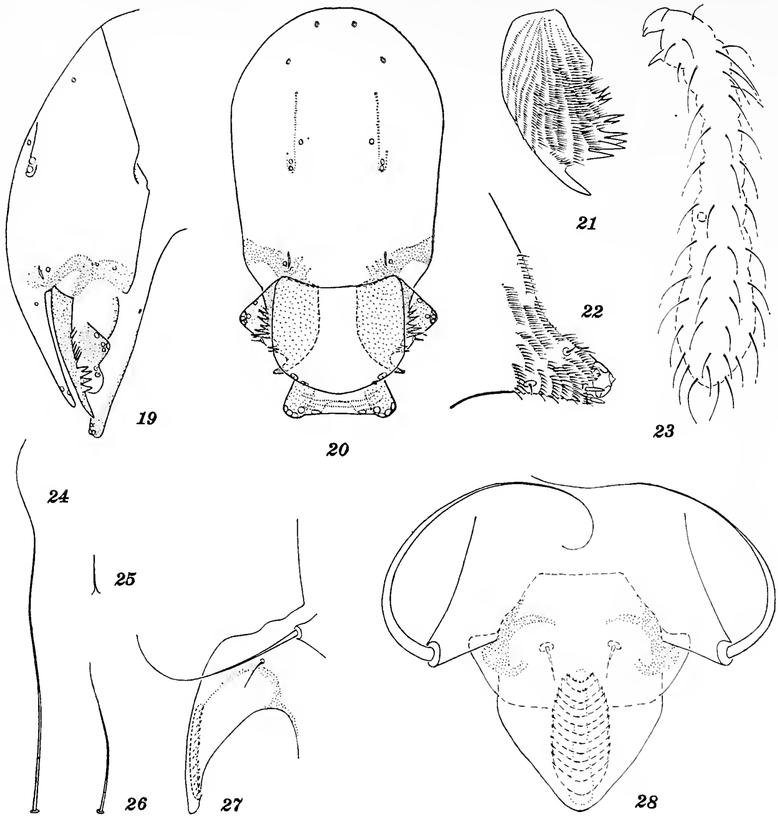
Genus *Leptomesites* Kutter

As explained above under the genus *Leptanilla,* we are unable to separate *Leptomesites* generically from *Leptanilla.* Therefore our subfamilial description will have to suffice for this genus.

Kutter (1948, p. 287) has characterized the genus thus: "Körper sehr langgestreckt-zylindrisch, gegen das Ende keulenförmig aufgetrieben. Labrum ohne gezähnte, laterale Läppchen. Mandibeln abwärts gerichtet, gezähnt. Auf der Ventralseite des Prothorax mit breitem, in der Mittelpartie mit chitinisiertem, quergerilltem, lappigem Anhang. Beiderseits dieses einzigartigen Anhanges je eine sehr lange, sichelförmig ventralwärts gebogene Borste. (Ein Tympanalorgan, wie es von der *Leptanilla*-Larve gemeldet wird, konnte nicht mit Sicherheit nachgewiesen werden.)"

Leptomesites escheri Kutter
(Fig. 19-28)

Length about 1.5 mm. Body elongate and slender, apparently constricted at the metathorax; anterior end slightly curved ventrally; abdomen clavate, with the posterior end narrowly rounded. Projecting ventrally from the anterior portion of the prothorax is a curious flap-like structure furnished with 14 ridges on the posterior surface. Only one pair of spiracles present, on abdominal somite III (or IV?). Body hairs simple. Of two types: (1) minute (0.009-0.026 mm long), longest near the spiracle, numerous, uniformly distributed, without alveolus and articular membrane; (2) short to very long (0.042-0.096 mm), a few on each somite, the apical portion fine and flexible, with alveolus and articular membrane. Head naked; elongate; widest above the antennal level; cranium subovoidal. Antennae small



Figures 19-28. *Leptomesites escheri.* 19, head in side view, ×278; 20, head in anterior view, ×278; 21, left mandible in anterior view, ×423; 22, left maxilla in anterior view, ×415; 23, restoration of larva in side view (minute hairs omitted), ×33; 24-26, three body hairs, ×139; 27 and 28, ventral prothoracic structure in side view and in anterior view, ×272.

and slightly raised; each with two sensilla, each of which bears a spinule. Labrum slightly broader than long; the ventral border semicircular; posterior surface spinulose, the spinules in long rows, the rows concentric with the ventral border. Mandibles with the toothed border directed laterally; feebly sclerotized; each with a rather long slender sharp-pointed apical tooth, which is curved laterally; lateral border with nine long slender sharp-pointed teeth; anterior surface furnished with numerous short rows of long spinules, the rows so close together that the spinules overlap. Maxillae conoidal, pointing laterally; palp apical and consisting of five sensilla; galea represented by two sensilla, each of which bears a digitiform spinule. Labium feebly bilobed, flap-like, narrowed basally; palp a low ventrolateral projection bearing five sensilla; an isolated sensillum between each palp and the opening of the sericteries; the latter a transverse slit on the ventral surface. Hypopharynx spinulose, the spinules in short transverse rows, the rows so close together that the spinules overlap.

Material Studied: — Two semipupae (?) from southern India. These are the specimens studied by Dr. Heinrich Kutter (1948, p. 290-292) of Männedorf, Switzerland. In 1963 we asked Dr. Kutter whether he would be willing to let us examine them. His generous response was to send them to us as a gift. We studied them first with the phase microscope; then they were dismounted, stained lightly, remounted and studied under both phase and light microscopes. We were not able to inflate the wrinkled specimens; therefore our drawing of the larva in side view is a restoration.

Literature. Kutter (1948, p. 290-292): a description of the species; Fig. 6, larva in side view; Fig. 7, anterior end enlarged.

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THE AUSTRALIAN ANTS OF THE GENUS *PRISTOMYRMEX*, WITH A CASE OF APPARENT CHARACTER DISPLACEMENT[1]

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Introduction

The Old World myrmicine ant genus, *Pristomyrmex* Mayr 1866, contains about 40 named forms, mostly from rain forests of the Ethiopian, Oriental and Australian regions. The Australian mainland fauna is small compared to that of New Guinea; it includes four species, three of which are newly described here. There are two species-groups, those of *P. foveolatus* n. sp., and *P. quadridentatus* (André) 1905, each containing two species.

The former group includes *P. foveolatus* and *P. thoracicus* n. sp., closely related species with strong foveolate-reticulate sculpturation, having clear affinities with components of the New Guinean fauna, and known only from rain forests in the Cairns district of North Queensland. *Foveolatus* seems to be restricted to the Atherton Tableland, at elevations greater than 1000 ft, while *thoracicus* is apparently more widespread, but is not known from the Tableland proper.

The affinities of the *quadridentatus* group are less clear; its species occur further south, in extreme S.E. Queensland, and N.E. New South Wales, and they may be derived from a separate, older, Melanesian stock. The group includes *P. quadridentatus* and *P. wheeleri* n. sp. *Quadridentatus* was originally placed in a separate monotypic genus, *Odontomyrmex* André 1905, which was synonymized with *Pristomyrmex* by Emery (1922). The lack of foveolate sculpturation on the head and body, and the presence of pronotal spines were thought by André to taxonomically characterize *Odontomyrmex*. But these characters occur together or separately in many *Pristomyrmex* species, and cannot be used to logically define a separate taxon (Brown, 1953). Nonetheless the *"Odontomyrmex"* habitus seems to characterize a natural phyletic group within the Australian fauna, and *quadridentatus* and *wheeleri* are undoubtedly cognate, or at least closely related. The former species is typically self-colored golden-brown, but it has an apparently conspecific bicolored variant, *quadridentatus* variety

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[1] Research supported by U.S. National Science Foundation Grant No. GB 1634 (1963-1965). Australian field studies in 1962, reported here, were supported by the Committee on Evolutionary Biology, Harvard University.

queenslandensis Forel 1915, which is synonymized below. These two forms differ only slightly, except in coloration, and distributional evidence suggests that the bicolored form is a character-displaced variant, produced wherever the range of *quadridentatus* overlaps that of *wheeleri* (see fig. 15, plate 3, and discussion on p. 53). Like their northern congeners the *quadridentatus*-group species are known only from rain forest, usually at elevations of + 1000 ft.

Available biological information is given in the taxonomic section to follow. Nesting apparently occurs in rotting logs in all species except *wheeleri,* colonies of which are usually located in the soil, under stones. Feeding and foraging behavior have not been extensively studied, but the bicolored form of *quadridentatus* forages nocturnally, in the open, on logs, tree trunks and low foliage. It appears that *wheeleri* may restrict its foraging activity to the soil and leaf litter, since strays have not been taken elsewhere, in spite of extensive search by the author.

All Australian *Pristomyrmex* types are workers, and the females are known for all species except *foveolatus;* I have seen no male specimens. Larvae of a North Queensland species were described by G. C. and J. Wheeler (1954). I have been unable to locate adults from the series involved; they would conform to the *foveolatus*-group diagnosis according to their collector, Dr. W. L. Brown, Jr.

This study is based on material from the Museum of Comparative Zoology collection at Harvard University, from Entomology Division, CSIRO, Canberra, The National Museum of Victoria, Melbourne, and the collection of Rev. B. B. Lowery, S.J., Sydney.

MEASUREMENTS AND INDICES

The following abbreviations are used in the descriptions below. Measurements were prepared using a stereomicroscope fitted with an eyepiece scale, reading directly in units of 0.1 and 0.01 mm at 100 × magnification. The measurements cited are the *maxima* obtained after a series of trials, a fact of special importance when dealing with HL and WL.

HL	Maximum *head length,* frontal view, from apex of median clypeal denticle to median occipital border.
HW	*Head width,* frontal view, *including* the eyes.
CI	*Cephalic index* (HW × 100)/HL
SL	*Scape length,* excluding articular boss and condyle (*but* including the expanded lamella at base of shaft).
SI	*Scape index* (SL × 100)/HW
PW	*Pronotum width,* anterior view, immediately below the bases of the pronotal spines.

Scutum Width (females only), dorsal view, across the widest part of the sclerite.

WL *Weber's length of mesosoma,* lateral view; in *worker,* maximum diagonal distance from junction of anterior and dorsal faces of pronotum to apex of inferior metapleural lobe; in *female,* the anterior limit of measurement is the point where the pro-mesonotal suture meets the anterodorsal mesosomal profile.

Pronotal Spine L(ength), as seen in PW measuring position, true *vertical* distance between base of spine on its mesial side, and the level of its apex.

Propodeal Spine L(ength), lateral view, maximum distance from apex of spine to opposite edge of propodeal spiracle.

Petiole L(ength), lateral view, from tip of metapleural spine to posterodorsal edge of petiolar tergite.

Postpetiole Height, lateral view, maximum distance from apex of subpostpetiolar process to postpetiolar dorsum.

Eye Diameter, maximum diameter of eye.

Ocular Index (Eye Diameter × 100)/HW.

KEY TO THE AUSTRALIAN *Pristomyrmex* SPECIES
(Based on the workers)

1. Front of head, between the antennal scrobes, with numerous large shallow umbilicate foveae, their average diameter about 0.05-0.06 mm (group of *P. foveolatus*) 2
   Area of frons between antennal scrobes entirely smooth, lacking sculpturation apart from a few minute, pilosity-bearing punctures (group of *P. quadridentatus*) 3
2. Scapes barely reaching level of occipital border when at rest in the antennal scrobes, with the head held in full-face view (fig. 1); *Scape Index* 78-83 .... *P. foveolatus* n. sp.
   Scapes exceeding level of occipital border by 1-1.5 × their maximum thickness when at rest in the antennal scrobes, with the head viewed full-face (fig. 3), *Scape Index* 96-101 .... *P. thoracicus* n. sp.
3. Head relatively narrow (*Cephalic Index* 97-103) (fig. 7), either concolorous with mesosoma or much lighter in color (plate 3); pronotal spines, in side view, distinctly longer and stronger than those of propodeum (fig. 8) .... *P. quadridentatus* (André)
   Head relatively much broader (*Cephalic Index* 110-116) (fig. 11) and usually much darker in color than the mesosoma (plate 3); pronotal spines subequal in size to propodeal ones, or very slightly smaller (fig. 12) .... *P. wheeleri* n. sp.

SPECIES-LEVEL TAXONOMY

1. **Pristomyrmex foveolatus** new species

(Figs. 1, 2)

Holotype worker. HL 0.84 mm; HW 0.92 mm; CI 110; SL 0.75 mm; SI 81; PW 0.55 mm; WL 0.79 mm; Propodeal Spine L 0.35 mm; Petiole L 0.30 mm; Postpetiole Height 0.30 mm. General features as in figures 1 and 2. Mandibles with two adjacent strong acute apical teeth and a truncated basal one, separated by a broad, shallowly concave diastema. Clypeus with a median longitudinal carina, its anterior border with 5 obtuse denticles, the median and outer lateral ones largest. Antennal scrobes shallow, their ventral borders obscure. Occipital area of cranium enclosed dorsally and laterally by a fine arched carina. Scapes barely attaining level of occipital border when lying in the antennal scrobes, with the head viewed in HL measuring position (see p. 36). Funiculus with a 3-segmented club, proportions of its segments as in Figure 1. Eyes moderately large, maximum diameter 0.12 mm, their anterior edges almost twice this distance from the anterior genal borders. Mesosomal profile as in Figure 2. Pronotum truncated anteriorly, its inferior angles edentate. Humeri each with a small acute tooth about 0.05 mm long, inclined dorsolaterally to project beyond the main lateral outline of the pronotum, when viewed from above. Posterolateral corners of pronotal dorsum forming blunt angles of about 90 degrees in dorsal view. Anterodorsal edge of mesepisternum extended anteriorly as a strong, moderately acute process which partially overlaps the fore-coxa. Propodeal spines long, almost straight, each diverging from the dorsal midline at an angle of about 20 degrees. Metapleural spines small, moderately acute, each about 0.07 mm long, slightly wider at base. Petiolar and postpetiolar profiles as in Figure 2. Petiole slightly narrower than postpetiole when viewed from above, its crest transverse in posterior view and feebly convex.

Mandibles generally smooth, with several longitudinal ribs. Clypeus strongly shining. Head polished and reflective, with numerous large shallow subcircular umbilicate foveae, averaging about 0.06 mm in diameter, largest on the posterior genal surfaces, lacking on a small smooth area between eye and antennal socket on each side, generally separated by distances averaging about one-third their mean diameter. Postgenae obscurely foveolate. Antennal scrobes smooth, with an almost effaced rugulosity and several arched transverse striae anteriorly. Pronotal dorsum obscurely foveolate, with several median longitudinal costulae. Posteriorly these meet a transverse carina which apparently represents the mesonotum. Propodeal dorsum smooth, framed by lateral and posterior carinae. Sides of mesosoma generally smooth, ventral parts of mesepisternum, metepisternal area, and sides of propodeum obscurely roughened. Petiole, postpetiole and gaster, antennae and legs, smooth and shining.

Pilosity moderately long and abundant on head and mesosoma, erect to sub-erect, longest on clypeus, crown of head, and pronotal dorsum; shorter erert hairs on scape, sub-erect ones on mandibles, funiculus and legs. Hairs lacking on sides of mesosoma. Petiolar and postpetiolar tergites each with three bilaterally symmetrical pairs of hairs (positions as in Figure 2), postpetiolar sternite with a single pair. Gaster very finely pilose apically, its first tergite completely bare. Pubescence lacking.

Color rich golden sienna-brown, mandibles, clypeus, antennae and legs lighter, eyes black, pilosity whitish.

Type-locality. Clump Point, west of Tully, N. Queensland.

The holotype was taken in a rotting wood fragment on the floor of very disturbed, depauperate rain forest, a few feet above sea level (June 25, 1962; R. W. Taylor acc. 1746).

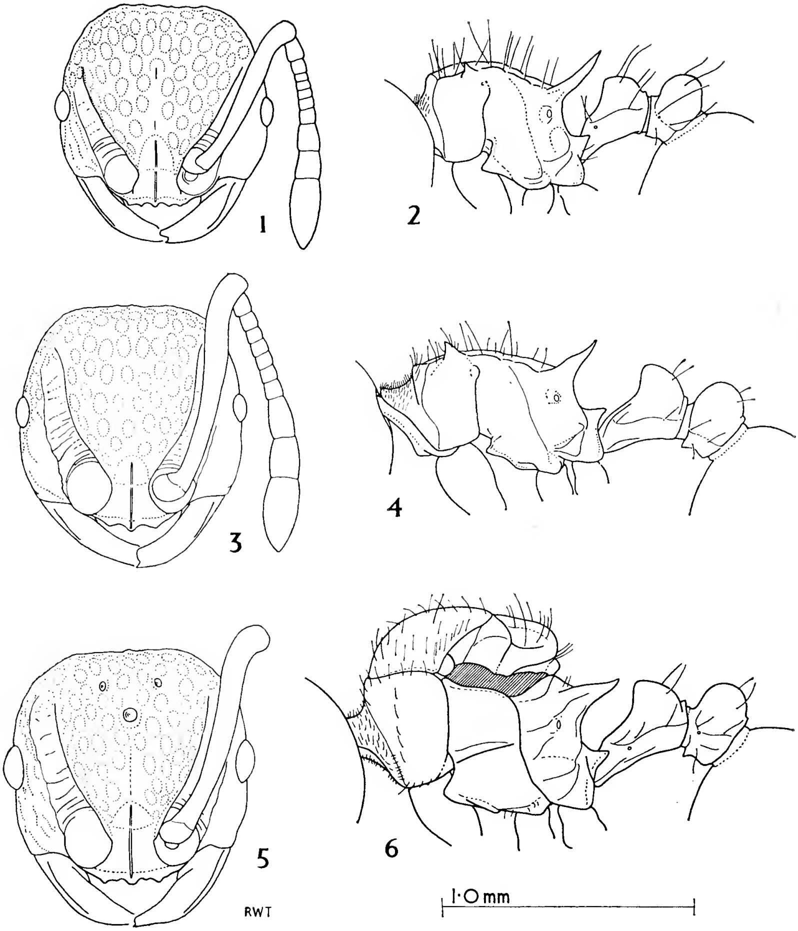
Paratype workers. Three specimens collected with the holotype resemble it closely; they have the following dimensions: HL 0.82-0.88 mm; HW 0.87-0.96 mm; CI 106-109; SL 0.72-0.75 mm; SI 78-83; PW 0.52-0.57 mm; WL 0.77-0.79 mm; Propodeal Spine L 0.32-0.35 mm; Petiole L 0.29-0.33 mm; Postpetiole Height 0.28-0.30 mm.

An additional specimen from rain forest at Thornton Peak (Mt. Alexander), north-west of Daintree, N. Queensland (elevation not specified but probably +1000 ft (Darlington, 1960: 117), December 20-23, 1957; P. F. Darlington) has: HL 0.85 mm; HW 0.95 mm; CI 112; SL 0.75 mm; SI 79; PW 0.53 mm; WL 0.78 mm; Propodeal Spine L 0.32 mm; Petiole L 0.28 mm; Postpetiole Height 0.29 mm.

This species may show slight unimodal polymorphism. In the short series available SL, and the mesosomal dimensions PW and WL are negatively allometric relative to HW, while HL is positively allometric.

Distribution and Material Examined. Known only from the five workers listed above. Clump Point and Thorton Peak are within the area of the main "base-of-peninsula" rain forest system of North Queensland.

Type deposition. Holotype and three paratypes in Museum of Comparative Zoology (MCZ) at Harvard University (Type No.



Figures 1-6: North Queensland species of *Pristomyrmex foveolatus* species-group — *P. foveolatus* n. sp., holotype worker: fig. 1, head, frontal view; fig. 2, mesosoma, petiole and postpetiole, lateral view. — *P. thoracicus* n. sp., holotype worker: fig. 3, head, frontal view; fig. 4, mesosoma, petiole and postpetiole, lateral view. Paratype female: fig. 5, head, frontal view; fig. 6, mesosoma, petiole and postpetiole, lateral view.

31152); one paratype (from Clump Point) in Australian National Insect Collection (CSIRO), Canberra.

2. **Pristomyrmex thoracicus** new species

(Figs. 3-6)

Worker. The following description is based on the holotype and 14 paratypes collected with it. Dimensions (holotype cited first): HL 0.95, 0.89-0.96 mm; HW 0.95, 0.89-0.99 mm; CI 100, 98-104; SL 0.93, 0.90-0.96 mm; SI 98, 96-101; PW 0.49, 0.45-0.51 mm; WL 0.91, 0.87-0.94 mm; Propodeal Spine L 0.30, 0.28-0.32 mm; Petiole L 0.34, 0.33-0.36 mm; Postpetiole Height 0.32, 0.28-0.32 mm. General features as in Figures 3 and 4. Similar to *P. foveolatus*, differentiated from it by the following characters:

1. Relatively narrow head (CI 98-105 against 106-110 in *foveolatus*).

2. Much longer scapes, which surpass the level of the occipital border by 1-1.5 × their maximum thickness when lying in the antennal scrobes, with the head viewed in the HL measuring position (SI 96-101 against 78-83).

3. Proportionately much longer mesosoma (WL 0.94-1.00 × HW, against 0.81-0.89 × in *foveolatus*), which is relatively very narrow (PW 0.51-0.53 × HW, and 0.50-0.55 × WL against 0.56-0.62 × and 0.67-0.73 × respectively in *foveolatus*).

4. Eyes relatively slightly smaller; antennal scrobes more distinctly outlined. Humeral teeth more erect, failing to project beyond lateral pronotal outline when viewed from above. Posterolateral corners of pronotal dorsum obtuse, broadly rounded in dorsal view. Propodeal spines slightly sinuate, their apices turned upwards; diverging from the dorsal midline at angles of about 20 degrees. Metapleural spines more acute. Petiolar crest strongly convex in dorsal view, its outline almost a half circle.

5. Sculpturation virtually identical. Cephalic foveae a little more spaced; sides of mesosoma less sculptured, generally smooth and shining.

6. Pilosity similarly distributed, the hairs shorter, especially on the crown of the head, and the pronotal dorsum; less abundant on propodeal dorsum. Hairs of petiole, postpetiole and gaster placed exactly as in *foveolatus*.

Type-locality. Vision Falls, Lake Eacham National Park, N. Queensland. The type nest series was taken from a rotting log in rain forest, elevation *c.* 2500 ft (June 6, 1962; R. W. Taylor acc. 1399).

Additional paratype workers. Three workers from Beatrice River, Crawford's Lookout, N. Queensland (elevation probably *c.* 1000 ft. (Darlington, 1960: 118), rain forest, February 21-22, 1958; Darlingtons) and a single worker from Kuranda, N. Queensland (1100 ft, rain forest, July 4, 1962, R. W. Taylor acc. 1358) have the following dimensions (Crawford's Lookout material cited first): HL 0.86-0.89, 0.89 mm; HW 0.87-0.90, 0.93 mm; CI 101-102, 105; SL 0.88-0.89, 0.90 mm; SI 99-101, 97; PW 0.45-0.47, 0.47 mm; WL 0.84-0.85, 0.88 mm; Propodeal Spine L 0.27-0.28, 0.31 mm; Petiole L 0.31-0.33, 0.33 mm; Postpetiole Height 0.29-0.31, 0.31 mm. Polymorphism weak, as in *P. foveolatus* — SL, PW and WL negatively allometric relative to HW, HL positively allometric.

Paratype females. Two females are present in the type series, one from the holotype nest, the other from the Crawford's Lookout collection. Dimensions (Lake Eacham specimen cited first): HL 0.96, 0.95 mm; HW 1.04, 1.02 mm; CI 109, 108; SL 0.95, 0.92 mm; SI 91, 90; Scutum W 0.67, 0.65 mm; WL 1.09, 1.04 mm; Propodeal Spine L 0.32, 0.31 mm; Petiole L 0.38, 0.38 mm; Postpetiole Height 0.35, 0.35 mm; Eye Diameter 0.17, 0.17 mm; Ocular Index 16, 17. General features as in Figures 5 and 6. Pronotum without humeral spines; mesoscutum lacking parapsidal lines, propodeal spines diverging from dorsal midline at angles of 30 and 33 degrees. Mesonotal sclerites moderately coarsely longitudinally costulate, with vestiges of interstitial foveae. Pilosity as in worker; petiolar and postpetiolar hairs similarly arrayed, the petiolar peduncle with an additional pair of lateral hairs.

Color as in worker; each ocellus with an adjacent black spot; the mesosomal suture lines darkly infuscated.

Distribution and material examined. Known only from the 19 workers and two females discussed above. Lake Eacham, Crawford's Lookout and Kuranda are all at moderately high elevations on the Atherton Tableland, within the compass of the main "base-of-peninsula" rain forest system of N. Queensland.

Type deposition. Holotype, 11 paratype workers and paratype female (from holotype nest) in MCZ (Type No. 31153); four paratype workers and female in CSIRO; single paratypes in Queensland Museum, Brisbane; National Museum of Victoria, Melbourne; and British Museum (Nat. Hist.), London.

3. **Pristomyrmex quadridentatus** (Ern. André)

(Figs. 7-10, Plate 3)

Odontomyrmex quadridentatus **Ern. André, 1905, Rev. Ent. Caen., 24: 207, worker. Type-locality: Sydney.**

Pristomyrmex quadridentatus: Emery, 1922, Gen. Ins., 174c: 234.

Pristomyrmex (Odontomyrmex) quadridentatus v. *queenslandensis* Forel, 1915, Arkiv F. Zool., 9 (16): 53, worker. Type-locality: Mt. Tambourine (=Tamborine Mountain). NEW SYNONYMY.[2]

Pristomyrmex quadridentatus var. *queenslandensis*: Emery, 1922, Gen. Ins., 174c: 234.

Syntype workers. Two *quadridentatus* syntypes, each labeled "Sydney/Duchaussoy/TYPE" have kindly been loaned for study by Mlle. S. Kelner-Pillault of the Muséum National D'Histoire Naturelle, Paris. These specimens are here designated lectotype and paralectotype and are so labeled. The paralectotype gaster is missing.

Judging from subsequent records the Sydney type-locality may be outside the true range of this species and should be regarded with reservation as a distributional record until confirmed.

Dimensions as given in Table 1 (lectotype cited first). General features as in Figures 7 and 8. Mandibular dentition as in *P. foveolatus*. Clypeus with a median longitudinal carina, its anterior border with three separated, moderately acute denticles (apparently representing the median and outer-lateral ones of *foveolatus*). Antennal scrobes open posteriorly but well defined dorsally and ventrally by distinct sharp sub-parallel carinae. Occipital carina distinct. Scapes, in frontal view, laid in the scrobes, exceeding the level of the occipital border by about 1.5 × their maximum thickness. Funicular proportions as in Fig. 7. Ocular Index 17-18.

Mesosomal profile as in Figure 8. Pronotum with a distinct transverse anterior carina. Pronotal spines almost vertical, considerably stronger than propodeal ones. Mesonotum represented by a transverse carina on mesosomal dorsum. Propodeal spines each diverging from the midline at an angle of about 12 degrees; about equal in size to metapleural spines in lectotype, somewhat smaller in paralectotype. Petiole and postpetiole as in Figure 9; petiolar crest strongly arched in posterior view; postpetiole very slightly wider than petiole in dorsal view.

Head and body almost completely lacking sculpturation, smooth and strongly shining, except for a little fine shagreening on the pronotal collar and slight obscure roughening on the sides of the propodeum. Pilosity generally as in *P. foveolatus;* petiolar and postpetiolar hairs similarly distributed, but with an additional pair on the petiolar peduncle (as in the *thoracicus* female). First gastric tergite completely naked. Pubescence virtually absent.

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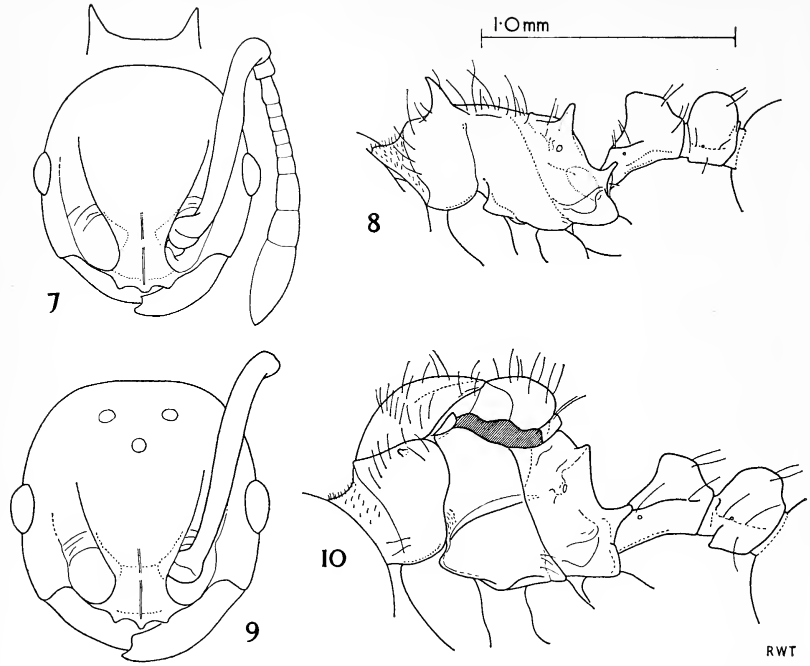
[2] I have not seen the *queenslandensis* type, but specimens from the Mt. D'Aguilar series, listed below, have been directly compared with it for me by Dr. W. L. Brown, Jr.



Figures 7-10: *Pristomyrmex quadridentatus* André. — lectotype worker: fig. 7, head and pronotal outline in frontal view; fig. 8, mesosoma, petiole and postpetiole in lateral view. Female (self-colored form): fig. 9, head, frontal view; fig. 10, mesosoma, petiole and postpetiole, lateral view.

Color almost even rich light-golden sienna-brown, mesosoma a shade darker, masticatory border of mandible, and segments 2-8 of antennal funiculus darkly infuscated, less dark infuscation on scapes and the various carinae and spines of head and mesosoma. Eyes dark brown, almost black.

Additional material examined, distribution. Additional distributional records fall into two geographical clusters (Fig. 15) which coincide with the distribution of two morphological forms, apparently representing geographical variants of a single species. These variants are discussed in detail below and illustrated in plate 3; essentially there is a southern, self-colored golden-brown form (to which the lectotype and paralectotype belong), and a more northern bicolored form with dark blackish-brown mesosoma, petiole and postpetiole (equivalent to Forel's suppressed variety *queenslandensis*). They are distributed as follows:

1. *Self-colored form:* N.E. NEW SOUTH WALES between about S. lat. 29.40 and 30.20 (not including Sydney — see above) (open circles in Fig. 15).

Specific records are: *Point Lookout to Grafton,* dealate female, April 1958, (P. F. Darlington). *New England National Park,* Platypus Creek (elevation not given, probably 2-3000 ft — see LeGay Brereton, 1963, fig. 1), in log, February 27, 1961 (Nicholls). *The Dorrigo* 3000 ft (W. Heron).

2. *Bicolored form:* Extreme S.E. QUEENSLAND, between about S. lat. 27.20 and 28.20 (closed circles in Fig. 15).

Specific records are: *Mt. D'Aguilar Range,* 2000 ft, nest in rotting log, May 4, 1962 (RWT acc. 799). *Cunningham's Gap,* 2500 ft, nest in rotting log, May 1, 1962 (RWT). *Stradbroke Island,* dealate queen, December 3, 1912 (H. Hacker). *Tamborine Mountain:* no further data (A. M. Lea); Cedar Creek, ex rotting logs — dealate female, May 15, 1951, workers November 13, 1950 and May 12, 1951 (W. L. Brown); worker under log, February 27, 1956 (B. B. Lowery). *Binna Burra: c.* 2600 ft: nests in rotting logs, one with alate female, May 22-23, 1962 (RWT accs. 1145, 1182); several series of workers collected straying at night (see below under "ecology"), May 21-23, 1962 (RWT). *Lamington National Park,* Coomera Gorge: leafmold berlesate, October 29, 1955 (T. E. Woodward); 2200 ft, nest in rotting log, May 23, 1962 (RWT acc. 1168).

All the above records are specifically cited as rain forest collections, except the dealate female from Stradbroke Island, which has no ecological data.

Worker variation. Measurements and indices of workers from the above series are summarized in Table 1. The similarity of ranges and means in the two color variants is obvious and reflects their considerable resemblance in all characters except color.

The coloration of the types (Plate 3, lower figure) is typical of the self-colored form. The bicolored form has the mesosoma, petiole and postpetiole very dark blackish-brown, contrasting sharply with the golden-brown head, gaster and appendages (Plate 3, middle figure), and the antennal infuscation is much less intense. The pronotum and postpetiole may be medium to dark reddish-brown, usually in the larger specimens of a given series. Such individuals are probably incompletely colored; since these areas are the last to become fully pigmented in callow specimens.

The mesosomal spines vary in thickness, length and inclination. The pronotal pair are typically longer and thicker than the propodeal ones,

	SELF-COLORED FORM				BICOLORED FORM			
Series No.	**Types**	**1**	**2**	**Total**	**3**	**4**	**5**	**Total**
Number	2	4	11	17	10	14	31	55
HL	0.95, 0.99	1.03-1.07 *(1.04)*	1.00-1.06 *(1.03)*	0.95-1.07 *(1.00)*	0.88-1.06 *(0.97)*	0.92-1.11 *(1.03)*	0.97-1.11 *(1.01)*	0.88-1.11 *(1.00)*
HW	0.95, 1.00	1.01-1.06 *(1.04)*	0.97-1.06 *(1.03)*	0.95-1.06 *(1.00)*	0.88-1.03 *(0.97)*	0.92-1.12 *(1.03)*	0.89-1.14 *(0.98)*	0.88-1.14 *(0.99)*
CI	100. 100	98-100 *(99)*	100-103 *(101)*	98-103 *(100)*	97-103 *(100)*	98-101 *(100)*	98-103 *(101)*	97-103 *(100)*
SL	0.90, 0.93	1.01-1.06 *(1.04)*	1.00-1.03 *(1.01)*	0.90-1.06 *(0.97)*	0.88-1.04 *(0.97)*	0.87-1.09 *(1.02)*	0.86-1.15 *(1.01)*	0.86-1.15 *(1.00)*
SI	95, 93	100	97-103 *(99)*	93-103 *(97)*	97-103 *(99)*	95-105 *(99)*	95-103 *(98)*	95-105 *(99)*
PW	0.46, 0.50	0.48-0.53 *(0.51)*	0.48-0.52 *(0.50)*	0.46-0.53 *(0.49)*	0.43-0.50 *(0.48)*	0.44-0.53 *(0.50)*	0.45-0.56 *(0.50)*	0.43-0.56 *(0.49)*
WL	0.95, 0.99	1.03-1.06 *(1.04)*	1.01-1.06 *(1.03)*	0.95-1.06 *(1.00)*	0.92-1.03 *(0.99)*	0.92-1.05 *(1.00)*	0.92-1.15 *(1.03)*	0.92-1.15 *(1.01)*
$\frac{WL \times 100}{HW}$	100, 99	100	100-105 *(101)*	99-105 *(100)*	100-104 *(101)*	100-101 *(100)*	98-103 *(101)*	98-104 *(101)*
$\frac{PW \times 100}{HW}$	48, 50	48-50 *(49)*	46-50 *(48)*	46-50 *(49)*	47-51 *(48)*	47-50 *(48)*	47-51 *(49)*	47-51 *(48)*
$\frac{PW \times 100}{WL}$	48, 50	47-50 *(48)*	46-48 *(48)*	46-50 *(48)*	47-50 *(48)*	47-50 *(48)*	47-51 *(48)*	47-51 *(48)*
Pronotal Spine L.	0.15, 0.15	0.17-0.19	0.15-0.20	0.15-0.20	0.13-0.18	0.13-0.17	0.13-0.17	0.13-0.18
Propodeal Spine L.	0.23, 0.22	0.18-0.20	0.20-0.24	0.18-0.24	0.15-0.20	0.16-0.19	0.16-0.20	0.15-0.20
Petiole L.	0.33, 0.33	0.34-0.37	0.33-0.37	0.33-0.37	0.32-0.37	0.30-0.37	0.30-0.38	0.30-0.38
Postpet. H.	0.32, 0.33	0.34-0.35	0.33-0.37	0.32-0.37	0.32-0.35	0.31-0.36	0.28-0.35	0.28-0.36

Table 1. *Pristomyrmex quadridentatus* André. Comparison of standard measurements (in mm) and indices, yielded by specimens from all known series. Mean values *italicized*. The types are ostensibly from Sydney (*but* see text). Numbers in the "series" column refer to the following localities: *1.* New England National Park; *2.* The Dorrigo; *3.* Mt. D'Aguilar; *4.* Tamborine Mt.; *5.* Binna Burra.

which are usually about sub-equal to the metapleurals. The bicolored form tends to have thicker pronotal and smaller propodeal spines than the self-colored form; but the overall variation is such that the available *quadridentatus* material cannot be divided into two sets, coextensive with the color-variants, on the basis of spinational characters.

A weak negative allometric relationship between spine development and body size is evidenced; this is best marked in the bicolored form, probably because of its better representation in the study series.

Female (previously undescribed). Six female specimens are available for study; one self-colored, five bicolored.

1. *Self-colored form.* A single dealate labeled Point Lookout — Grafton, N.S.W., has the following dimensions: HL 1.05 mm; HW 1.07 mm; CI 102; SL 0.98 mm; SI 88; Scutum W 0.68 mm; WL 1.20 mm; Propodeal Spine L 0.22 mm; Petiole L 0.35 mm; Postpetiole Height 0.39 mm; Eye Diameter 0.22 mm; Ocular Index 21. General features as in Figures 9 and 10. Pronotum with a partly broken fine, arched transverse carina, its humeri each with a low obtuse tubercle. Parapsidal lines of mesoscutum very obscure, essentially vestigial. Bases of propodeal spines connected by a transverse carina. Metapleural spines slightly longer and more acute than propodeal ones.

Color and pilosity as in worker, the ocelli each with an adjacent small dark brown spot, the mesosomal suture lines and axillary sclerites infuscated dark brown.

2. *Bicolored form.* Two dealate specimens from Mt. D'Aguilar Range, one each from Stradbroke Island and Tamborine Mt., and an alate from Binna Burra, have the following dimensions: HL 0.95-1.22 mm; HW 0.99-1.30 mm; CI 102-106; SL 0.94-1.18 mm; SI 91-95; Scutum W 0.62-0.85 mm; WL 1.10-1.42 mm; Petiole L 0.32-0.46 mm; Postpetiole Height 0.32-0.43 mm; Eye Diameter 0.19-0.26 mm; Ocular Index 19-20. The smallest specimen is from Mt. D'Aguilar Range, the largest is the Binna Burra alate (which has a forewing length of 1.9 mm, hindwing length of 1.3 mm). Distribution of indices in the series implies negative allometry of scape length and head length, relative to head width. Pronotal spine development variable, apparently negatively allometric, smallest specimen with a low obtuse tubercle, largest one with an almost imperceptible slightly raised convexity. Propodeal spines similarly variable, best developed in smallest individuals (about comparable to self-colored specimen), represented only by slightly raised propodeal corners in largest specimen. Characters otherwise as in self-colored form, with the scapes proportionately slightly longer.

Coloration as in worker, ocellar area darkly infuscated; pronotum and scutum reddish brown in the Binna Burra alate, which may be incompletely colored.

Ecology. All detailed records of *quadridentatus* show that nests are usually located in rotting logs, a fact confirmed in the field by the author, and by the experienced Australian collector B. B. Lowery, S. J., (pers. comm.).

On May 21-23, 1962, I established that the bicolored form is probably an exclusively nocturnal forager. During 4 days of intensive collecting in rain forest near Binna Burra, workers were never encountered abroad from nests during the day. At night, however, 22 workers in seven samples were taken as strays, during about four hours total collecting. These specimens were all collected between two and six hours after sunset (the limits of the observation period), and all were in the open on the surfaces of widely separated rotting logs. Several further individuals were taken near the ground on tree trunks, and one was collected from foliage in a sweep-net. In several cases these individuals appeared to be following trails, but they were always well separated from each other, at distances of 14-20 cm. The ants moved slowly, their rate of progress being estimated at 10-15 cm per minute. The nature of the food was not determined.

Relationships. See discussion on p. 35.

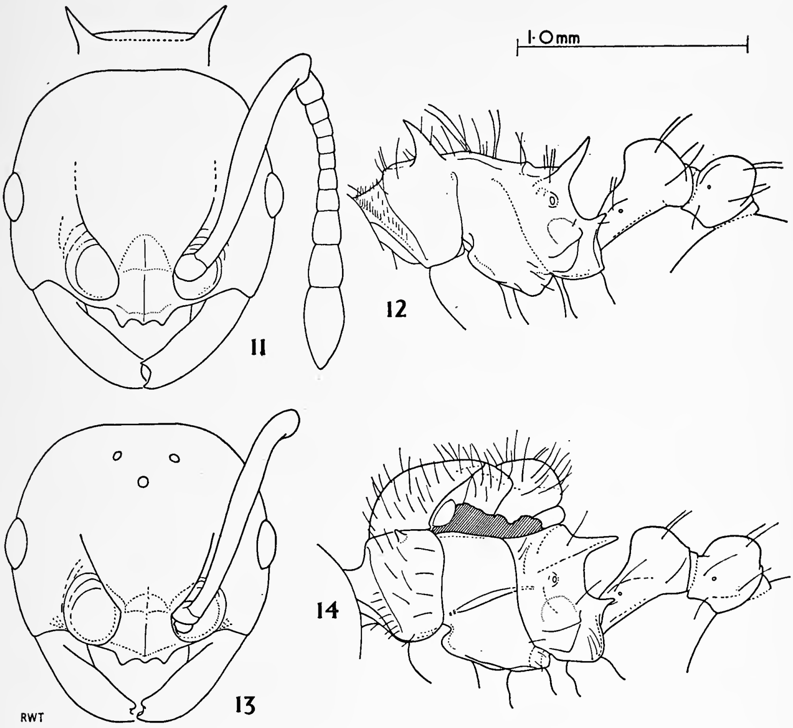
4. **Pristomyrmex wheeleri** new species

(Figs. 11-15, Plate 3)

Type workers. The following description is based on the holotype and numerous paratypes from all parts of the distributional range given below.

Dimensions (holotype cited first): HL 1.14, 0.97-1.23 mm; HW 1.26, 1.04-1.40 mm; CI 111, 108-116; SL 1.11, 0.92-1.14 mm; SI 88, 81-90; PW 0.60, 0.51-0.67 mm; WL 1.09, 0.89-1.20 mm; Pronotal Spine L 0.17, 0.15-0.20 mm; Propodeal Spine L 0.35, 0.27-0.39 mm; Petiole L 0.41, 0.36-0.44 mm; Postpetiole Height 0.38, 0.31-0.43 mm. General features as in Figures 11 and 12, and Plate 3 (upper figure). Similar to *P. quadridentatus*, as described above, but differing in the following features:

1. Generally larger size (HW 1.04-1.40 mm, opposed to 0.88-1.14 mm in *quadridentatus*), with much broader head (CI 108-116 against 97-103), and lower Scape Index (81-90 opposed to 93-105).
2. Inferior carina of antennal scrobe vestigial or absent.
3. Pronotal and propodeal spines longer and more slender, in side view approximately sub-equal in length; metapleural spines acute, rarely more than half as long as propodeals.
4. Pilosity similar, the body hairs thicker and longer, petiolar peduncle with a single hair on each side, first gastric tergite naked.
5. Color distinctive; head deep dark umber-brown. Mandibles, clypeus and antennae rich golden-brown. Remainder of body golden-brown, much like the self-colored form of *quadridentatus*, but more



Figures 11-14: *Pristomyrmex wheeleri* n. sp. — Holotype worker: fig. 11, head and pronotal dorsum, frontal view; fig. 12, mesosoma, petiole and postpetiole, lateral view. — Paratype female: fig. 13, head, frontal view; fig. 14, mesosoma etc., lateral view.

yellowish. Posterior half of first gastric tergite shaded medium to dark reddish brown.

Type locality. Vicinity of Binna Burra, S.E. Queensland. The type colony was taken in soil under a stone in rain forest, elevation *c.* 2800 ft (May 24, 1962, R. W. Taylor acc. 1281).

Worker variation. Negative allometry of head length and scape length, relative to head width, is suggested by the distribution of cephalic and scape indices in the study series. Other characters, including the clypeal structure and the development of the mesosomal spines, show no apparently significant variation.

Paratype females. A female from the type-nest (cited first), and six others, one from each locality given below except National Park and Woodenbong, have the following dimensions: HL 1.11, 1.17-1.25 mm; HW 1.23, 1.31-1.42 mm; CI 112, 112-114; SL 1.04,

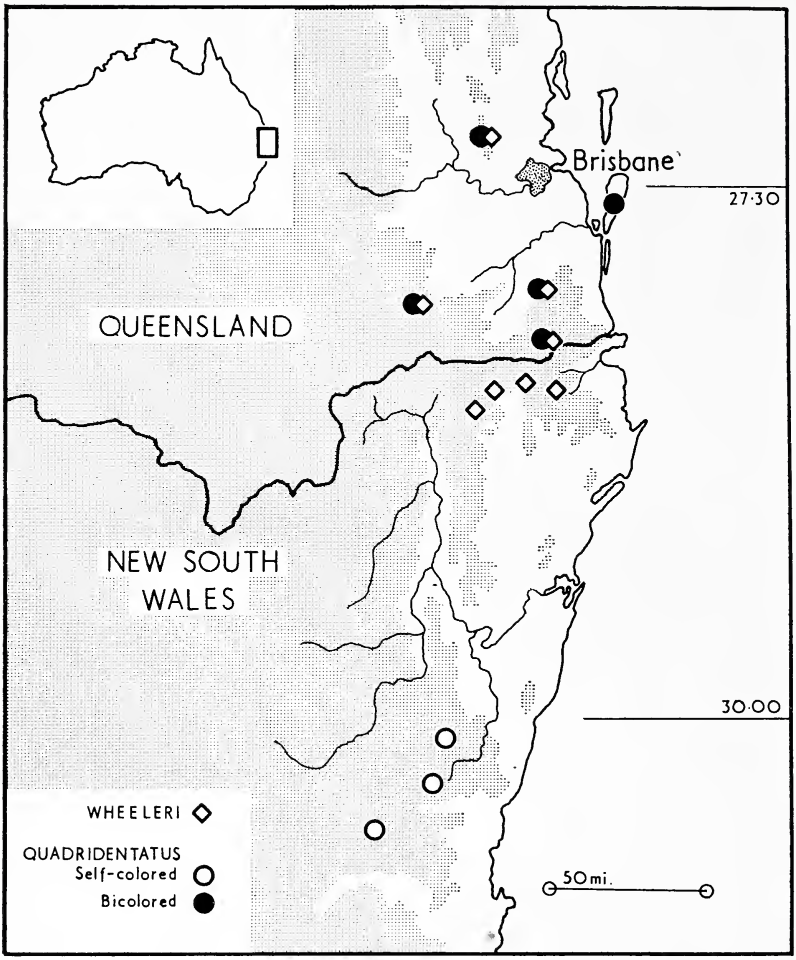
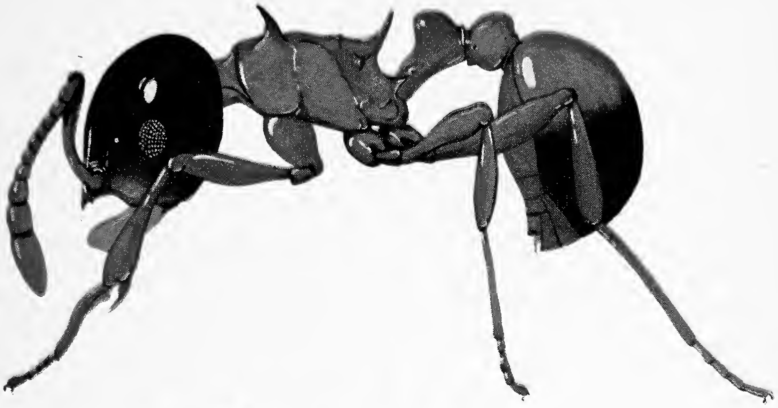
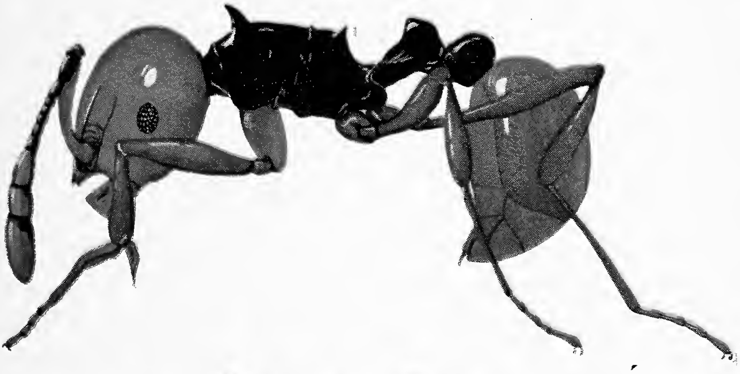


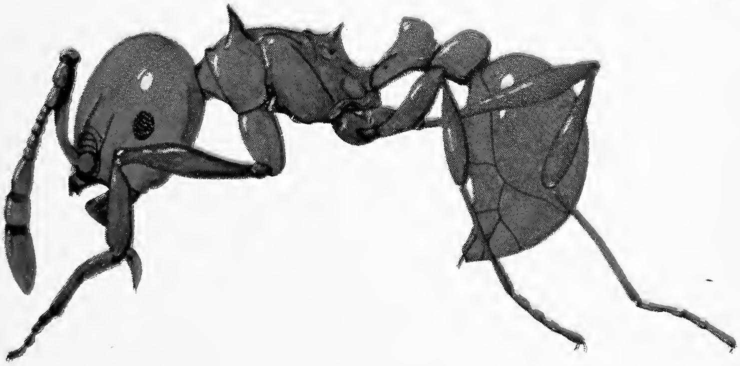
Figure 15 (above): Distribution of members of the *Pristomyrmex quadridentatus* group. Land above 200 meters elevation shaded.

EXPLANATION OF PLATE 3 (opposite)

Workers of the *Pristomyrmex quadridentatus* group, to illustrate coloration. Top: *P. wheeleri* n. sp., from Binna Burra, S. E. Queensland. Middle: *P. quadridentatus* André, bicolored form, from Binna Burra (sympatric with *wheeleri*). Bottom: *P. quadridentatus* André, self-colored form, from New England National Park (Point Lookout) (allopatric with *wheeleri*). Author *del.*







TAYLOR — PRISTOMYRMEX

1.08-1.12 mm; SI 85, 79-82; Scutum W 0.67, 0.78-0.84 mm; WL 1.19, 1.26-1.36 mm; Propodeal Spine L 0.33, 0.35-0.39 mm; Petiole L 0.41, 0.44-0.48 mm; Postpetiole Height 0.39, 0.41-0.45 mm; Eye Diameter 0.24, 0.26-0.27 mm; Ocular Index 20, 19-20. Negative allometry of scape length and head length, relative to head width, is indicated. General features as in Figures 13 and 14. Distinguished from *P. quadridentatus* by very different proportions and coloration. Structure of clypeal apron variable, usually as in Figure 13; the median projection narrowed with reduced teeth in one specimen, bidentate in another, and completely edentate in a third. Transverse pronotal carina distinct. Pronotal spines variable, ranging from low rounded tubercles to small acute teeth (maximally about 0.03 mm long), with no apparent allometric tendency. Parapsidal lines feeble to moderately distinct. Propodeal spines almost invariable, their bases bridged by a low carina. Metapleural spines acute, distinctly shorter than propodeals.

Color and pilosity as in worker, mesosomal suture lines and alary sclerites infuscated dark brown.

Distribution and Material Examined. All records of *P. wheeleri* are from S. E. Queensland and N.E. New South Wales, between about S. Lat. 27.20 and 29.00 (Fig. 15), as follows: QUEENSLAND: *Mt. D'Aguilar Range,* 2000 ft, colony, May 4, 1962 (RWT acc. 819). *Cunningham's Gap:* 2500 ft, six colonies, January 22, 1961 (B. B. Lowery); 2000 ft, colony, May 1, 1962 (RWT acc. 721). *Tamborine Mountain:* no further data (A. M. Lea); colony, January 15, 1957 (B. B. Lowery); Curtis Falls, workers, leafmold berlesate, May 8, 1953 (T. E. Woodward). *Binna Burra:* 2800 ft, colonies, May 21-25, 1962 (RWT accs. 1192, 1281 *(holotype nest series),* 1290, 1293); stray, forest floor, 2 hours after sunset, May 23, 1962 (RWT acc. 1210); 2600-3000 ft (P. F. Darlington). *National Park,* December 1919 (H. Hacker). NEW SOUTH WALES: *Woodenbong; Unumgar Forest, c.* 2000 ft; *Tooloom Range, c.* 2000 ft, dealate female; all May 1958 (Darlingtons). *Mt. Warning,* 2600-3000 ft, five colonies, September 13, 1962 (B. B. Lowery).

Type deposition. Holotype and numerous paratypes (worker and female) in MCZ (Type No. 31154), paratypes in CSIRO; Queensland Museum, Brisbane; Australian Museum, Sydney; National Museum of Victoria, Melbourne, and other Australian collections, also British Museum (NH), London, and B. P. Bishop Museum, Honolulu.

Ecology. All the above records are from rain forest. Sixteen of the

18 colonies listed were found in soil under or between stones, one was in a rotting log (RWT acc. 819), and one in a rotting wood fragment (RWT acc. 721). Nesting behavior thus contrasts with that of the sympatric bicolored form of *quadridentatus,* which has been found nesting only in rotting logs. Lowery's six Cunningham's Gap colonies each contained 18 to 36 workers and one queen. At Binna Burra I searched extensively for foragers of *wheeleri* but encountered only one (acc. 1210), which was taken two hours after sunset on top of a small rock, later found to shelter a colony. Foraging behavior presumably is unlike that of *P. quadridentatus* (see p. 48).

Relationships. See below.

DISTRIBUTION AND VARIATION IN THE QUADRIDENTATUS GROUP

All known bicolored series of *Pristomyrmex quadridentatus* were collected in immediate geographical and temporal sympatric association with *P. wheeleri,* while the self-colored form has never been taken in such association. This correlation invites the hypothesis that character displacement of *quadridentatus* has occurred wherever the species is sympatric with *wheeleri.*

Character displacement is the situation, usually involving several related species, where interspecific differences are more distinct in areas of sympatry than in areas of allopatry. This phenomenon has long been recognized, but was first crystalized by Brown and Wilson (1956), who reported its occurrence in birds, frogs, fishes, crabs and various insects. Subsequent reports involve many animal groups, including the South African cyprinid fishes, *Barbus marequensis* and *B. natalensis* (Farquharson, 1962), the North American salamanders *Plethodon cinereus* (Green) and *P. richmondi* Netting and Mittleman (Highton, 1962), the Central American iguanids *Basiliscus plumifrons* Cope and *B. vittatus* Weigmann (Maturana, 1962), the East African gekkonids *Holodactylus africanus* Boettger and *H. cornii* Scortecci (Laurent, 1964), several pairs of Indian nuthatches of the genus *Sitta* (Ripley, 1959) and the New Zealand pelecypods *Bassinia yatei* (Gray) and *B. parva* Marwick, which apparently underwent displacement on becoming sympatric in the Lower Pleistocene (Fleming, 1959). Few of these cases have been studied in detail aimed at elucidating the selective significance of the displacement, though it seems clear that secondary reinforcement of premating isolating mechanisms, or special adaptation to greater niche specificity resulting from competitive displacement, are involved in some cases.

This hypothesis is invoked to explain the origin of the bicolored form of *P. quadridentatus* on limited distributional evidence, which needs supplementation. A selective mechanism is difficult to envisage since there is no evidence that color is involved in interspecific relations between these ants. Ecological differences between the sympatric forms are reported above; at Binna Burra *quadridentatus* nests in logs and forages openly at night, while *wheeleri* nests under stones and apparently forages cryptically. Nothing is known of the behavior of self-colored *quadridentatus* and such information is required. Bicolored *quadridentatus* and *wheeleri* are perhaps the most spectacularly colored members of their genus; their coincident distribution suggests that the causal factors producing their color patterns may be inter-related. The two "forms" of *quadridentatus* might prove ultimately to be good biological species, but even if this is the case, character displacement need not be rejected in explaining their color differences. These ants are worthy of much further study.

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A NEW SPECIES OF *MEGALOMYRMEX* FROM THE CHILEAN ANDES (FORMICIDAE, HYMENOPTERA)

By George Ettershank*
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The genus *Megalomyrmex* has generally been thought of as associated with the wet tropical rain-forests of the New World. Members of the *goeldii* species-group in particular forage openly on the rain-forest floor and tend Homoptera on low bushes. It was thus a considerable surprise to receive a few specimens of a *goeldii* group species collected only 25 miles from the crest of the Andes in Chile. This is a new species, and its discovery extends the genus into a new habitat.

The specimens under study were found by Mr. E. Ackerman at Pachon Peak (Cerro Pachon), near La Serena, Coquimbo Province, Chile, at an altitude of 8500 ± 100 feet. The collection site is a rather flat hill crest with sparse low shrub cover; the substrate is andesite boulders resting on andesite rubble and soil. The colonies, Mr. Ackerman notes, were populous and by no means rare. A few live workers were sent to Dr. Caryl P. Haskins of the Carnegie Institution of Washington, who placed the workers in a laboratory nest; a few eggs were laid, from which three larvae were reared. All the material was later sent to me; this consisted of four live workers and three preserved larvae. My thanks are offered to Dr. Haskins for allowing me to study this interesting species.

Measuring techniques and abbreviations quoted below follow the system of Brown (1) while certain other terminology follows Ettershank (2).

Megalomyrmex bicolor n. sp.

Holotype worker (measurements in millimeters; those for two paratype workers are enclosed in parentheses): total length, TL 4.8 (4.6, 4.4), head length, HL 1.04 (0.98, 0.94), length closed mandibles, ML 0.24 (0.22, 0.20), alitrunk length, WL 1.34 (1.32, 1.26), head width, HW 1.00 (0.92, 0.88). Cephalic index, CI = 100 HW/HL = 96 (94, 94), mandibular index = 100 ML/HL

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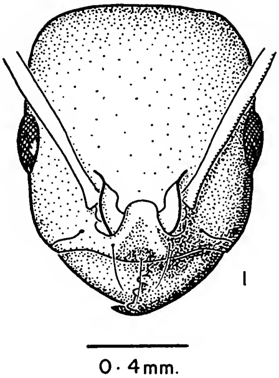
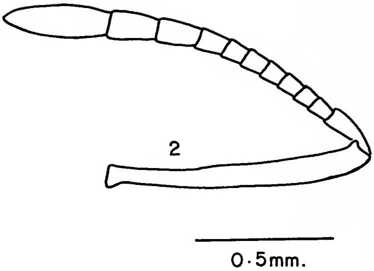
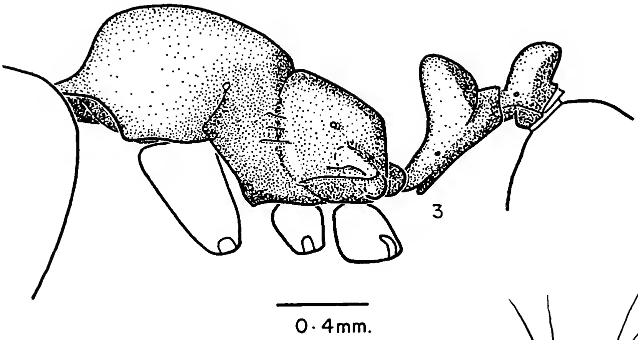
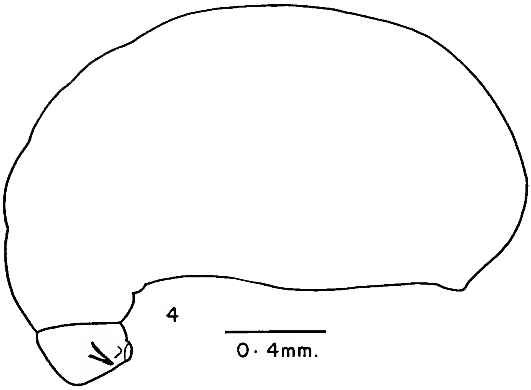
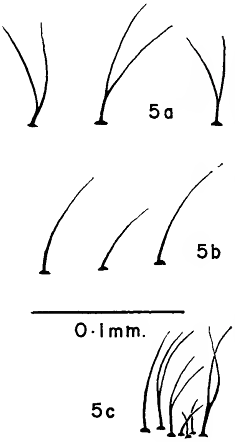
Manuscript received by the editor January 4, 1964











ETTERSHANK — MEGALOMYRMEX

= 23 (22, 21). A fourth paratype worker was dissected and not measured.

This species is smaller than the other *goeldii* group species. The head (fig. 1) in dorsal view is rather more square in shape. The eyes are large, about 15 ommatidia high and 8 wide, and their black color contrasts strongly with the golden-brown ground color of the head. Antennae 12-segmented with a weak 3-segmented club (fig. 2). Clypeus strongly convex with a slight median sulcus, giving a weakly bicarinate effect. Median seta present, but variable in position around the midpoint of the oral margin of the clypeus; one pair of intercarinal setae present; first paracarinal setae well developed, higher paracarinal setae weaker. A few strong lateral setae present. Lateral areas of clypeus and oral margin of median area concolorous with mandibles. Mandibles with dental formula 1 + 4, masticatory margin more darkly colored, brown black, rest of mandible red-brown. Palpal formula 4, 3.

Alitrunk (fig. 3) of normal worker form. Promesonotal suture very distinct on the pleurae to the height of the spiracle, curving forward and then posteriorly; indistinct laterally above the spiracle and on the dorsum. Metanotal groove distinct, impressed on the dorsum and on the pleurae. Faint grooves separate the anepisternum from the notum above and the katepisternum below. Mesothoracic dorsum narrowing rapidly above, quite distinctly compressed at the metathoracic groove. Propodeum with angle distinct but rounded; declivity distinctly impressed. Propodeal spiracle small, round. Inferior propodeal plates large, semicircular. Metapleural glands large, very distinct, surmounted postero-ventrally by a rounded protuberance bearing the gland opening.

Petiole and postpetiole of normal *Megalomyrmex* form, with nodes high and rounded (see fig. 3). Subpetiolar process dentiform, distinct; anterior subpostpetiolar process distinct, posterior process slight; nodes not particularly broad above. Gaster biconvex in profile, attached at its most anterior end, in life normally carried with its long axis inclined downward so that the posterior end just clears the substrate.

Smooth shining ants, bearing a few faint and several distinct rugae on the mesokatepisternum and metapleuron. Posterodorsal flange of the postpetiole finely granulose. Head, alitrunk and gaster bearing sparse, long, white setae. Head (except as noted earlier), alitrunk,

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EXPLANATION OF PLATE 4

Megalomyrmex bicolor, n. sp., Worker: Fig. 1, head, dorsal full-face view. Fig. 2, antenna. Fig. 3, alitrunk and nodes, lateral view. Larva: Fig. 4, lateral profile. Fig. 5, setae (see discussion in text); a, dorsal and lateral abdominal; b, of head and prothorax; c, of ventral abdominal tufts.

petiole and postpetiole golden brown, with a narrow margining of darker brown ventrally on the alitrunk; gaster brown-black, the sheen of the rest of the body being reduced noticeably by a fine shagreening over all the gaster.

Malpighian tubules 5 (one worker dissected), the tips of the tubules being attached to the rectum (cryptonephric).

Larvae: Three larvae were reared from worker-laid eggs and were presumably genetically male. A profile drawing of the larva is shown in fig. 4, and is essentially similar to that of *M. symmetochus* shown by G. C. and J. Wheeler (3). The head and prothoracic dorsum bear simple, slightly curved setae of the type shown in fig. 5b. The remaining body segments dorsally and laterally bear deeply cleft setae of the type seen in fig. 5a, while ventrally on each abdominal segment are paired clusters of setae of mixed types: short simple; long simple; and long deeply bifid, as shown in fig. 5c. In their characterization of *Megalomyrmex* larvae, the Wheelers (loc. cit.) state that only simple setae are present — short ones on the head, long ones on the body — and that the ventral and lateral surfaces of the abdomen are nearly naked. This diagnosis is based on *M. symmetochus,* a member of the *modestus* species group. Further comparative study is required, but perhaps this setal character represents another fundamental difference between the two species groups.

Disposition of Types: Holotype worker, three paratype workers (one dissected) and three larvae have all been deposited in the collection of the Museum of Comparative Zoology, Cambridge, Mass., under type number 31139.

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THE HABITS AND DISTRIBUTION OF *CRYPTOCERUS ROHWERI* WHEELER (HYMENOPTERA: FORMICIDAE)

By
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and
William L. Nutting, University of Arizona[2]

When W. M. Wheeler described *Cryptocerus rohweri* in 1916 he stated that the specimens which Rohwer sent him had been taken by Chrisman in a canyon of the Santa Catalina Mountains of Arizona and that they had been nesting in the dead limbs of a palo verde tree (1). There was no reason for Wheeler to question that the host tree was *Cercidium torreyanum*, but this question has since arisen and it is advisable to consider it here. The host plant identification appears to have been made from the dead limb sent in with the ants. Chrisman's field notes stated only that his specimens were nesting in "palo verde", which would cover either of the two species of *Cercidium* in the Santa Catalina area. But in this area *C. torreyanum* is scarce and it usually occurs at elevations below those where *rohweri* has been taken. The abundant and widespread species is *C. microphyllum* and all seven colonies of *rohweri* which we took in the Santa Catalinas were nesting in this tree. The probability is that

Table 1. Distributional Data for *Cryptocerus rohweri* Wheeler

STATION	ELEVATION	NESTS	NEST SITE	COLLECTOR
STA. CATALINA MTS.				
Buehman Canyon	—	1	palo verde	M. Chrisman
Brush Corrals	3700′	1	palo verde	M. Chrisman
Sabino Canyon	3000′	2	hackberry	E. D. Algert
Sabino Canyon	—	1	not given	W. D. Edmonton
Catalina Springs	—	1	not given	Hubbard & Schwarz
Catalina Foothills	2800′	1	palo verde	Wm. L. Nutting
Catalina Foothills	2800′	6	palo verde	Wm. S. Creighton
Saguaro Nat. Mon.	3100′	strays	unknown	F. G. Werner
BABOQUIVARI MTS.				
Baboquivari Canyon	3500′	1	mesquite	Wm. S. Creighton
Baboquivari Canyon	3500′	1	mesquite	C. H. Musgrove
AJO MOUNTAINS				
Alamo Canyon	—	stray	unknown	E. D. Ball
ATASCOSA MTS.				
Peña Blanca Sprs.	3700′	1	live oak	Wm. S. Creighton

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Manuscript received by the editor December 28, 1964.

Chrisman's specimens came from *C. microphyllum* and not from *C. torreyanum.* The list in Table 1 is an expanded version of the list of localities for *rohweri* which M. R. Smith presented in his 1947 study of *Cryptocerus* (2).

While this list is unbalanced by the preponderance of records from the Santa Catalina Mountains it permits several conclusions. The range of *rohweri* covers a number of mountainous areas in southern Arizona. In each of these areas *rohweri* prefers to nest in canyon bottoms or on foothills at comparatively low elevations (2800-3700′). Although as yet unconfirmed, it is certain that the range of *rohweri* extends into northern Sonora. Peña Blanca Springs is (or perhaps better "was", for the area has been dammed and flooded) about five miles north of the border of Sonora and the mountains there run south into Mexico. It is clear that *rohweri* will accept at least four different trees as nest sites (*Cercidium microphyllum, Prosopis juliflora, Quercus emoryi* and *Celtis* sp.). Despite the large number of records from palo verde there are indications that *rohweri* has no special preference for this tree. In 1954 Creighton and Gregg showed that *Crypt. texanus* prefers to live in live oaks (3). This view was based not only on a preponderance of records for nests in live oak limbs but also on the fact that *texanus* nests in live oaks wherever these occur within its range. If *rohweri* prefers to nest in palo verde limbs it might be expected to do so over its entire range. As far as we have been able to determine it does not do so. In January of 1963 the senior author made an extensive survey of palo verde trees in the area between Benson and Ajo. This survey failed to produce a single nest of *rohweri.* Negative evidence of this sort is not conclusive but at least it may be said that the high incidence of *rohweri* nests in palo verde limbs in the Santa Catalina Mountains is not maintained in other parts of its range. It is possible that our present fragmentary view of the range of *rohweri* is an outcome of the fact that the tree which it prefers as a nest site has not yet been recognized.

Most of the observations in the remainder of this paper are based on three captive colonies of *rohweri.* One of these was observed by the junior author from October 1961 until August 1963. During this period the colony was studied at Tucson, less than five miles from its original nest site in the Santa Catalina Mountains. The senior author was less fortunate for the two captive colonies which he observed were carried far out of their range. From January to mid-April of 1963 they were studied at Riverside, California. Thereafter until June 1964 they were studied at Rockport, Ontario. It would appear, however, that these expatriate colonies behaved in a normal fashion, for there was no noticeable difference between their behavior and that of the Tucson colony. This colony was housed in a plastic petri dish 90 mm. in diameter. A short polyethylene tube connected this petri dish to a second one which served as a feeding chamber. This arrangement permitted a close watch on the development of the brood. The other two colonies were kept in sealed aquaria which contained oak block observation nests. This provided the ants with passages similar to those which they normally use and at the same time gave them the opportunity to forage outside the nest.

Most of the habits of *rohweri* are like those of *texanus* but there are some significant differences in the behavior of the two species. At maturity the *rohweri* colony is notably smaller than that of *texanus*. There are seldom more than seventy-five workers present and in most of the colonies that we have seen the total has been less than fifty individuals. This is undoubtedly due to the fact that *rohweri* is seldom, if ever, pleometrotic. Each of the nine colonies of *rohweri* which we have examined had a single queen. The nests of *rohweri* are established in abandoned burrows of wood-boring beetles (often those of small buprestids) which are cleared of the detritus left in them by the beetle larvae. While most of the branches selected by *rohweri* consist of hard, sound wood it will nest in rotten branches as well. A limb housing one of the Santa Catalina colonies was so badly decayed that the ants were extracted by crumbling the wood between the fingers. As shown elsewhere (4) *texanus* ordinarily rejects nest sites in rotten wood. The burrows chosen by *rohweri* are of a size that permits the major to occlude the terminal opening. This occlusion is like that of *texanus;* the opening is blocked by the head and pronotum of the major, who crouches to admit the minor. An interesting variation of this response was observed in the junior author's colony. This colony originally occupied burrows in a large, dead palo verde branch. Just inside the entrance of one of these burrows was a circular flange of detritus. The circular opening in this flange was slightly more than 2 mm. in diameter. This opening was occluded by the cephalic disc of the major, who stood in the passage behind the flange. The workers of *rohweri* pack themselves tightly into the outer portion of the nest passage, as do those of *texanus,* but show one response under these conditions that *texanus* does not display. The minor worker of *rohweri* can reverse its position in the passage by a twisting somersault. This begins with a lowering of the head. whose forward edge is thrust under the anterior coxae. Thereafter the body is swung forward and downward and during this arc it is twisted sidewise. The end result is that when the minor regains its feet it is facing in the opposite direction. No major of *rohweri* was ever seen to behave in this way.

The foraging activities of *rohweri* are of interest since there is evidence that it deliberately forages on the ground. This is probably true of *texanus* as well but it has not yet been conclusively proved in that species. On one occasion Dr. F. G. Werner took six foraging workers of *rohweri* from white cholla in the Saguaro National Monument. Unless the ants were living in the cactus, which seems completely unlikely, they must have reached it over the surface of the soil. It is not clear why the foragers had visited the cholla. It was not in bloom and efforts by both writers to interest the captive colonies in cholla were unsuccessful. Workers in the aquarium colonies spent much time crawling over leaves and twigs of various plants with which they were kept supplied. When a worker fell from a leaf its righting reaction was completely different from that of *texanus*. When a worker of *rohweri* lands on its back it shows no fixed righting reaction. The body is violently contorted and the legs are flailed about until one of them anchors on something that enables the ant to pull itself over. The stereotyped righting reaction of *texanus* has been described elsewhere (4).

The junior author's colony was fed on diluted honey, which was supplied through a wick from a reservoir. They were also fed on the juices of phalaenid caterpillars. It was necessary to tear the caterpillars open before the workers would feed on them. Entire insects, either alive or dead, were avoided, as was pollen taken from honey bees. The colonies of the senior author were fed on pollen from the start. It was found that *rohweri* will accept a wide variety of pollen if it is smeared on the surface of leaves, although they seldom take it from the anthers of flowers. Of the various sorts of pollen fed to the colonies that of *Quercus agrifolia* was clearly the most relished. As will be shown, the colonies were also fed with aphid honey dew. As a rule they preferred this to pollen but on one occasion, while the ants were feeding on honey dew, catkins of *Quercus agrifolia* were placed in the aquaria. The response to these was immediate and spectacular. The foragers feeding on honey dew deserted it for the oak catkins and practically every worker turned out to take pollen from them. They gathered such quantities of pollen that they returned to the nest with masses of grains in their jaws. These masses were held against the heads of the larvae who nibbled away the pollen grains. The original experiments with honey dew were disappointing. The ants paid little attention to coccids on the leaves of *Quercus chrysolepis* or to the rims of liquid which surrounded them. They were definitely interested in *Aphis fabi,* a species that is abundant on *Mesembryanthemum* at Riverside. The ants tried to milk the aphids but the latter, who were clearly afraid of the *rohweri* workers, failed to coöperate. They would usually run away from the ants, which resulted in some of them being killed when the ants tried to catch them. Much better results were secured with *Aphis sphaericola.* This aphis produces such large quantities of honey dew that it will drip from the leaves on which the aphids are feeding. When leaves of *Viburnum suspensum* bearing *Aphis sphaericola* and coated with its honey dew were placed in the aquaria the foraging ants gorged themselves until their intersegmental gastric membranes were visible. This they did by lapping the honey dew from the surface of the leaves. The ants paid little attention to the aphids and made no attempt to milk them.

Since the colonies were well-supplied with food a number of eggs were soon present. When the major or female handles an egg it is positioned so that its long axis runs through the notch in the anterior edge of the cephalic disc. The larger eggs fit the rim of this notch closely when so positioned. Most of the eggs hatched in about 27 days. The voiding of the larval meconium was observed three times and took between 60 and 75 minutes. The movement of the black meconium, both within the larva and during its emergence is so slow that it is difficult to follow. Infrequent contractions of the posterior half of the larva probably reflect peristaltic movements of the gut within. Once outside the larva the meconium invariably attracted workers, both majors and minors, although they were never observed to assist the larva in any way. It was only after the meconium was presented that the larva was groomed. On one occasion the meconium was eaten by the attendant worker. On the other two it was carried to the dump in the feeding chamber. The period between the passing of the meconium and pupation was from six to ten days. The pupal moult was never observed. New pupae are ivory white and the first suggestions of pigmentation appear in the compound eyes. The color of the pupa darkens from yellow ochre to brown during the second and third weeks. There is a four- or five- day callow period after the adult emerges. In the senior author's colonies worker brood developed from egg to adult in about three months (egg to larva ± 27 days; larva to pupa ± 33 days; pupa to adult ± 23 days). The nests were kept at room temperature and the range, for the most part, lay between 60°F and 70°F. Since the temperature range to which a free colony is subjected is far wider, these figures are useful only as an indication of the relative length of the several stages. Moreover, the development of the larva may be drastically modified. In the junior author's colony eight males emerged during the period from July 3 to July 24, 1963. These males developed from eggs which had been laid in June of 1962. These eggs developed into larvae in about a month and the larvae grew for about two months. But from September 1962 to June 1963 the larvae showed no further development. In short, these eight males over-wintered as larvae. They emerged in July and it is interesting to note that the marriage flight of *rohweri* occurs in that month. The senior author took a female of *rohweri* which had just completed her marriage flight in Baboquivari Canyon on July 28, 1951.

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CONTRIBUTIONS TO A RECLASSIFICATION OF THE FORMICIDAE. IV. TRIBE TYPHLOMYRMECINI (HYMENOPTERA)

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The Typhlomyrmecini (spelling here emended) are a tribe of Ponerinae here considered to contain the single small genus *Typhlomyrmex.* In this sense the tribe dates only from Brown, 1953. The name Typhlomyrmicini *(sic),* however, goes back to Emery, 1911, who first proposed it as a subtribe of tribe Ectatommini to contain the three genera *Prionopelta, Typhlomyrmex,* and *Rhopalopone.* Brown (1950) showed that *Prionopelta* belongs to tribe Amblyoponini, while *Rhopalopone* is a synonym of *Gnamptogenys* in tribe Ectatommini (Brown, 1958). After these subtractions, the genus *Typhlomyrmex* could not be placed comfortably in any existing tribe, and its present taxonomic position is an expression of this fact.

At first sight, *Typhlomyrmex* workers look like rather ordinary small cryptobiotic members of tribe Ponerini, although the frontal lobes are not as prominently developed as in Ponerini, and the petiole is never quite "right" in form. The males and larvae clearly conform to Emery's "Section Proponerinae," including Amblyoponini, Ectatommini, and Platythyreini in the modern sense; (the cerapachyines all probably belong here as well), so that the resemblance of the workers to those of certain Ponerini (in Emery's "Section Euponerinae") is either convergent or else marks a side lineage from near the base of the stock that led to the Ponerini.

Among "proponerines", *Typhlomyrmex* shows some similarities to Amblyoponini and to Ectatommini, but it can be distinguished from both by the wing venation of the sexes and the larval mandibles. The main similarity between Typhlomyrmecini and Amblyoponini, other than in "basic ponerine" traits, lies with the shape of the petiolar node of one *Typhlomyrmex* species, *T. rogenhoferi.* This node, because of its elongate form without a distinct posterior face, resembles that of an *Amblyopone* very closely in side view. In dorsal view, however, *T. rogenhoferi* proves to have a much thinner (bilaterally compressed) petiolar peduncle, and this makes it seem possible that its amblyoponine features could have been convergently acquired. Whether or not this is the correct interpretation, it is true that, aside from basic "proponerine" characters, the *Typhlomyrmex* adult has little in common with the Amblyoponini. It shares more characters with the small "degenerate" members of *Gnamptogenys,* but here again, though less certainly, I feel that the similarities may be convergent ones. The two main characters contributing to this opinion are the forewing venation of the larger *Typhlomyrmex* species (Mf1 arising basad of cu-a) and the shape of the mandible in the larva (inflated basal part, suddenly narrowed to an acute apical blade). Even these characters do not weigh decisively against a possible origin of *Typhlomyrmex* from ectatommine ancestors, and it must be admitted that the convergence hypothesis is to some extent based on subjective impressions that remain to be tested.

Tribe Typhlomyrmecini

Genus *Typhlomyrmex*

Typhlomyrmex Mayr, 1862, Verh. zool.-bot. Ges. Wien, 12: 736. Type species: *Typhlomyrmex rogenhoferi* Mayr, 1862, monobasic.

Typhlomyrmex Emery, 1911, Gen. Insect., 118: 33-34, characterization and catalog of species.

Nec Typhlomyrmex Gistel: J. Betrem and C. Jacot-Guillarmod have called my attention to a generic name *Typhlomyrmex* obscurely published by J. Gistel in his *Mysterien der europäischen Insectenwelt* (1856, cf. p. 447) for a *"Myrmica typhlops* L." This species name is a *nomen nudum* of Lund (not Linnaeus!), published in 1831 in Ann. Sci. Nat., 23: 128. Because it was based on an unavailable species name, and is itself without description, indication or figure, *Typhlomyrmex* Gistel is considered to be a stillborn name *(nomen nudum),* and I am well satisfied to let it subside into permanent nomenclatorial limbo.

Worker: Monophenic ("monomorphic") or feebly polyphenic; size small (full length under 2 mm to slightly over 5 mm); pigment-poor, yellowish to ferruginous in color.

Head parallel-sided, or sides slightly converging anteriad, occipital margin straight to slightly concave. Eyes reduced to minute vestiges with or without pigment. Clypeus with a broad, convex median part and narrow, concave side pieces, the anterior median border often with a narrow translucent margin, in a minority of cases produced as a variously-shaped small median process. Frontal carinae forming small frontal lobes that lie close together and roof a small basal part of the antennal scape insertion (but not the basal collar of the scape); lobes not or only weakly pinched in behind, and not expanded as in typical members of tribe Ponerini. Between the lobes lies a narrow, often indistinct frontal fossa, and a shallow median furrow may run back from the fossa to the vertex, or even to the occipital margin; it is not usually as distinct as in most Ponerini. Antennae short, with thick scapes that either fail to reach the occipital margin, or else surpass it just barely, when held straight back. Funiculus of 11 segments, with the last 3 or 4 enlarged and forming a more or less distinct club.

Mandibles triangular in basic plan, their dorsal surfaces convex in both directions; basal border distinct from masticatory border, although they may meet either in an angle or a broad curve. Masticatory border with minute crenulation, denticulation and/or small, uneven teeth; apical tooth large to very large, and tending to cross with its opposite number when the mandibles are fully closed. Shape and dentition varying with the species.

Under-mouthparts relatively bulky; labrum bilobed, with a broad median excision. Palpi segmented maxillary 1, labial 2.

Alitrunk robust, with rounded humeri and propodeum, slightly constricted at posterior mesonotum; promesonotal suture distinct and apparently movable; metanotal groove distinct, only feebly impressed. A distinct line curving posteroventrad from the propodeal spiracle represents the upper edge of the metapleural gland atrium showing through the integument. Legs short and thick; tarsal claws small, those on the anterior legs toothed, the others simple; tibial calcariae of middle and hind legs 1 or 2, indistinctly pectinate or simple.

Petiole briefly pedunculate; node distinct, variable in form (Figs. 1, 3); subpetiolar process well-developed, acute or rounded at apex. Gaster porrect or slightly downcurved, of the usual ponerine type, with slight but distinct constriction after postpetiole; sternum fused to tergum in abdominal segment III (postpetiole) and IV, but not fused in V (*T. rogenhoferi* worker, female). Sting well-developed and acute, usually exserted in dried specimens.

Sculpture generally fine, varying in development with the species and, within species, allometrically. Cranium longitudinally striate or striolate above, especially mesad, mostly shading off to reticulate on the sides. Mandibles and central part of clypeus usually smooth and shining. Alitrunk, petiole and gaster smooth, with spaced punctation, or partly reticulo-striate or otherwise roughened, the sculpture always becoming weaker caudad. Pilosity fine, rather short, uneven, fairly abundant and widely distributed. A pair of long fine sensory hairs rises steeply from the clypeus.

Alate female, or gyne: Slightly *(T. pusillus)* to considerably *(T. rogenhoferi)* larger than associated workers, and often darker in color, at least around the ocelli; darkest in *T. rogenhoferi,* which is brown. Sculpture sometimes better developed than in workers, and petiolar node distinctly shorter and more transverse. Compound eyes large and hairy; ocelli developed.

Alitrunk somewhat box-like, with a rather flat dorsal surface;

notauli obsolete; parapsidal furrows present but inconspicuous. Venation nearly "complete," with the median abscissae of Rs (Rsf2•3) missing, so that the cubital cell is undivided (single). The first abscissa of M forks off from Cu basad of crossvein cu-a, as in the army ants. (This pattern of venation does not hold for *T. pusillus,* in which the veins are reduced and their relationships modified.) The hind wing entirely lacks an anal lobe, but has the large discal cell, usually with 2 or 3 stubs of apical abscissae corresponding to Rs, M and Cu; another small cell may occur at the base of the discal cell behind, or may be incorporated into the discal cell. The hamuli number 3, and usually arise from a small darkened sclerotic patch a little beyond the midlength of the costal margin.

In other characters, gynes resemble workers.

Male: (Based on *T. rogenhoferi* and *T. clavicornis*) smaller and more slender than the corresponding gyne, but the difference is slight in the smaller species; dark brown to black in color; habitus typical of proponerine males. Eyes large and hairy, occupying nearly half of the sides of the head. Ocelli distinct. Scapes straight, of moderate length, usually equal to about the basal 3 or 4 flagellar segments; flagellum 12-segmented, the segments all longer than broad and increasing very slightly in thickness toward the apex. Mandibles well-developed, opposable or crossing at closure, dentition a variably reduced copy of that of the corresponding worker. Palpi segmented 1, 2 *(rogenhoferi)* or 1, 1 *(clavicornis)*. Clypeus with a large, swollen mid section and small sunken side pieces.

Alitrunk with notauli developed only as the anterior arms of the "Y" and obsolete medially; parapsidal furrows present but inconspicuous. Wings as in gyne (see above). Legs slender, all three pairs with tarsal claws toothed.

Petiole subclavate, i.e., with the peduncle rising gradually caudad toward nodal summit, which is rounded; ventral tooth or process present. Gaster with a slight constriction behind postpetiole; the latter segment has tergum and sternum firmly fused, but the next segment, abdominal IV, appears to have them connected only by thin cuticle or membrane. Genitalia only partly retractile, with parameres broadly rounded at apex; volsellae varying with the species (Figs. 7, 8); aedeagal valves ordinary, serrate. Hypopygium with a long, more or less digitiform, upcurved, hairy, median process (ventral view, Fig. 9).

Head longitudinally striate, rest of body predominantly smooth and shining, with fine scattered punctures. Pilosity fine, mostly erect and rather short, abundant and generally distributed.

Larva: (After G. C. and J. Wheeler, 1952 *(rogenhoferi = robustus)* and 1964 *(pusillus)*. Thorax moderately stout and bent ventrally; slightly constricted at first abdominal somite; remainder of abdomen stout and ovoidal. Body densely covered with moderate-sized branching (mostly trifid) hairs; head with a few bifid hairs. Mandible distinctive, composed of a strongly inflated basal 2/5 and a very narrow, acute apical 3/5, the latter with 2 small median teeth in addition to the apical. This mandible is somewhat like those of amblyoponine larvae, except that the basal portion is relatively much wider than in *Amblyopone*.

Distribution and biology: So far as known, *Typhlomyrmex* is restricted to the warmer parts of the Americas, from southern Mexico to northern Argentina. Within this region, *T. rogenhoferi* is the most widespread and by far the most often-collected species, being an inhabitant of rotten logs in forest. This species is common in the Amazon Basin, where I have seen nests of several hundred workers moving in file through the rot zone just beneath the bark of a log. I have examined several such aggregations in the field, but I was not able to find definite indications of the prey of these undoubtedly predaceous ants. In some sites in the Amazon Basin, where *rogenhoferi* is moderately common, I found the species in very close proximity to termite colonies, but I never saw it actually taking or feeding upon a termite.

T. pusillus appears to be a soil dweller in cultivated and pampas areas as well as in forest (Kempf, 1961). It also seems to exist at higher elevations (e. g., in a coffee plantation at Venecia, near Medellin, Colombia). Probably it is strongly subterranean in foraging and nesting habits. The small series taken by P. F. Darlington at the mouth of the Amazon came from a rotten root in rain forest soil.

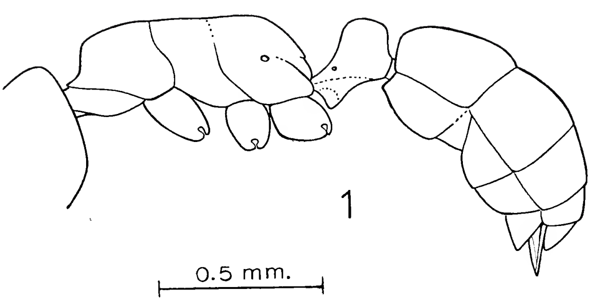
The remainder of the species are rare, and nothing is known of their biology. Probably their habits are strongly cryptic; the large proportion known from alate males and females indicates that most samples are taken during or after nuptial flight. *T. major* may be restricted to the south of Brazil and neighboring countries, while *T. clavicornis* is widespread in South America. *T. prolatus* is known only from the unique type, a female from Costa Rica.

Synonymic synopsis of *Typhlomyrmex* species

Typhlomyrmex clavicornis (Figures 4, 5, 7)

Typhlomyrmex clavicornis Emery, 1905, Bull. Soc. ent. Ital., 37: 112, nota, alate female. Type locality: Mapiri, Bolivia. Holotype examined in Coll. Emery, Museo Civico di Storia Naturale, Genoa.

Typhlomyrmex clavicornis var. *divergens* Forel, 1906, Ann. Soc. ent. Belg.,



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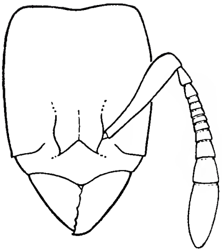

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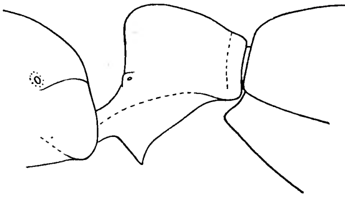

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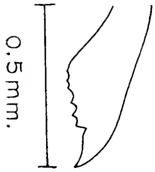

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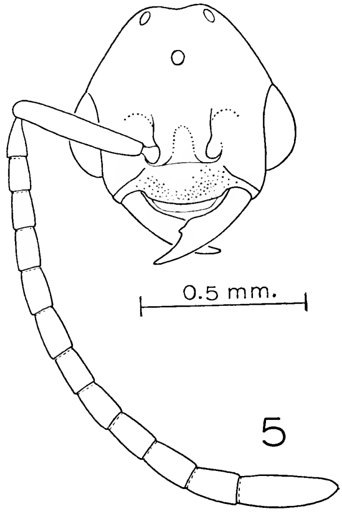

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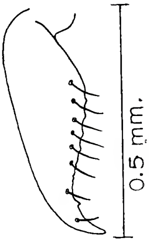


6

BROWN — TYPHLOMYRMEX

50: 248, female, male (in cop.). Type locality: San Bernardino, Paraguay. Type examined in Coll. Forel, Muséum d'Histoire Naturelle, Geneva. New synonymy.

Typhlomyrmex richardsi Donisthorpe, 1939, Ent. mon. Mag., 75: 161, male. TL: Mazaruni Clearing, British Guiana. Type series examined in British Museum (Natural History). New synonymy.

This species is distinguished in all castes by means of the wide head; long, falcate apical mandibular tooth (Figs. 4, 5); and oblique basal borders of the mandibles, which fail to meet the clypeus when closed. The worker-female antennal club is prominent, as the name suggests, and the petiolar node is short. A single worker (taken at Bartica, British Guiana by H. O. Lang, together with winged females) has a head length, without mandibles, of 0.67 and a head width of 0.65 mm., which is within the size range of the smaller *T. rogenhoferi* workers.

The type series of *T. richardsi* consists of numerous males, accompanied on one card by a female specimen (the latter not mentioned by Donisthorpe). The differences cited among the synonymous species by Forel and Donisthorpe mainly concern mandibular form and the proportions of the antennal segments. On examining all the types and comparing them with digms from British Guiana, I was impressed by the similarity of the mandibles between members of the same caste from different series. The basal segments of the funiculus show noticeable variation in length among males, even in those on one card, and I do not think they make a good diagnostic character.

T. clavicornis is known from the above-mentioned widely separated localities in South America, ranging from Bolivia and Paraguay north to British Guiana. A female with forewings missing, probably fully alate when captured, comes from the Floresta di Tijuca, near Rio de Janeiro, February 1960, C. A. Campos Seabra leg. The *T. richardsi* types were a part of a large series (apparently nearly all males) taken from a nest of the social vespid *Polybia bistriata.*

Typhlomyrmex major, new status

Typhlomyrmex pusillus st. *major* Santschi, 1923, Rev. Suisse Zool., 30: 246, worker. Type locality: Blumenau, Santa Catarina, Brazil. Location of type unknown (not in Santschi Collection).

EXPLANATION OF PLATE 5

Figures 1-6, *Typhlomyrmex* spp. Fig. 1, *T. pusillus* worker from El Rey, Salta, Argentina, lateral view of body. Fig. 2, Same, head in full-face view. Fig. 3, *T. rogenhoferi,* large worker, lateral view of petiole. Fig. 4, *T. clavicornis,* mandible of gyne from British Guiana, hairs omitted. Fig. 5, *T. clavicornis* from British Guiana, full-face view of male head. Fig. 6, *T. prolatus* sp. nov., female holotype, anterodorsal view of right mandible. Drawings by Nancy Buffler, D. Alsop and the author.

I refer to this species a worker from Agudos, São Paulo State, Brazil (W. W. Kempf leg.) with head length (HL) 0.71 mm, head width (HW) 0.63 mm. In habitus, this worker is like a small specimen of *T. rogenhoferi,* but the short, *pusillus*-like petiolar node separates it at once. It is distinguished from *pusillus* by its larger size and longer antennae. the scapes of which reach or surpass the occipital border when they are held straight back. The cephalic striation is also coarser and more distinct than in *pusillus.*

A female from Petropolis, Guanabara, Brazil (T. Borgmeier leg.), apparently belonging to this species, has HL 0.76 and HW 0.65. As has already been indicated, the female described by Santschi as *T. foreli* may belong to *T. major.*

Typhlomyrmex prolatus species nov. (Figure 6)

Diagnosis (gyne): A medium-sized *Typhlomyrmex* with unusually elongate, narrowly subtriangular mandibles; basal border short and curving broadly into long, indistinctly denticulate masticatory border (Fig. 6); apical tooth very long and acute. Petiolar node as seen from above broader than long, with feebly concave (almost straight) anterior border and strongly concave posterior border. Postpetiole with a distinct, sharp median longitudinal carina on the anterior third of its dorsal surface.

Holotype gyne, further description: Total outstretched length (TL) 3.8 mm, head length (HL) 0.72, head width without eyes (HW) 0.63, in full-face view, closed mandibles extend beyond median clypeal margin (ML) 0.31, straight-line length of right mandible from external point of insertion to apex 0.49, length of alitrunk (WL) 1.13, scape length 0.52, greatest diameter of eye 0.18, petiolar node length in dorsal view 0.20, width 0.33 mm. Cephalic index (HW/HL × 100) 88.

Head with parallel, feebly convex sides; occipital border with a shallow v-shaped concavity. Eyes feebly convex. Clypeus with the raised median area very smooth, with a broad strip hairless. Mandibles smooth, with small elongate punctures, becoming striatopunctate and opaque laterally toward insertions. Antennal scapes just barely reaching occipital margin in full-face view when held straight back from insertions; antennal club rather distinctly 3-segmented; flagellar segments 2-8 broader than long. Median furrow distinct, reaching anterior ocellus. Ocelli small but distinct.

Remainder of body much as in other species. Middle and hind tibiae each with a single simple calcar. Forewing as in *T. rogenhoferi,* but M forking from Cu even farther back toward wing base. In hind wing, there is only a single large cell.

The median carina on the postpetiole is a curious feature; it is symmetrical and does not look like a pathological condition. It is followed by a flat central area, which may even be slightly impressed. It remains to be seen whether the corresponding worker also carries it.

On the head, the longitudinal striation is indistinct except on the cheeks, and dense opaque reticulo-punctulation prevails. Dorsal surface of alitrunk densely punctulate, opaque to subopaque; propodeum mostly smooth and shining; sides of alitrunk weakly shining, pronotal part densely punctulate, remainder finely longitudinally striate, with scattered punctures. Petiole smooth and shining, with sparse punctulation on sides. Gaster smooth and shining, but with dense punctulation. Scapes densely punctulate, subopaque, as are also most of legs; mesal surfaces of femora smooth and shining.

Pubescence short, reclinate or appressed, fairly abundant over most dorsal body surfaces, gaster and appendages; longer fine hairs on clypeus, mandibles, and sparse on gaster above and below (abundant at gastric apex). Short oblique hairs extend beyond pubescence on scapes, funiculi and legs.

Color light ferruginous, legs lighter and more yellowish; head infuscated around ocelli.

Holotype (and only known specimen) from the vicinity of San José, Costa Rica, in 1940 (H. Schmidt leg.). Deposited in the collection of W. W. Kempf, São Paulo, Brazil.

Typhlomyrmex pusillus (Figures 1, 2)

Typhlomyrmex pusillus Emery, 1894, Bull. Soc. ent. Ital., *26*: 141, pl. 1, fig. 2, worker. Type locality: Bolivia.

Typhlomyrmex schmidti Menozzi, 1927, Ent. Mitt., *16*: 268, female, male. Type locality: vic. San José, Costa Rica. Syntypes in Istituto di Entomologia della Universitá, Bologna, Italy; 2 alate females examined. New synonymy.

This is the smallest species of the genus. It will probably turn out to be much more common and widespread than it seems at present; its habitat in the soil and its very small size have made it scarce in collections.

Samples that I have referred to this species show so much variation that they may actually represent more than one species. Specimens from the south (northern Argentina, Santa Catarina) and the Colombian Andes (Venecia, near Medellin) average larger and more robust (HW 0.34-0.50 mm) than those from Amazon drainage and the Guianas. Among the smaller forms, most samples (Surinam: Dirkshoop and Maripaheuvel; Brazil: near Belém do Pará; Peru: Finca Santa Beatriz, Chanchamayo) have the petiolar node and postpetiolar dorsum very finely and densely sculptured, usually striolate with interspersed shallow punctulation, and opaque or nearly so, but two samples from Tambahredjo in Surinam have the petiole and postpetiole smooth and shining, with only the usual abundant fine punctures. Of special interest is the occurrence, in two of the above samples (Peru: Finca Santa Beatriz, Chanchamayo, 10°57'S, 75°12'N, 1000 m, C. A. Portocarrero leg., No. 88-SB29, 11 July 1964. Brazil: Utinga tract, near Belém, Pará, P. F. Darlington leg., No. 335, Aug. 24, 1962) of a small, square to sharply trapezoidal lamellar lobe or process on the median anterior clypeal margin. This process is variable in shape and size, and is transparent and thus very difficult to see unless the mandibles are open at least partly. It appears to represent a modification of the lamellar free clypeal margin seen in other samples. This margin is usually evenly convex, but some Surinam specimens show a tendency for its most central part to form a narrow, shallow truncate lobe. Such a character would normally separate good species among ponerine ants, but the overall variation in the small *Typhlomyrmex* calls for caution and more than the present meager material before we draw new species boundaries.

The wings of the female of this species are atypical for *Typhlomyrmex,* in that M leaves Cu distad of cu-a, and the crossvein r-m is missing, so that the cubital cell is open at its apex.

The Santa Beatriz collection was made from a single chamber about 4 mm in diameter, located in the ground; Portocarrero found there 21 workers and one queen, plus 8 pupae, 1 larva, and 10 eggs. The Utinga collection came from a red-rotten root in rain forest.

Typhlomyrmex rogenhoferi (Figures 3, 8-11)

Typhlomyrmex rogenhoferi Mayr, 1862, Verh. Zool.-bot. Ges. Wien, 12: 737, worker. Type locality: "Amazonas."

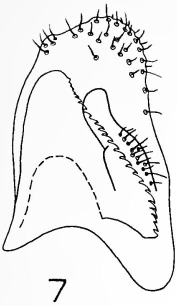
Typhlomyrmex Rogenhoferi r. *robustus* Emery, 1890, Bull. Soc. ent. Ital., 22: 40, worker. Type locality: Alajuela, Costa Rica. Syn. Brown, 1957.

Typhlomyrmex robustus subsp. manco Wheeler, 1925, Ark. f. Zool., 17A (8): 2, worker. Type locality: Pablobamba, Peru. Syn. Brown, 1957.

Centromyrmex sculpturatus Santschi, 1931, Revista Ent., Rio de Jan., 1: 266, dealate female. Type locality: Panama Canal Zone. Holotype examined in Naturhistorisches Museum, Basel. New synonymy.

Easily recognized by the relatively large size, triangular mandible and shape of the petiolar node in worker and female. The male can be recognized by size, the distinct angle between basal and masticatory borders of the mandible, and by the distinctive volsella of the genitalia.

Interesting Brazilian records for the species have been furnished by W. W. Kempf from his collection: Goiás State, Goiânia, Campinas (Schwarzmaier leg.). Espírito Santo State, Santa Teresa



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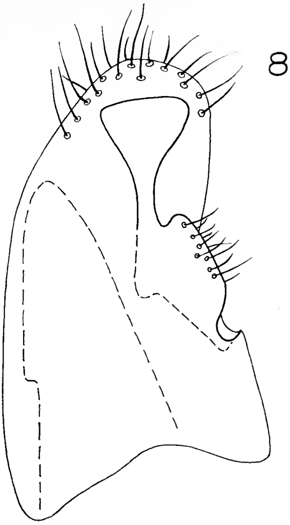

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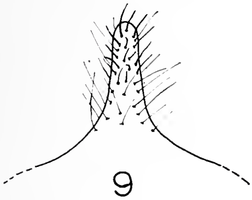

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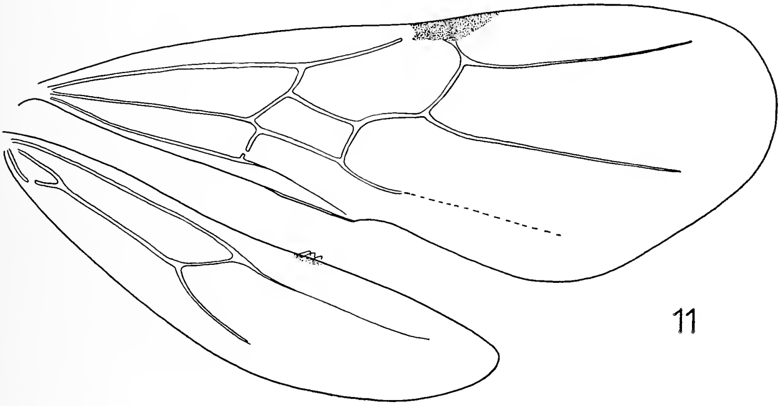

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Figures 7-11, *Typhlomyrmex* spp. Fig. 7, Right half of genital capsule of *T. clavicornis* male from British Guiana, viewed from inside, ventral side to right, semidiagrammatic. Fig. 8, same, *T. rogenhoferi,* aedeagal valve omitted. Fig. 9, hypopygial process of *T. rogenhoferi,* ventral view. Fig. 10, maxillary palpus (left) and labial palpus (right) of *T. rogenhoferi.* Fig. 11, right wing of *T. rogenhoferi* Figs. 8-11 are drawn from a male from Perene, Peru. Drawings by D. Alsop and the author.

(O. Conde leg.). Minas Gerais State, Serra Caraça (K. Lenko leg.). São Paulo State, Fazenda Itaquerê, Nova Europa (K. Lenko leg.). The species ranges from Bolivia to Veracruz State in Mexico.

Typhlomyrmex foreli

Typhlomyrmex foreli **Santschi, 1924, Ann. Soc. ent. Belg., 64: 6, female. Type locality: Rio Negro, Parana, Brazil. Location of type unknown (not in Santschi Collection).**

This species was described from a single gyne. I suspect it to be the gyne of *T. major,* but some items in Santschi's description will leave doubts until the type can be re-examined. Probably the "court sillon médian" on the clypeus can be dismissed as an illusion caused by the shiny surface here; I have noticed this in other species. Santschi says that the external margins of the mandibles are slightly concave, a description that will fit no specimen of any species of *Typhlomyrmex* in full-face view, but will fit all of them if viewed obliquely from above and slightly to the side.

The "bord terminal long, finement denticulé avec une dent apicale bien dévelopée" would fit the new species *prolatus* (see above), but would also fit *T. major* reasonably well.

Santschi's statement, "The first article of the funiculus is not quite as long as the three following ones taken together" fits *prolatus* fairly well, while in a gyne I take to be *major,* the first funicular segment is shorter than this.

In spite of these difficulties, the like of which often crop up in connection with Santschi's descriptions of ants, I think it probable that *T. foreli* and *T. major* are conspecific. The distributional evidence weighs for this decision, and Santschi mentions no posterior concavity of petiole and no median postpetiolar carina such as *prolatus* carries.

Summary of changes proposed in species-level taxonomy of *Typhlomyrmex*

clavicornis Emery
    = *clavicornis* var. *divergens* Forel, n. syn.
    = *richardsi* Donisthorpe, n. syn.
? foreli Santschi (possibly a synonym of *T. major*)
major Santschi, raised to species level
prolatus sp. nov.
pusillus Emery
    = *schmidti* Menozzi, n. syn.
rogenhoferi Mayr
    = *robustus* Emery

= *robustus manco* Wheeler
= *Centromyrmex sculpturatus* Santschi, n. syn.

Note: Brown (1953) cited *Prionopelta marthae* Forel as a synonym of *Typhlomyrmex rogenhoferi.* The synonymy was based on a specimen labeled as a cotype of *P. marthae,* found in the Wheeler Collection, and which is clearly a specimen of *T. rogenhoferi.* Studies in European museums in 1963 and 1964 show that this specimen is mislabeled, because *P. marthae* syntypes ("cotypes") in the Forel Collection and elsewhere are true *Prionopelta* close to, and possibly conspecific with, the species currently called *Prionopelta antillana. P. marthae* must, therefore, be deleted from the synonymy of *T. rogenhoferi* and returned to genus *Prionopelta.*

Key to *Typhlomyrmex* species, workers

1. Petiolar node longer than high, without a differentiated posterior face (Fig. 3) .... *rogenhoferi*
Petiolar node as high as or higher than long, with a differentiated posterior face (Fig. 1) 2
2. Head width <0.55 mm .... *pusillus*
Head width >0.55 mm 3
3. Mandibles triangular, with basal border fitting tightly against clypeus at full closure; apical tooth stout, not notably elongate .... *major*
Mandibles more elongate, basal borders oblique and not closing up against clypeus; apical tooth notably elongate and very acute (Fig. 4) .... *clavicornis*
Note: The worker of *T. prolatus,* at present unknown, probably would key to couplet 3, where it would undoubtedly be distinguished from both alternatives by having mandibles like those of its gyne (Fig. 6).

Key to *Typhlomyrmex* species, gynes

1. Petiolar node without a differentiated posterior face; size large, head width (without eyes) normally >0.85 mm .... *rogenhoferi*
Petiolar node with a differentiated posterior face; size smaller .. 2
2. Head width (without eyes) <0.58 mm; r-m crossvein missing from forewing .... *pusillus*
Head width (without eyes) >0.58 mm; r-m present in forewing 3
3. Petiolar node as seen from above concave behind; mandibles elongate but only weakly denticulate, of a particular form (Fig. 6); postpetiolar disc with a distinct anteromedian longitudinal carina .... *prolatus*

Petiolar node as seen from above with a straight or convex posterior margin; mandibles not as in Fig. 6; no carina on postpetiolar dorsum 4

4. Same as couplet 3 of worker key, above: *major* vs. *clavicornis*. Note: *T. foreli* is not included in the key. It may be the female of *T. major*.

Acknowledgements

I am indebted to my colleagues G. Grandi, F. Keiser, W. W. Kempf and C. Portocarrero for the opportunity to review important material in their care. This project was supported by National Science Foundation Grants G-23680 and GB-2175, and publication was aided by a grant from the Grace Griswold Fund, Department of Entomology and Limnology, Cornell University.

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A REVISION OF THE ANT TRIBE CARDIOCONDYLINI (HYMENOPTERA, FORMICIDAE)

I. The Genus *Prosopidris* Wheeler[1]

By Jonathan Reiskind
Biological Laboratories, Harvard University

This is the first of a series of papers revising the tribe Cardiocondylini, a group of small myrmicine ants (up to 3.0 mm in length), characterized by the possession of a pedunculate petiole, a wide postpetiolar dorsum, propodeal spines, and a general lack of pilosity. The tribe currently embraces the genera *Cardiocondyla* Emery (virtually cosmopolitan, mainly Old World), *Xenometra* Emery (West Indian) and *Prosopidris* (Papuasian). *Xenometra* includes a single poorly known species which is apparently parasitic on *Cardiocondyla emeryi* (Emery, 1917). *Cardiocondyla* and *Prosopidris* are free living, and form small inconspicuous colonies usually in the soil or in rotting logs.

In this contribution Wheeler's subgenus *Cardiocondyla (Prosopidris)* is elevated to full generic status. The worker and female types of its single previously known species, *P. sima* Wheeler (Philippines), are redescribed and a second species, *P. papuana* (New Guinea), is newly described. The *papuana* material includes the first known male of the genus, along with females and workers. The male is highly ergatoid, like those of some *Cardiocondyla* species.

Measurements and Indices: In order to characterize properly cardiocondyline ants the following measurements and indices (with their abbreviations) will be used in this and succeeding papers:

Head Length (HL) — Maximum length of head in frontal view from clypeal apex to posterior border of occiput.

Head Width (HW) — Width of head measured in frontal view immediately behind the eyes.

Scape Length (SL) — Maximum measurable length of scape, not including its articular condyle.

Weber's Length (WL) — Weber's length of mesosoma (=alitrunk), measured in lateral view along a line connecting the place where the pronotum joins the cervix and the apices of the

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[1] Research supported by U.S. National Science Foundation Grant No. GB1634.

the flanges of the sides of the propodeal declivity (Brown, 1953). The lateral viewing position of specimens must be standardized by lining up the tips of the propodeal spines.

Pronotum Width (PW) — Width of pronotum, measured in dorsal view, disregarding humeral angles.

Propodeal Spine L(ength) — Maximum measurable length of propodeal spine, in lateral view, from its apex to the far edge of the propodeal spiracle.

Petiole L(ength) — Length of petiole, measured in lateral view, from the apices of the flanges of the sides of the propodeal declivity to the dorsal posterior border of the petiolar tergite.

Petiole Height — Height of petiole, measured in lateral view, on a line perpendicular to the petiole length; from the dorsalmost point on the petiolar node to the ventral side.

Postpetiole W(idth) — Maximum width of postpetiolar dorsum.

Postpetiole L(ength) — Midline length of postpetiolar dorsum.

Cephalic Index (CI) — Head width expressed as a percentage of head length. HW × 100/HL

Scape Index (SI) — SL × 100/HW

Mesosomal Index — PW × 100/WL

Propodeal Spine Index (SpI) — Propodeal Spine L. × 100/WL

Petiolar Index — Petiole L. × 100/Petiole Height

Postpetiolar Index — Postpetiole L. × 100/Postpetiole W.

Genus *Prosopidris* Wheeler new status

Cardiocondyla subgenus *(Prosopidris)* Wheeler, 1935, Psyche 42: 40-41.
Type-species: *Cardiocondyla (Prosopidris) sima* Wheeler, Ibid: 42-43.

Wheeler's subgenus *Prosopidris* is here raised to full generic status. This change of rank is based on the distinctive clypeus, the 11-segmented antennae, and the high mesosoma, which readily distinguish *Prosopidris* from *Cardiocondyla,* though the two genera are obviously closely related.

Wheeler's (1935) subgeneric diagnosis requires some modification in light of the new species, *Prosopidris papuana,* described below. In the workers the mesometanotal impression is lacking or very feeble. In the female wing venation the stub of vein Rs, extending beyond the cubital cell, may or may not be present. The only known male of the genus is described below.

Prosopidris papuana new species
(Figures 1-8)

WORKER

Measurements: Based on the holotype and 4 paratype workers (holotype cited first): HL 0.59 mm, 0.59-0.60 mm; HW 0.44 mm, 0.44 mm; CI 75, 73-75; SL 0.49 mm, 0.49-0.52 mm; SI 111, 111-118; PW 0.33 mm, 0.33 mm; WL 0.70 mm, 0.68-0.70 mm; Mesosomal Index 47, 47-48; Propodeal Spine L. 0.18 mm, 0.18-0.20 mm; SpI 26, 26-29; Petiole L. 0.28 mm, 0.28-0.29 mm; Petiole Height 0.17 mm, 0.17-0.18 mm; Petiolar Index 159, 155-164; Postpetiole W. 0.24 mm, 0.24 mm; Postpetiole L. 0.15 mm, 0.15-0.16 mm; Postpetiolar Index 60, 60-65. Palpal formula *Maxillary* 5: *Labial* 3 (paratype dissected).

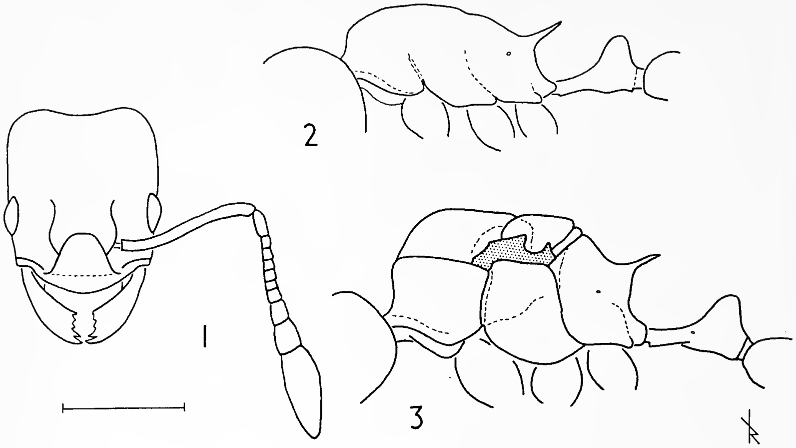
Description: General form is shown in Figures 1 and 2. Head subrectangular, sides sub-parallel, slightly convex; posterior corners rounded; occipital border slightly concave. Scape slightly curved distally, exceeding occipital border by a distance about equal to its maximum diameter. Antennae 11-segmented, with a 3-segmented club, the apical segment about 3 times as long as the preapical. Eyes strongly convex, maximum diameter (in all specimens) 0.13 mm; their anterior edges at a distance of 0.7 × their diameter from the lateral genal border. Outer borders of mandibles convex; masticatory border with 5 teeth, the 2 apical enlarged. Clypeus produced anteriorly, forming a shelf over the mandibular bases and bulging outwards; anterior border convex, with thick lateral sections anterior to each antennal sulcus; posterior portion extending broadly between the frontal carinae.

Mesosomal profile as in Figure 2; lacking a promesonotal constriction, humeral angles indistinctly rounded. Mesometanotal impression weakly developed on mesosomal dorsum as a very shallow concavity, lacking an incised sutural trace. Propodeal spines moderately long, pointed, uncurved. Petiolar node from above, oval, distinctly wider than long. Postpetiole with convex anterior and posterior margins and convex sides. Dorsal width of first gastric segment 2.1 × postpetiole width.

Head and mesosoma strongly reticulate-punctate and mat; petiole, postpetiole and gaster moderately reticulate and shining.

Yellow pilosity on clypeus, mandibles and posterior end of gaster. Yellowish adpressed pubescence dense on antennae, moderate on head, petiolar node, postpetiolar dorsum, and gaster.

Entire body yellow to dark yellow.



Figs. 1-3. *Prosopidris papuana* new species. Figs. 1 and 2, worker (Holotype). Fig. 1. Head, frontal view. Fig. 2. Mesosoma and petiole, lateral view. Fig. 3, female (Paratype); mesosoma and petiole, lateral view. Scale line: 0.40 mm.

Type locality: Bisianumu, near Sogeri, Papua, 15-20 March, 1955 (E. O. Wilson acc. 655).

FEMALE

Measurements: Based on 5 specimens collected with the workers: HL 0.60-0.62 mm; HW 0.46-0.47 mm; CI 76-78; SL 0.49-0.52 mm; SI 103-114; PW 0.46-0.47 mm; WL 0.83-0.85 mm; Mesosomal Index 54-57; Propodeal Spine L. 0.20-0.21 mm; SpI 23-25; Petiole L. 0.31-0.33 mm; Petiole Height 0.20-0.21 mm; Petiolar Index 146-167; Postpetiole W. 0.28-0.29 mm; Postpetiole L. 0.16 mm; Postpetiolar Index 56-59.

Description: General form of mesosoma as in Figure 3. Head, antennae, clypeus and mandibles similar to worker. Ocelli slightly elevated. Eyes strongly convex, maximum diameter (in all specimens) 0.16 mm; their anterior edges at a distance of 0.5 × their diameter from the lateral genal border. Propodeal spines longer and thinner than worker. Petiolar node and postpetiolar dorsum as in worker. Dorsal width of first gastric segment 2.2-2.4 × postpetiole width.

Head and mesosoma strongly and coarsely reticulate-punctate and moderately shining; petiole, postpetiole and gaster moderately reticulate and shining.

Yellow pilosity as in worker. Yellowish adpressed pubescence dense on antennae, postpetiolar dorsum and gaster, and moderate on head and mesosoma.

Color as in worker, pterostigma pale brown, wing veins pale yellow; apical stub of wing vein Rs absent beyond cubital cell.

MALE

Measurements: Based on a single specimen collected with the workers: HL 0.59 mm; HW 0.47 mm; CI 81; SL 0.44 mm; SI 93; PW 0.36 mm; WL 0.75 mm; Mesosomal Index 48; Propodeal Spine L. 0.15 mm; SpI 20; Petiole L. 0.34 mm; Petiole Height 0.21 mm; Petiolar Index 162; Postpetiole W. 0.29 mm; Postpetiole L. 0.15 mm; Postpetiolar Index 52.

Description: Ergatoid. General form as shown in Figures 4 and 5.

Head with sides slightly divergent behind eyes, then strongly converging; posterior corners rounded; occipital border slightly concave. Scapes straight, their apices falling slightly short of the occipital border. Antennae 12-segmented. Funiculus and clypeus as in worker. Eyes strongly convex, maximum diameter 0.13 mm; their anterior edges at a distance of 0.7 × their diameter from the lateral genal border. Mandibles narrowly falcate, ending in a point. Frontal carinae more extensive than in the worker.

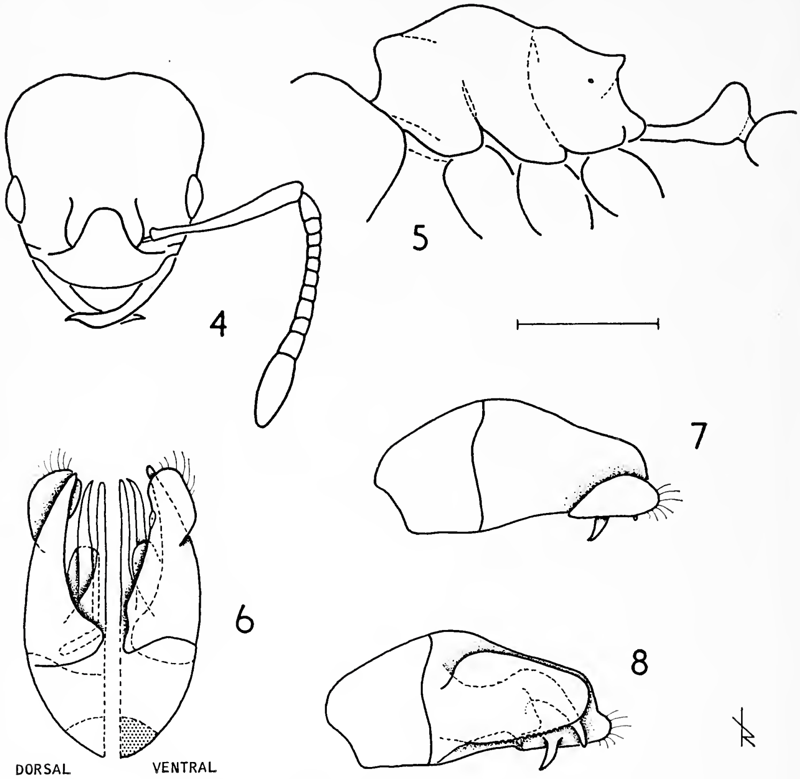
Mesosoma high, in lateral view, with no promesonotal constriction, but with distinctly rounded humeral angles; mesometanotal impression and constriction clearly developed, but lacking an incised suture. Propodeal spines blunt; shorter and wider at base than in worker. Petiolar node and postpetiole dorsally, as in worker. Dorsal width of first gastric segment 2.0 × postpetiole width.

Pro- and mesonotum strongly reticulate-punctate; rest of mesosoma, head, petiole, postpetiole and gaster moderately reticulate. Whole ant very shining.

Yellowish pilosity on clypeus and posterior end of gaster. Yellowish adpressed pubescence very dense on antennae, pronotum, mesonotum, gaster, and dorsa of petiole and postpetiole.

Entire body yellow.

Genitalia: General form shown in Figures 6, 7, and 8. Basal ring entire; the genital foramen inclined ventrally. Gonoforceps each with a lobate, hirsute ventrolateral subapical extension; a peculiar large ventrally directed curved tooth arising on the ventral part of the inner face (Figure 8). Volsella hook shaped, its apex directed ventrally, the base swollen with a small acute ventrally directed tooth (Figure 8). Penis valves rounded apically, each with a row of fine teeth on its ventral edge.



Figs. 4-8. *Prosopidris papuana* new species. Figs. 4-8, male (Paratype). Fig. 4. Head, frontal view. Fig. 5. Mesosoma and petiole, lateral view. Fig. 6. Genitalia, dorsal and ventral views. Fig. 7. Genitalia, left half, external lateral view, showing gonoforceps and basal ring. Fig. 8. Genitalia, right half, internal lateral view, showing penis valve, volsella, gonoforceps and basal ring. Scale line: 0.40 mm., for Figs. 4 and 5; 0.15 mm., for Figs. 6, 7 and 8.

Type deposition: The holotype and most paratypes are deposited in the Museum of Comparative Zoology at Harvard College, Cambridge, Massachusetts (Type No. 31156), single worker and female paratypes in the Australian National Insect Collection, CSIRO, Canberra.

Prosopidris sima Wheeler

Cardiocondyla (Prosopidris) sima Wheeler, 1935, Psyche 42: 40-43, figs.

The worker and female are adequately described (with figures of the worker) in Wheeler's paper. The measurements and indices applied above to *Prosopidris papuana* have also been applied to *P. sima* and are listed here:

WORKER

Based on 5 workers from Wheeler's syntype series (MCZ Type No. 20798), the lectotype (by present designation, so labelled) cited first, the others paralectotypes: HL 0.57 mm, 0.55-0.57 mm; HW 0.46 mm, 0.44-0.46 mm; CI 80, 79-80; SL 0.51 mm, 0.47-0.52 mm; SI 111, 107-114; PW 0.34 mm, 0.33-0.34 mm; WL 0.68 mm, 0.67-0.68 mm; Mesosomal Index 50, 48-50; Propodeal Spine L. 0.20 mm, 0.18-0.20 mm; SpI 29, 26-29; Petiole L. 0.28 mm, 0.26-0.29 mm; Petiole Height 0.20 mm, 0.19-0.20 mm; Petiolar Index 141, 133-154; Postpetiole W. 0.23 mm, 0.23-0.24 mm; Postpetiole L. 0.16 mm, 0.15-0.16 mm; Postpetiolar Index 69, 64-71. Dorsal width of first gastric segment 2.1-2.3 × as wide as postpetiole.

FEMALE

Based on three paralectotypes: HL 0.59 mm; HW 0.46-0.47 mm; CI 78-81; SL 0.49-0.51 mm; SI 104-111; PW 0.46-0.47 mm; WL 0.80 mm; Mesosomal Index 57-59; Propodeal Spine L. 0.21-0.22 mm; SpI 27; Petiole L. 0.31-0.33 mm; Petiole Height 0.20-0.21 mm; Petiolar Index 148-167; Postpetiole W. 0.25-0.26 mm; Postpetiole L. 0.16 mm; Postpetiolar Index 63-65. Dorsal width of first gastric segment 2.3-2.4 × as wide as postpetiole.

Type Locality: Dansalan, on Lanao Island, Philippine Islands.

The following chart presents the major distinguishing characteristics of the two *Prosopidris* species considered above:

Prosopidris sima Wheeler	*Prosopidris papuana* n.sp.
Worker	
Anterior clypeal border straight.	Anterior clypeal border evenly convex.
Mesosoma almost smooth, shining.	Mesosoma mat, highly reticulate-punctate.
Yellow-brown.	Yellow to dark yellow.
Female	
Anterior clypeal border flattened.	Anterior clypeal border evenly convex.
Propodeal spines thicker than in worker.	Propodeal spines thinner than in worker.
Pronotum shining, almost smooth.	Pronotum highly reticulate-punctate.
Pronounced lateral propodeal striae converging on propodeal spine.	No clear propodeal striae.
Stub of vein Rs extending beyond the cubital cell.	Stub of vein Rs beyond cubital cell lacking.

The author wishes to thank Dr. Robert W. Taylor of Harvard University for his invaluable assistance.

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"QUEENLESSNESS," WORKER SIBSHIP, AND COLONY VERSUS POPULATION STRUCTURE IN THE FORMICID GENUS *RHYTIDOPONERA*

By Caryl P. Haskins[1] and Roy M. Whelden[2]

INTRODUCTION

William Morton Wheeler, in his *Colony Founding Among Ants* (1933), called special attention to the fact that in a number of formicid genera, and particularly in the socially primitive subfamilies Ponerinae and Cerapachyinae, typical alate female forms have never been described. In such genera as *Onychomyrmex, Eusphinctus, Acanthostichus, Megaponera,* and *Plectroctena,* this normal female may be replaced by a wingless ergatogyne, intermediate in structure between queen and worker. The same condition obtains among certain species of the archaic subfamily Myrmeciinae, as Wheeler also pointed out. In some cerapachyine species, normal females typically coexist with ergatogynes, and such caste duality occurs elsewhere also.

In certain respects, the shift from a "queen-like" toward a "worker-like" form of reproductive female is curious and striking. At first sight it may even suggest a reversal of the trend tending to emphasize the dichotomy between more "vegetative" and more actively "foraging" forms which, as Wigglesworth (1954) and Kennedy (1961) have pointed out, is so characteristic of evolution in insects generally, whether at the level of "successive polymorphism" in the juvenile and adult phases of the individual, or of "alternative polymorphism" among adult populations of such forms as aphids, migratory locusts, and the social insects. Among the ant genera cited, however, evolution from alate to ergatoid reproductive may only superficially appear to lie in that direction, for the ergatoid is clearly at least as effective a reproductive as the winged female. In most species with such females, moreover, it seems likely that the ergatoid has been directly derived by a stabilization of a queen-worker intercaste, as Brown (1960) has suggested, and merely replaces the normal queen, with no drastic change in the general economy or structure of the colony. Even in the ponerine genus *Leptogenys sens. str.,* where the laying female is no longer morphologically distinguishable from the worker, the course of evolution still seems relatively clear. As Wheeler (1933) pointed out, a normal female is present in the related *Lobopelta langii,* and

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in *L. ergatogyna* the wingless laying female still possesses well developed ocelli and a normal female thorax. In the genus *Myrmecia* similar series, ranging through increasing female microptery toward total aptery, can be assembled, culminating in the ergatoid-like gynes of, for instance, *M. tarsata.* In all these species, however, there is little evidence of any significant modification in the social structure of the colony, which remains at base a typically matrifilial community.

Certain other ponerine genera referred to by Wheeler, however, may present a rather different picture. In the genera *Diacamma, Streblognathus,* and *Dinoponera,* and in some species of *Rhytidoponera,* for example, distinguishable ergatogynes have not been reported. A male of a Philippine species of *Diacamma* has been described *in copula* with a form indistinguishable from a worker by Wheeler and Chapman (1922), suggesting that in this organism the normal reproductive may have been replaced by what is in effect a worker-producing worker. Our overall knowledge of the first three genera, however, is hardly sufficient to support even speculation about their social situations at present. For the genus *Rhytidoponera,* however, something more is known or knowable, and it may quite possibly represent a situation of considerable interest to the student of social evolution in the Formicidae.

The Ponerine genus *Rhytidoponera* comprises an extensive but relatively compact series of species inhabiting the Australian and parts of the Melanesian and Malaysian areas, ranging from New Caledonia in the east through New Guinea and neighboring parts of Melanesia to Timor, the Moluccas, and the southern Philippines in the west and occcupying a large portion of the Australian continent and of Tasmania (Brown, 1954, 1958; Wilson, 1958, 1959a). They are members of the widely distributed ponerine tribe Ectatommini, bearing considerable resemblance in many respects to the generalized New World tropical genera *Acanthoponera* and *Ectatomma,* as well as to the pantropical *Heteroponera,* with the Old World components of which they may well have shared common ancestry. The females of *Ectatomma* and *Acanthoponera,* so far known, are of the normal winged form. Those of *Heteroponera* may be winged or ergatoid.

In at least three species of *Rhytidoponera, R. impressa, R. purpurea,* and *R. chalybaeae,* typical winged queens are the rule. Normally a single queen is found in each colony examined in the field, and communities appear to be initiated by isolated dealated females following a normal Ponerine dispersion and mating flight. These species are confined in distribution to well-watered and warmer areas, ranging from New Guinea and eastern Queensland rain forest southward along a belt down the eastern edge of Australia at least as far as south central Victoria (Brown, 1958).

In a second and much larger group of *Rhytidoponera* species, an exactly opposite situation obtains with respect to the queen. Many of these species include among the largest and most conspicuous members of the genus, are widely distributed, abundant, and well known, especially in the drier areas of Australia, and have been extensively collected over long periods. Yet in none of them has a reproductive morphologically or functionally distinguishable from a normal worker ever been described.

Finally there is a third group, designated by Brown (1958) the *Rhytidoponera metallica* complex, which may be the most interesting from the standpoint of social evolution. The type species is one of the most widely distributed and ubiquitous of Australian ants; an inhabitant of thickly populated as well as remote situations over a very large area both temperate and subtropical; and so familiar as to have been known to a wide public for many years by the popular name of "greenhead" ant. Alate typical queens of this species have been described, and are represented in limited numbers in some collections, notably that of the Harvard Museum of Comparative Zoology. Wheeler described a single dealate and possibly colony-founding female of *R. inornata,* a member of the complex from southwestern Australia in 1931 (Brown, 1958). Brown (1958) has described a dealate female of another related species, *R. aspera,* collected by H. Hacker in southeastern Queensland and also in the Harvard Museum of Comparative Zoology. A single perfect female of *R. victoriae,* taken by Brown at Seaford, Victoria, is in the same collection. But it is striking that so few typical females have been identified in a complex of species as extraordinarily abundant and well-collected. It is clear that the vast majority of colonies in nature must exist without such females.

Even more interesting is the fact that in no species of *Rhytidoponera,* including those of the *metallica* complex, has a queen-worker intermediate ever been recorded. This could suggest that evolution to the loss of the typical female took a somewhat different course from that in the *Lobopelta-Leptogenys* complex or even in *Heteroponera.* Instead of the alate female reproductive being morphologically modified toward a stabilized intermediate between queen and worker while continuing the same functional role in the colony, the original queen caste may have disappeared entirely and one or more laying workers substituted as the usual reproductives. If, as Carroll Williams (in Brown, 1960) has suggested, worker development in ants is due to a precocious decline of juvenile hormone titer in the maturing larva, or if on the other hand as Brian (1959, 1961) proposes, to a sharp rise in the concentration of ecdyson near the critical period or periods of caste determination in larval ontogeny, it seems conceivable that mutations have accumulated in evolution affecting neurosecretory products or processes or timing, such that the threshold for worker-queen determination is passed only rarely in species of the *R. metallica* complex, and never in many of the larger species. Alternatively, it is conceivable that dimorphic female reproductive forms originally existed, as they presently do, for example, in species of *Neophyrcaces,* one form being ergatoid and the other unmodified, and that further evolution resulted in the loss of the latter and so close an approximation of the worker form by the former that it is no longer distinguishable except through its reproductive capacity. If the latter course has been the actual one, however, we should perhaps suspect that the fertile "workers" would be comparatively rare in the *Rhytidoponera* colony, at least as rare as are the laying true queens in colonies of relatively primitive pleometrotic species. It appears, as will later be indicated, that they are in fact much more abundant.

Whatever the channel of evolution at the level of individual morphology, its end result poses some intriguing questions about the direction of evolution in *Rhytidoponera* at the level of the society. Some years ago Sturtevant (1938), and later Williams and Williams (1957), emphasized the evolutionary significance of the close family relationships which typically obtain among the members of the matrifilial colony so characteristic of the higher social Hymenoptera. Very recently W. D. Hamilton (1964), in two important papers, beginning with Haldane's (1955) concept of the evolutionary significance of genetically based altruistic behavior, has derived a quantity in social evolution that he defines as "inclusive fitness." It may be regarded in certain respects as an analogue at the social level of the concept of Darwinian reproductive fitness at the level of the individual. Like the latter it should be found to maximize in evolution. This maximization, in the social insects, has obviously involved an extraordinary evolution of worker altruism, at both structural and behavioral levels. Now as Hamilton demonstrates, it can be expected that such an evolution will be positively correlated with the maintenance of close genetic relatedness among the members of a colony. In the absence of parthenogenesis, the closest genetic relationship between queen and worker possible in a colony is that of mother to daughter, and among workers that of siblings. The pronounced evolutionary trends toward the inclusion of but two generations in the colony structure and toward the restriction of fertilized reproductives in the colony to a single or a few individuals, so evident in a great number of ant species, both evidently contribute to maintaining this maximal degree of relatedness within the community.

Exceptions to both trends, to be sure, are known. On the one hand, they are well illustrated by the puzzling situations explored in species of the *Formica obscuriventris* group (King, 1949, 1955; King and Sallee, 1951) and the *Formica rufa* group (Sturtevant, 1938; Chauvin, Courtois, and Lecompt, 1961) where it appears that young reproductives, even of different species, may be adopted by large colonies, thus prolonging the existence of the colony well beyond the second generation and introducing both multiple queens and what must be a remarkable degree of unrelatedness among the worker personnel of individual colonies. Exceptions to the second trend may be presented by the numerous pleometrotic species of ants, though it is still unclear, as in the Polybiine and Polistine wasps, how usually such multiple reproductives are in fact sisters, and how often or how elaborately special behavior patterns may be adapted to restricting reproduction in practice to a single dominant female, or to preventing non-sisters from coexisting in the colony.

In this context, the course of social evolution in the genus *Rhytidoponera* is of special interest, as is the probable degree of average relatedness among the workers of a single community of both normal and "queenless" forms. In the so-called "queenless" species, do workers in fact regularly give rise to workers? Is the same true of those species possessing functional typical queens? Is worker production accomplished in one or both groups through parthenogenetic thelytoky, so common among lower nonsocial Hymenoptera, and frequently reported in the Cape honey bee? Such thelytoky has been described in ants by several investigators over a long period of years, including Reichenbach (1902), Crawley (1912), and Comstock (1903) for *Lasius niger,* Haskins and Enzmann (1945) for *Aphaenogaster picea* and *A. lamellidens,* Soulié (1960) for *Cremastogaster,* and Otto (1960) for *Formica polyctena,* while Ledoux (1949, 1954) has reported extensively on a specialized social adaptation of thelytoky in the workers of *Oecophylla.* If such thelytoky obtains in *Rhytidoponera,* the pattern of relatedness among colony members might be quite different than if laying workers possess developed spermatheca and are fertilized in the manner normal to ordinary ergatoid queens, by active low-flying males from other colonies. Such males are indeed characteristic of all species of *Rhytidoponera,* both those possessing and those lacking typical queens. Do laying workers of the "queenless" species occur only one to a colony, or are they present in some numbers? If the latter, are they commonly actual siblings, or how closely are they, on average, related? Is there a tendency, in the "queenless" species, to confine worker production to a single individual even if a number of potential worker-producers are present? If such laying workers are in fact fertilized, are their mates normally derived from the same or from other colonies? Are such workers singly or multiply inseminated? Is a single individual inseminated more than once during its lifetime? What is the average contribution of male progeny by the non-fertilized members of the colony, and how is the production of males regulated? How resistant is the genus to extreme inbreeding? Is it the rule that a proportion of each successive brood of workers brought to maturity in a colony is fertilized and that these individuals remain with the parent colony, so prolonging the life of the community well beyond the normal two generations, or do newly fecundated workers typically leave the parental nest? How indeed are new colonies normally formed?

Such questions as these must be answered before any critical assessment of the direction of social evolution in *Rhytidoponera* can be undertaken. The results reported in the present paper, derived in the course of some ten years of investigation of the genus both in the field and in the artificial nest, represent the early stages of an observational attempt to provide answers to a very few of them.

SOURCE OF WORKER AND MALE BROOD IN A SPECIES OF RHYTIDOPONERA POSSESSING NORMAL QUEENS

Rhytodoponera purpurea

Rhytidoponera purpurea is a typical member of the *R. impressa* group, in which normal queens are characteristic. A single such queen is typically found in each colony taken in the field. According to Brown (1954) the species occurs in New Guinea and ranges in Australia through the rain forests of the Cairns-Atherton Tableland region of northern Queensland.

On December 27, 1963, a typical, populous colony of *R. purpurea,* comprising the parent female, some 250 workers, and numerous larval and pupal brood including sexual males and females, was collected near Kuranda in northern Queensland. The following day a similar colony was taken at Millaa Millaa on the Atherton Tableland. In early January these colonies were housed in a type of modified earth-containing glass Lubbock nest used throughout these investigations. The colony from Kuranda was divided at the time of nesting into several isolated groups of workers with broods of cocoons and larvae. Only one such group had access to the brood female. The colony from Millaa Millaa was divided into two portions, one with and one without the brood queen. An interval was then allowed to permit the maturation of larvae and pupae in the nests at the time of capture. In the fragments of both colonies lacking parent queens, as well as in those where the normal females were present, oviposition soon occurred, and fairly copious broods were shortly reared. By late March abundant pupae were present in several groups. In that month, and over a following period until mid-January, 1965, samples of cocoons were regularly withdrawn from these colony-fragments and opened, and their contained pupae scored for sex and caste. The results, in which the numbers of pupae in all the queenless fragments of Colony No. 1 are summed for each date, appear below:

No. of Colony Fragment	Dates of Examination	Assay of Pupal and Young Adult Samples	
		Workers	Males
1 A (Kuranda — with parent female)	4/29/64	23 pupae; 3 callows	0
	6/ 4/64	14 pupae;	0
	7/12/64	15 pupae; 1 callow	0
	9/20/64	15 pupae	0
	12/ 5/64	34 pupae	0
	1/19/65	30 pupae	0
	Total: 131 worker pupae; 4 callow workers; 0 males.		
1 B-E (Kuranda — fragments of colony without brood queen)	4/29/64	0	47 pupae; 26 adults
	5/10/64	0	3 pupae
	6/ 4/64	0	12 pupae
	7/12/64	0	10 pupae
	9/20/64	0	27 pupae
	12/ 5/64	0	34 pupae
	1/19/65	0	47 pupae
	Total: 180 male pupae; 26 male adults; 0 workers.		
2 A (Millaa-Millaa — with parent female)	4/29/64	23 pupae; 2 callows	0
	6/ 4/64	39 pupae	0
	6/22/64	1 pupa	0
	12/ 5/64	32 pupae	0
	1/19/65	29 pupae	0
	Total: 124 worker pupae; 2 callow workers; 0 males.		
2 B (Millaa-Millaa — fragment without parent female)	4/29/64	3 callows*	15 pupae
	6/ 4/64	0	5 pupae
	6/22/64	0	4 pupae
	9/20/64	0	8 pupae
	12/ 5/64	0	14 pupae
	1/19/65	0	14 pupae
		Total: 60 male pupae; 3 callow workers.*	

*These callow workers, found fresh-hatched on April 29, 1964, almost certainly represent the final fragment of maturing brood collected with the original colony, and seem with little doubt to have been progeny of the fertilized brood female.

Thus, summing the output of the two colonies together over the period of approximately a year after observation was begun, those fragments containing a brood queen produced a total of 255 pupae which were identified as workers, 6 identifiably callow workers, and no males. Those fragments of both colonies containing workers only brought to maturity a total of 240 pupae identified as males and 26 identified young adult males, a total of 266 males. In Colony No. 2 B, three callow workers were also brought to maturity at the time of an early count. It seems a safe assumption, however, that these individuals represented the final, delayed residual of queen-laid brood "inherited" from the partitioning of the colony some three months earlier.

Thus it seems very clear that in *R. purpurea* worker brood is entirely derived from the fertilized brood female in typical Formicid fashion. Workers, however, can produce and rear a prolific male brood, at least in the absence of the parent female. Whether the male brood which typically appears seasonally in large numbers in normal wild colonies is queen- or worker-derived, or both, is an interesting and important question for future investigation. It applies with equal cogency, of course, to the vast range of "normal" Formicid species.

SOURCE OF WORKER AND MALE BROOD IN SPECIES WHERE NORMAL QUEENS ARE RARE OR ABSENT

Rhytidoponera metallica

Between December 23 and 25, 1963, a number of vigorous colonies of *Rhytidoponera metallica* were collected at various points in the Blackall Range in Queensland, Australia, some sixty miles north and thirty miles east of Brisbane. No perfect females were found. These colonies were housed and maintained in modified glass Lubbock nests of the same design as those used for *R. purpurea*. After a preliminary incubation period of approximately six months, to allow brood resident in the colonies at the time of capture to mature, samples of cocoons were withdrawn at intervals, opened, and the contained pupae scored for sex and caste. Callow workers that were obviously fresh-hatched were scored at the same time. The result are given in the table below (p. 95).

Thus a total of 644 worker pupae or young adults were produced in the five "queenless" colonies of *R. metallica* over a period of little more than six months, and only 11 males. It seems clear that worker production by morphological workers is a normal feature of this species.

Colony No.	Dates of Examination	Assay of Pupal and Young Adult Samples	
		Workers	Males
1.	7/12/64	20 pupae; 1 fresh-hatched callow	0
	12/15/64	24 pupae; 13 fresh-hatched callows	0
	1/23/65	33 pupae; 1 fresh-hatched callow	2 pupae
2.	7/12/64	43 pupae	2 pupae
	12/15/64	44 pupae; 36 fresh-hatched callows	0
	1/23/65	46 pupae	4 pupae
3.	7/12/64	20 pupae	0
	12/15/64	38 pupae; 6 fresh-hatched callows	0
	1/23/65	69 pupae; 4 fresh-hatched callows	0
4.	7/12/64	27 pupae	0
	12/15/64	67 pupae; 28 fresh-hatched callows	0
	1/23/65	66 pupae; 4 fresh-hatched callows	2
5.	12/15/64	31 pupae; 23 fresh-hatched callows	1

Queensland appears to lie near the northern limit of the natural range of *R. metallica.* Ample confirmation that the same situation obtains elsewhere in its range, however, was provided by counts made from a single colony of the species taken at Sutherland, N. S. W., on June 2, 1952, and observed continuously in the artificial nest over a ten-year period. This colony contained no typical females when collected, though much later in its history some were produced, as will be described later. It was kept as a single unit in the standard glass modified Lubbock type of nest until July 8, 1956, when it was split into three portions, one of which perished rather shortly. The second and third were maintained in Lubbock nests until January 1, 1962, when the second also died out. The third portion survived somewhat longer, but eventually perished on July 30, 1962.

Throughout the ten years of observation, these two colony fragments were kept in closed foraging arenas, to which no males could enter from outside and from which no individuals matured within could escape. The ants established and maintained regular kitchen-middens within these arenas, outside the nests proper. The ambient humidity of the arenas was maintained low, and the contents of the middens therefore remained well preserved and readily recognizable for considerable periods. Thus periodic removal of the middens and examination of their contents could provide a rather accurate picture of the quality and type of brood produced.

Until June 13, 1954 (two years after observation was begun), only workers were brought to maturity. A count of cocoon fragments accumulated in the middens at intervals during this period thus offered a measure of the number of workers produced from worker parentage. Only cocoon fragments were tallied which either were nearly intact or which included the larval meconium, thus ensuring that each fragment represented no more than one individual.

Between January 30, 1954, and March 13, 1954, 1472 such cocoon-fragments were counted, representing the workers arising from worker parentage in a typical one and one-half months' production for that period.

Rhytidoponera tasmaniensis

R. tasmaniensis is a species closely allied to *R. metallica* and resembling it closely in both habitus and ethology. It is characterized by a relatively southern distribution in Australia, including south Victoria and Tasmania.

A colony of *R. tasmaniensis* was collected at Lower Fern Tree Gully Station, Victoria, on January 2, 1962, and a number of further colonies were taken in the Domain at Hobart, Tasmania, on January 10 and 11.* None contained perfect females. All these colonies were housed in the usual glass modified Lubbock nests. On May 19 and on subsequent dates samples of cocoons were removed, and opened and assayed for sex and caste as usual. The results follow:

Colony No.	Dates of Examination	Assay of Pupal and Young Adult Samples	
		Workers	Males
1.	5/19/62	17 pupae	0
	9/17/62	37 pupae; 4 fresh-hatched callows	0
	1/ 5/63	24 pupae	0
	2/ 9/63	27 pupae	0
	3/10/63	18 pupae	0
	3/ 1/64	24 pupae; 7 fresh-hatched callows	0
	9/20/64	13 pupae	0
Other colonies grouped	9/ 9/62	2 pupae; 1 fresh-hatched callow	0
	10/22/62	8 pupae	0
	1/ 5/63	0 (2 male-producing nests)	10 pupae

Thus over a period of two years and four months, beginning four and one-half months after capture, a single colony of *R. tasmaniensis* produced 171 worker pupae or fresh-hatched adults, another 8, and a third contributed two worker pupae and a single adult. Two further (and small) groups contributed 10 male pupae. Once again the evidence for worker production is very clear.

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*I am especially appreciative of the help given in obtaining the Hobart material by Mr. John Hickman of the University of Tasmania.

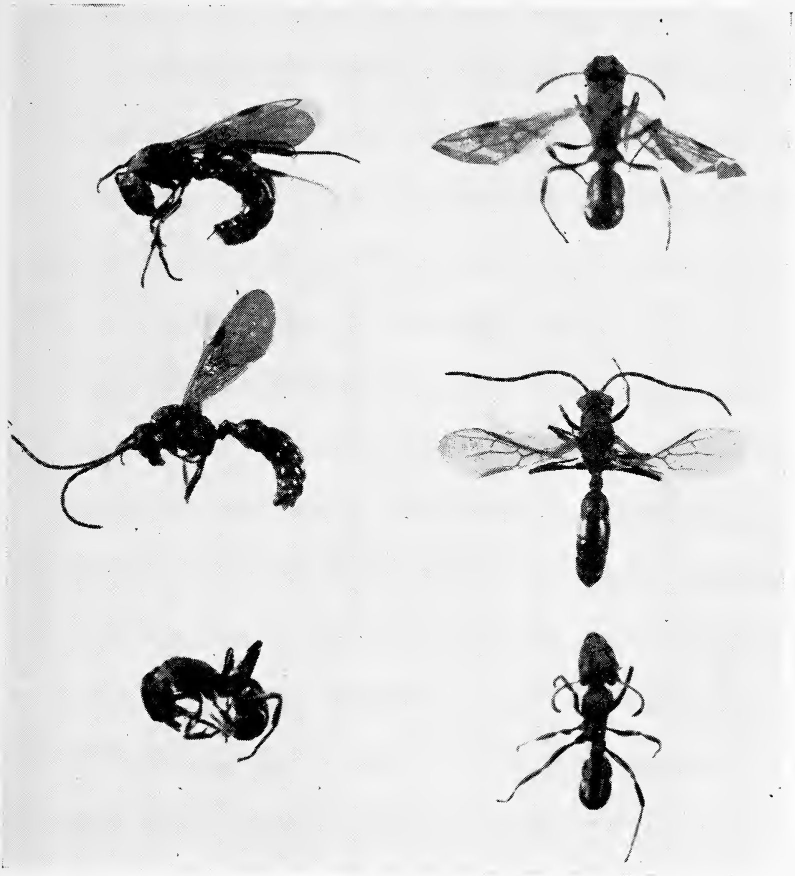


Fig. 1. Alate Female, Male, and Worker of *Rhytidoponera metallica.*

Rhytidoponera inornata

This species, also allied to *R. metallica* but normally, according to Brown (1958) having a range allopatric to it, is a typical resident of extreme southwestern Australia. Two colonies without typical queens were collected at Manjimup, West Australia, between December 25 and 27, 1959, and housed in the usual glass modified Lubbock nests. As in the preceding instances, cocoons were removed at intervals after a suitable beginning period, opened and scored for sex and caste. The totals from the two colonies on each examination have been pooled. The results follow:

	Assay of Pupal and Young Adult Samples	
Dates of Examination	Workers	Males
5/ 5/60	1 fresh-hatched callow	
5/14/60	1 pupa	
5/18/60	1 pupa	
6/15/60	1 pupa	
6/20/60	1 pupa	
7/23/60	51 pupae	
3/ 1/64	33 pupae; 13 fresh-hatched callows	5 pupae
6/22/64	7 pupae	4 pupae

Thus over a period of approximately four and one-half years after being taken from the field, and beginning five and one-half months after capture, these colonies were observed to produce a total of 109 worker pupae or fresh-hatched callows, and 9 male pupae. The evidence of consistent production of workers by workers in this species seems clear.

Rhytidoponera victoriae

This small form is a common eastern Australian species, especially abundant in Victoria. On January 2, 1962, a colony was collected at Lower Fern Tree Gully Station, near Victoria National Park, and on January 3 a number of colonies was collected within the Park itself. All were without typical females. They were again housed in glass modified Lubbock nests, and maintained until May, 1962, in open arenas. Samples of cocoons were then removed and opened and the pupae scored for sex and caste in the usual manner, together with freshly hatched callow workers. The results, summed over all the colonies examined, are shown below:

	Assay of Pupal and Young Adult Samples	
Dates of Examination	Workers	Males
5/19/62	42 pupae	11 pupae
8/ 3/62		1 pupa
8/24/62	1 pupa	
9/16/62	1 pupa	
10/14/62	2 pupae	
10/22/62	55 pupae	13 pupae
7/ 2/64	31 pupae; 2 fresh-hatched callows	46 pupae
7/15/63	22 pupae; 3 fresh-hatched callows	1 pupa
9/21/64	17 pupae	7 pupae

Thus over a period of twenty-eight months a total of 176 workers is known to have been produced and a total of 79 males — good evidence once again that in this species worker production by workers is the rule.

Rhytidoponera violacea

This is an example of one of the larger species of the genus, in which alate females have never been observed. It is a typical inhabitant of rather dry country in southwest Australia, and closely resembles in appearance and habit the better known *R. convexa* of the eastern half of the continent. A single colony of *R. violacea* taken in Kings Park, Perth, W. A., on December 30, 1959, was maintained in an earth-filled modified glass Lubbock nest through January, 1965. Throughout this five-year period abundant broods of young workers were produced, together with a few males. On October 26, 1964, 3 cocoons were extracted from this colony and opened and their contained pupae scored for caste and sex, and a second sample of 8 was similarly examined on October 27. All eleven pupae were of workers. Thus worker production from workers was continuing four years and ten months after the colony was taken.

In three of the five species of *Rhytidoponera* investigated *(R. metallica, R. inornata,* and *R. victoriae)* perfect queens are represented in collections, though with great rarity in all except *R. metallica.* A fourth, *R. tasmaniensis,* is so closely similar to *R. metallica* that it is hard to imagine that similar alate females do not occur with it too, and that their absence from collections does not simply reflect the fact that this species has not been particularly extensively taken. Yet in all these species (together with the fifth, *R. violacea,* where alate females have never been found and, from all the circumstantial evidence, probably do not occur) worker production by individuals themselves morphologically indistinguishable from normal workers is clearly the rule. Males of the species, of course, must also be derived from workers. The question thus is posed whether worker production by workers results from thelytokous parthenogeny, or whether fertilization of workers, in the pattern of *Diacamma,* is the rule.

THE MODE OF PRODUCTION OF WORKERS BY WORKERS IN THE NORMALLY "QUEENLESS" SPECIES OF RHYTIDOPONERA

In a series of careful and extensive histological studies of workers of *Rhytidoponera metallica, R. inornata,* and *R. violacea* collected in the field, R. M. Whelden (1957, 1960, and unpublished data) has conclusively demonstrated that a normal fertilization mechanism is involved in the production of workers by "workers." Examination of the spermathecae of a total of 836 workers of these three species yielded the results shown below:

Species	Number in Sample	Number Individuals with Sperm	Per Cent Individuals with Sperm
R. metallica	386	21	5.4
R. inornata	176	4	2.3
R. violacea	274	22	8.0

It thus seems clear that thelytokous parthenogenesis at least is not usual in these species of *Rhytidoponera,* and that a normal mechanism of fertilization is involved in the production of worker progeny. Other questions concerned with an estimate of the average relatedness among workers in a single *Rhytidoponera* colony, earlier posed, are thus raised. It becomes important, for example, to ascertain whether single or multiple insemination of workers is the rule, whether individual workers may be inseminated more than once during their lifetimes, and to what degree outcrossing among different colonies obtains. These issues, of course, can only be determined by careful and complete observations of the mating flight. Our observations are still very incomplete. Since, however, they have provided answers to one or two such questions, even at this preliminary stage, they are presented here.

CHARACTER OF THE MATING FLIGHT IN RHYTIDOPONERA METALLICA

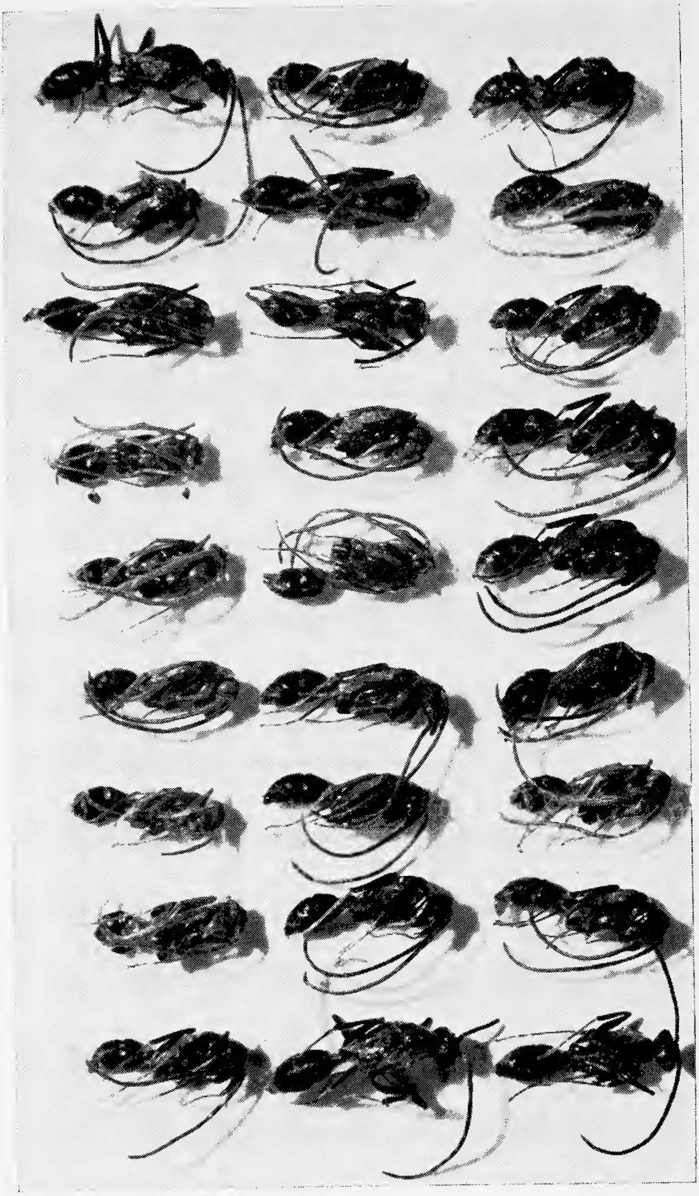
Some field evidence of the fertilization of workers by males in *Rhytidoponera metallica* has been obtained by W. L. Brown, Jr. (unpublished observations). He noticed males in low flight which alighted and entered the main gallery of an established nest of the species. There seems to be no observational record, however, of actual fertilization of workers. We have been so fortunate as to witness this.

A colony of *R. metallica,* cited earlier in another connection, was collected at Sutherland, N. S. W., Australia, on June 1, 1952. As already described, it was housed in a modified earth-containing glass Lubbock nest, and was then maintained for three months at 15-17°C, within the normal winter temperature range of its environment. During this period workers were allowed to forage from the nest in a closed arena, and were supplied dilute honey continuously and provided frequently with a considerable variety of living insect prey. On September 3, 1952, the nocturnal temperature was raised to 20°C, and diurnal temperatures were allowed to reach a maximum of 25°C. Two days after this temperature rise, a number of males which had matured in the nest during the cool period left it and wandered over the crater. Simultaneously, several workers were observed resting quietly outside the nest and in its near vicinity, with head and thorax rather closely appressed to the substrate on which they rested, but with the gaster held high and arched. The impression was strong that an attractant was being disseminated. Males which had emerged from the nest but had not yet flown paid no special attention to these individuals. Freshly emerged males, indeed, neither flew nor ran to any great extent, but went through extensive cleaning motions near the nest, and were frequently deported back into it by foraging workers which met them by chance. Nothing further occurred at this time.

On the morning of September 6, with an ambient temperature of 22°C, ten workers were observed resting quietly near the nest crater with head and thorax appressed and gaster raised. They remained immobile in this position for a measured minimum of 1 minute 5 seconds to a maximum of 12 minutes 10 seconds. Six were finally deported back to the nest by foraging workers encountering them apparently by chance. At the same time a few males emerged, and, after preliminary cleaning and running about, flew briefly. Nothing further occurred.

On September 7, with ambient temperature of 24°C, males emerged in some numbers and flew actively. Foraging workers encountering such males became greatly excited and commonly attacked them at once. After approximately one half hour of more or less continuous flight, a few males alighted near the nest crater and, running rapidly, sought out nearby workers. No obvious selection was made of workers resting immobile with raised gasters, although a few of these were still present. As soon as a male encountered a worker, it grasped the worker in the cervical region with the mandibles and, thus firmly attached, at once inserted the stipes. The mandibular grip was then relaxed at once, and the male, with wings folded, was maintained in a nearly vertical position by the stipes alone. The first and third pairs of legs of the male were characteristically folded, while the second pair projected upward so that they were pressed against the costal margins of the wings. Both members of the pair usually rested quietly in this position for a few seconds. Thereafter the worker characteristically executed grooming movements and began to move about, and almost at once seized the male by the thorax with the mandibles and forcibly disengaged it. On a few occasions the worker began to move almost as soon as copulation began, dragging the male and dislodging it after progressing for an inch or two.

The first copulation was observed at 8:50 A.M. and lasted for 40 seconds. Between that time and 10:50 A.M., ten matings were



HASKINS — RHYTIDOPONERA

closely watched and timed. Pairs remained *in copula* from a minimum of 30 seconds to a maximum of 52 seconds. It was noted with special interest that in one case the same pair copulated twice; in another an individual male paired successively with two workers. In two instances workers reentered the parent nest while still *in copula.*

All males observed sustained active flight for periods up to one half hour before seeking to copulate. The final stages of search, however, were accomplished in every case on the ground. The whole process was suggestive of the mating pattern observed in certain Ponerine species (such as *Amblyopone australis* and *A. (Stigmatomma) pallipes* — Haskins and Haskins, 1951; Haskins, 1928) where the alate female flies only occasionally and with reluctance but emerges from the parent colony to mate on the ground or on low vegetation. The vigorous pattern of dispersive flight and the general hyperactivity of the males during the flights seemed conspicuously adapted to securing outcrossing between colonies of the species. Such outcrossing, indeed, may be biologically essential, as will later be indicated.

No detectable morphological features distinguished workers which mated from those which did not. The group which was fertilized included both among the smallest and among the largest individuals in the population, as well as many in an intermediate range. This observation confirms the conclusion of Whelden (1957; 1960) derived from his histological investigations, that workers showing sperm content in the spermatheca included individuals of a wide range of size.

A second nuptial flight of identical pattern was observed in this nest on January 27, 1957. Shortly after 9:00 A.M. of that day male exodus and flight began in typical fashion, reaching a peak by 10:30 A.M. On October 17, 1952, July 17, 1953, and November 22, 1953 workers of this colony were again observed resting outside the nest with gasters elevated, but on these occasions there was no corresponding flight of males. Precisely this same behavior of workers has been observed with colonies of *Rhytidoponera tasmaniensis, R. inornata,* and *R. violacea,* all housed in the usual type of modified, earth-containing Lubbock nests. The intervals for which the position was maintained were similar to those in *R. metallica.* Males have been seen to fly actively from a nest of *R. violacea,* closely simulating the pattern of flight in *metallica.* Actual mating has not been observed in these species, but it seems a probable inference that the pattern is similar.

EXPLANATION OF PLATE 6

Late male Pupae of *Rhytidoponera purpurea,* from Brood Matured in Artificial Nest in Fragment Without Brood Queen.

Thus it is clear that both female and male behavior patterns in *R. metallica* are well adapted to secure outcrossing among colonies as a usual condition of the mating flight. Furthermore, multiple insemination of one worker, and insemination of more than one worker by a single male, can occur. The related question of whether a single worker can be inseminated several separate times during its life span has not yet been answered, nor has the question of whether new-hatched workers, after insemination, may return permanently to the parent colony to add to its reproductive potential and prolong its life beyond the limit of two generations so usual in Formicid communities. It may be suggestive in this connection, however, that not all of the worker spermathecae that contained sperm were found by Whelden to be filled. Indeed, of 22 individuals of *R. violacea* found to contain sperm, among a sample of 274 examined, in only two were the spermathecae completely occupied by a dense sperm ball of cells. In three individuals the sperm mass was very small and loose, comprising only an estimated 50-100 cells. In the remaining cases, the spermathecae were partially filled, though fully inflated.

All the evidence seems very suggestive that a rather high degree of heterozygosity must indeed be regularly maintained in colonies of *R. metallica,* involving the germplasm of populations greatly exceeding the single colony in numbers. It became of considerable interest, therefore, to enquire what might be the limits of viability in a single colony where strict inbreeding was enforced over several worker generations.

TOLERANCE OF RHYTIDPONERA METALLICA TO EXTENSIVE INBREEDING

In this context, certain further observations made on the colony of *R. metallica* already cited may be of interest. As already described, this colony was maintained throughout the ten years of its existence as a set of "closed" populations, from which no individuals could escape and which none could enter from the outside. By the time that its two longer-lived sections died out, at ages respectively of 9 years 6 months and 10 years 2 months, many new generations of workers had been matured, to be fertilized in turn by successive generations of males of the same colony. It is not possible to assess quantitatively the degree of homozygosity finally attained in these two populations. It must have increased very considerably, however, over the years. It is therefore of special interest to note that in the last months of the lives of both sections ova, although continuing to be produced in numbers, characteristically failed to hatch larvae. A cytological examination of these eggs by Whelden (unpublished) showed a high degree of abnormality in embryonic development. Examination of 119 eggs from the two colony fragments showed the greater number to be uninucleate. A few contained 2-4 small nuclei, tending to be clumped abnormally at one pole of the egg. In a very few cases embryonic development was sufficiently advanced to show some segmentation and to indicate the polarity of the embryo, but this was all. By contrast, a control sample of eggs taken at the same time from a colony housed and treated in the same manner but much more recently collected showed clear evidence of development in over 80 per cent of ova examined, ranging from early stages showing masses of well-defined cell nuclei to late and well-formed embryos.

Such evidence suggests that the maintenance of a rather high degree of female heterozygosity is no less a biological imperative for *Rhytidoponera* than for Formicid species possessing alate queens and exhibiting highly organized mating and dispersion flights involving both sexes. Indeed, the evidence for multiple insemination of workers suggests that it may be considerably more dependent than some species. It seems probable that a system of sex-locus lethal or semilethal alleles exists similar to that described by Mackensen (1951, 1955) and Rothenbuhler (1957) for *Apis,* and originally in *Habrobracon* by Whiting (1943). It would seem that such a requirement of heterozygosity, in the context of the kind of colony organization displayed by the "queenless" species of *Rhytidoponera,* must complicate the maintenance of close genetic relationships among workers within a colony.

THE FORMATION OF NEW COLONIES IN R. METALLICA

Central to the problem of whether successive generations of fertile workers remain in older colonies is the question of how new colonies are formed. At present it is uncertain what may be the normal life course of young workers subsequent to fertilization in a parent colony. Some observations have accumulated, however, which may bear on the mode of formation of new colonies in *R. metallica.*

Workers taken at random from established colonies in the artificial nest and isolated in new nests regularly attempted to initiate fresh communities. They secreted themselves in partly closed cells, from which they emerged occasionally to forage in the fashion typical of normal colony-founding Ponerine queens, laid eggs and tended them carefully, reared larvae, and in a number of cases matured adult progeny. Unfortunately, it has not so far proved possible to distinguish and select fertilized workers for these experiments, and all progeny reared by such isolated workers have been males. Had worker progeny been reared, however, a new colony might easily have arisen.

Thus it seems at least plausible that isolated workers of *R. metal-*

lica, if fertilized, may be capable of founding new colonies. It seems somewhat more likely, however, that under natural conditions new colonies are normally formed by the detachment from the parent nest of worker groups which include one or more fertilized individuals. Even though initially very small, such parties may expand rapidly in numbers and reach the status of full-fledged colonies in a remarkably short time. Thus on December 21, 1963, two isolated groups of workers were taken at Sutherland, N. S. W. One consisted of 7 workers, about 6 cocoons, and a few young larvae; the second, also of 7 workers, with 2 cocoons and about 6 young larvae. These two groups were colonized in the usual fashion in modified earth-containing nests, and housed throughout their history in adjacent arenas on the same laboratory table. On January 17, 1965, the first group included the following:

74 living adult workers.
127 dead workers found on the kitchen middens.
* 4 dead males found on the kitchen middens.
55 cocoons, which were opened and examined, and found to contain:
    26 worker pupae.
    9 semipupae, believed to be of workers from the size and shape of the cocoon.
* 11 male pupae.
    7 semipupae, believed to be of males from the size and shape of the cocoon.
    2 fresh-spun cocoons with larva present.
54 larvae of various sizes.
Several groups of eggs, totaling about 100.

Thus at least 227 workers and 15 males had matured to the pupal stage and beyond. In sharp contrast, the second group at the same date was found to contain 5 adult workers (almost certainly of the original 7), 2 males, and 3 cocoons, 2 of which contained male pupae and the third a semipupa. Thus this group as collected apparently had not included a fertilized worker.

It is particularly interesting, in view of the normally nonseasonal production of males in *R. metallica,* that at least 15 males were matured within the first year of life of this colony. This situation may be contrasted with the case of a colony of *Ectatomma ruidum*** kept under observation, from its establishment by the original female, over a ten-year period in the artificial nest. Here no males whatever appeared until near the close of the fourth year of community life.

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*Note presence of males at this early stage in colony development.

**An abundant New World Ectatomiine species with a well-defined alate female caste, forming communities which are commonly if not always monogynic.

THE PRODUCTION AND FUNCTION OF ALATE QUEENS IN R. METALLICA

As earlier mentioned, fully developed alate queens of at least four normally "queenless" species of *Rhytidoponera,* with bulky thoraces and typically large compound eyes have been collected — though rarely — in the field. Under what conditions are they produced? And what is their function?

On September 25, 1955, and again on October 23, 1955, a single typical female was found in a colony of *R. metallica* described earlier, which had been collected near Sutherland, N. S. W., in June, 1952. When discovered, each individual was already dealate, was actively foraging and feeding outside the nest with workers, and generally was behaving precisely like a worker. When isolated in an earth-containing modified Lubbock nest each female at first made an imperfect beginning of an isolated cell, behaving in the general fashion of an isolated worker. Neither female formed a true cell, however, and neither showed any sign of oviposition, so typical of isolated *metallica* workers. One female remained passive for a full month, and when at the end of that period it was lost, no trace of an established nest could be detected. The second female behaved in precisely the same manner and was ultimately killed and fixed for histological and cytological examination.

On October 7, 1954, during one of the flights of males from the same colony, two alate females, matured within the nest shortly before, emerged with the males and workers and ran actively about outside the nest. They showed no disposition to mate, however, and were ultimately captured and preserved.

In January, 1957, the same colony produced about twenty perfect females. On January 19 one of these emerged from the nest and wandered about for a short time. It shortly reentered without having flown. Eight days later, between 9:00 A.M. and 10:30 A.M., while a flight of males was in progress and several workers were resting motionless with elevated gasters, a dealate female made a number of trips together with workers to and from the nest carrying excavated soil and quite unaffected by the flight in progress. At 11:00 A.M. an alate female emerged from the nest and wandered briefly before returning, but gave no evidence either of dispersal flight or of any attempt to mate.

On February 2 a further dealate queen emerged and wandered. On March 15 yet another young alate female emerged simultaneously with three males, wandered, vibrated the wings briefly, then, without mating or making further attempts at flight, dealated in the open and returned to the parent nest. During the same day four additional females behaved in a similar pattern.

Another colony of *R. metallica,* taken at Ashton Park, Sydney, N. S. W., on January 8, 1964, had by May 20 produced two perfect females. Both emerged from the parent nest while still alate and perished shortly thereafter, having shown no disposition to found new colonies.

This sketchy evidence of the production and behavior of perfect females in *R. metallica* surely needs to be augmented. It does suggest, however, that in this species the true female is indeed an evolutionary remnant, in which innate behavior patterns governing emergence from the nest, the undertaking of at least rudimentary flight, and dealation are retained. Behavior leading to colony foundation, however, seems feeble, or actually absent, and replaced by a marked tendency to rejoin the parent colony and assume a worker-like function within it. It is of course impossible yet to be certain that abnormal environmental conditions may not have been responsible for this aberrant behavior, and the isolated dealate female of *R. inornata* found by Wheeler may be suggestive. But the virtual absence of true brood queens in normal wild colonies surely suggests both that colony foundation by isolated fertile females, if it occurs at all, must be seldom successful in competition with the mode observed, and that the longevity of such queens, even in the parent nest, can hardly be considerable. They indeed appear to be of relict-like character.

What brings about the occasional production of perfect females? In the two colonies where such production has been observed, it occurred at the height of the brood-rearing season, and at a period when the colony was most active in foraging and was most abundantly supplied with food. In each colony, the total brood of females was produced over a rather short interval, suggesting that trophic influences may have been important in effecting the crossing of a "difficult" developmental barrier. Quantitative studies of the phenomenon, analogous to those of Brian in *Myrmica,* are needed.

DISCUSSION AND SUMMARY

The work reported has shown that workers are regularly produced from worker eggs in five species of *Rhytidoponera* in which alate females are rare or unknown. On the other hand, worker-laid ova give rise only to males (though prolifically) in *R. purpurea,* a species in which normal queens are the rule. Males are also regularly and copiously produced from worker eggs in artificially maintained colonies of *R. metallica* which appear to lack worker-producing individuals. These observations suggest that sex determination in

Rhytidoponera is of the normal Formicid type, and thelytokous parthenogenesis, if it occurs at all, does not make a significant contribution to the production of females. Such a conclusion has been strengthened by the observation of nuptial flights and actual mating of males with workers in *R. metallica.* It has been physically proven in the finding by R. M. Whelden of sperm in the spermathecas of workers in *R. metallica, R. inornata,* and *R. violacea.*

It is clear from the evidence of collections that, at least in *R. metallica, R. inornata, R. victoriae, R. aspera, R. croesus,* and *R. strigosa,* in addition to the members of the *R. impressa* group, normal alate queens are produced under natural conditions. Numerous such queens of *R. metallica* have been matured in the artificial nest. These undertook some flight and dealated but neither mated nor made any attempt to found new colonies, although conditions were made as nearly optimal as possible. They proved uniformly very short-lived. This evidence, taken with the fact that perfect females have never been reported in a considerable number of species of *Rhytidoponera* including some of the largest and most conspicuous, and the fact that no queenworker intermediate has been reported for any species, suggest that the queen-form has been entirely dropped out in the "queenless" species, and that members of the *R. metallica* group (and possibly some other forms as well) may be in an intermediate stage of evolution, the queen persisting as a rare morphological form but being virtually without biological significance. This impression is strengthened by evidence both that individual workers, in contrast to queens, do show strong instincts of colony formation, and evidence that groups of as few as seven workers collected in the field can quickly expand to full colony size.

While such observations answer some questions about the general biology and social structure of the "queenless" species of *Rhytidoponera,* they raise a great many more. Whelden's finding of sperm in worker spermathecae in *R. metallica, R. inornata,* and *R. violacea* brought out two additional points of interest. First, sperm-containing individuals were relatively abundant in typical colonies of all three species collected in the field, ranging from 2.3 per cent of total workers in *R. inornata* to 8.0 per cent in *R. violacea.* Second, in only a few cases were worker spermathecae replete with sperm. Usually they were but partly filled, and in several instances only a very few sperms were present. This raises the question of whether an individual worker is fertilized more than once in its lifetime, or whether it is normally exclusively male-producing in the latter part of life.

It is clear, at any rate, that numerous worker-producing workers coexist in normal colonies of at least three species of *Rhytidoponera.* Further, in *R. metallica* at least, multiple insemination of workers, and insemination by individual males of more than one worker are not uncommon. It is also evident that workers can and do make rich contributions of male progeny, which may begin to appear (in small numbers) very early in the life of an isolated, expanding, worker group. All these circumstances make it seem improbable, at first glance, that an average degree of relatedness among members approaching sibship can be maintained in a typical *Rhytidoponera* colony. The situation might be quite different, however, if a single fertile individual normally dominated oviposition in a colony, rival fertile individuals being suppressed by hormonal or behavioral means. Whether any such situation obtains remains to be determined.

If the relatedness of workers within a single colony is indeed relatively low (at least not consistently maintained at the sibship level), it may well be that among the members of a continuous population of the species it is more than usually close. For if new communities normally arise from small parties containing at least one fertilized worker which leave parent colonies, it seems probable that the average distance traveled before settling down would be considerably less than that covered by actively flying queens before founding new communities. One might indeed expect the *Rhytidoponera* population to be considerably more "viscous," in Hamilton's term, than those of such an ant genus as *Lasius,* and might perhaps reasonably expect a lesser degree of "colony integrity" than in a monogynous species with actively flying alates of both sexes. Some measure of the degree of colonial integrity developed among those *Rhytidoponera* species normally without alate females might be gained by a careful study of "colony recognition" between communities — of the degree of worker-to-worker hostility among individual colonies of the same population, as compared to that between colonies from populations considerably separated geographically. Work of this character is planned.

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OBSERVATIONS ON THE NESTING SITE AND BIOLOGY OF THE ARIZONA DAMP-WOOD TERMITE *ZOOTERMOPSIS LATICEPS* (BANKS) (HODOTERMITIDAE)[1]

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The genus *Zootermopsis* includes the largest termites to be found in the United States. It contains but three species: *angusticollis,* the common damp-wood (or light-colored, rotten-wood) termite, ranging from southern British Columbia to northern Baja California and most abundant in the more humid coastal areas; *nevadensis,* the small (or dark-colored) damp-wood termite, roughly coextensive with the former but generally preferring cooler, drier areas and extending farther inland to western Montana; and *laticeps,* the Arizona damp-wood termite, recorded from southeastern Arizona and southwestern New Mexico (Castle, 1934). Because of its large size and relatively easy availability in logs and stumps, *angusticollis* has become moderately well known and has proved a useful laboratory animal in a wide variety of studies (Snyder, 1956, 1961). To a lesser extent this is true for *nevadensis.* In contrast, no new biological information has appeared on *laticeps* since the early contributions by Townsend (1893), Banks (1906) and Banks and Snyder (1920). Although it is by far the largest, with soldiers 16 to 22 mm. long and alates 25 to 30 mm. over all, it has remained the least known of the three.

The following account summarizes the data on 27 collections of the alates of this spectacular termite made by various members, students and friends of the Department of Entomology at the University of Arizona, mainly during the last ten years. It also includes information gathered on four colonies which were located by the author after several years of sporadic but diligent searching. When it is realized that this termite stages its flights during the night and that it colonizes living, often very large, trees, its rarity becomes more understandable. It is thus not likely to be taken by the casual collector or without considerable effort.

Distribution. The collections of alates, made under lights and in light traps (both white and ultra violet) have considerably broadened the range of the species within the state of Arizona (Fig.

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[1] Arizona Agricultural Experiment Station Journal, Article No. 967. *Manuscript received by the editor February 19, 1965.*

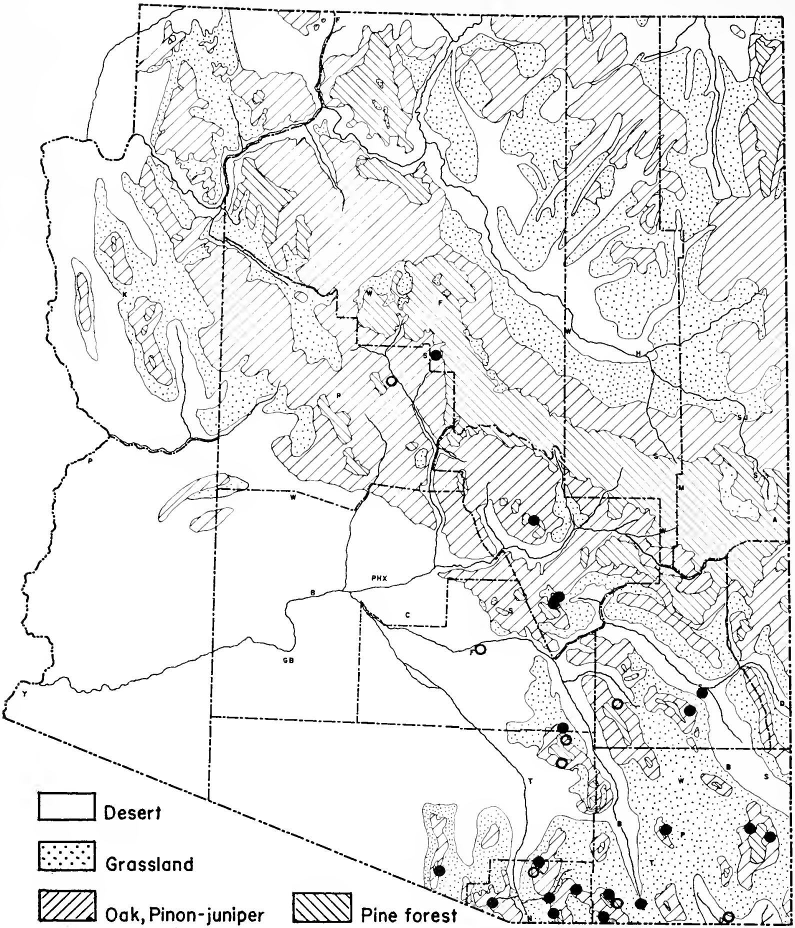

Figure 1. Map of the natural vegetation of Arizona, showing distribution of *Zootermopsis laticeps:* open circles, previous records; solid circles, new records.

1). Nineteen new localities are represented between Safford and the Chiricahua Mts. in the east and Sedona and the Baboquivari Mts. toward the center of the state. Except for Las Cruces, N. Mex., all previously published records fall within this area (Table 1). Each collection has been made in the vicinity of a sizeable watercourse — in canyons such as Ramsey in the Huachuca Mts., along more or less permanent streams as Sonoita Creek near Patagonia, in river bottoms as at Hereford or in heavily irrigated areas as in the Gila Valley at Safford. Although the altitudinal distribution ranges from 1500 feet in the creosote bush — salt brush desert around Florence to 5500 feet in oak — pine woodland along Workman Creek, all of these situations support at least thin stands of one or more large trees such as cottonwood, sycamore, ash, walnut and alder. Considering the intensity of light-trapping which has been done in Arizona, it does not seem likely that the range of *laticeps* will be extended much farther into the higher plateaus and mountains to the north or into the lesser ranges and desert to the west. However, it is highly probable that it might be found in the northwestern reaches of the Rio Grande, at least above and below Las Cruces, and south on both slopes of the Sierra Madre Occidental well into Sonora and Chihuahua.

Colonizing Flights. Lack of complete seasonal series of collections from any of the localities in Table 1 prevents a detailed characterization of the flight schedule of *Z. laticeps.* Alates appeared in a laboratory colony, maintained between 60 and 70°F, during the first three weeks of June. Obviously it may be expected to fly from late June into early August over most of its range in Arizona, apparently with little regard for small differences in altitude. The records from Safford and Madera Canyon indicate that the seasonal flight pattern involves small groups of alates taking part in frequent, perhaps almost daily, flights over a period of six weeks or more. Since the highest monthly maximum temperature over most of this region is usually reached in late June or early July, and prior to any significant amount of rain (Sellers, 1960), it is suggested that high temperature may provide the major stimulus for initiating the flight period rather than the advent of the summer rains. Both Werner and Burger reported that no rain of any significance had fallen prior to the collections they had made in Madera Canyon and at Workman Creek (Table 1).

Light and Weesner (1948, p. 55) took small numbers of alates between 1 and 4 A.M. and between 11 P.M. and 12:45 A.M. on two successive evenings in the Huachuca Mts. The complete absence of observations on any of the 27 flights recorded here, plus the fact that most collections were taken in light traps, further testifies to the fact that this termite does indeed fly during the night. The night at Peña Blanca (Table 1) might be cited as typical of most of the light-trapping ventures. The trap was run from shortly after sunset until sunrise and rather closely tended by four persons till midnight. No alates of any species of termite were seen; however, one alate of *laticeps* was taken from the trap the next morning. The only other data closely associated with any of the flights are the temperature and

TABLE 1. Distributional and flight data for *Zootermopsis laticeps*. An * indicates a previously published record (See Banks and Snyder, 1920).

LOCALITY	ELEVATION	DATE	NO. TAKEN IN FLIGHT	COLLECTOR
COCHISE CO.				
Turkey Cr., Chiricahua Mts.	5000′	VII-22-49	7	W. Nutting, F. Werner
Pinery Can., Chiricahua Mts.	5300′	VIII-17-49	1	W. Nutting, F. Werner
*Douglas	ca. 4200′	VIII		Snow and Biederman
Cochise Stronghold, Dragoon Mts.	5000′	VII-29-57	1	G. D. Butler
		VII-7-58	1	A. Ross
Hereford, S. Pedro River	4150′	X, XI-63	3 colonies	W. L. Nutting
Ramsey Can., Huachuca Mts.	5500′	VIII-11-55	1	G. Butler, Z. Noon
*Garcia (=Garces?, see Granger, 1960)	4000′	VI, VII		C. R. Biederman
*Palmerlee (=Garces, see Granger, 1960)		VII		C. R. Biederman
*Miller Can., Huachuca Mts.	5000′	VII-4, 5-46	?, 6	(Light and Weesner, 1948)
Cave Can., Huachuca Mts.	ca. 5600′	VII-13-56	1	R. B. Willey
SANTA CRUZ CO.				
Canelo (Flying B Ranch)	5100′	VII-10-54	2	G. D. Butler
		VII-12-57	1	G. D. Butler
W. Slope Patagonia Mts.	ca. 4600′	VII-27-49	1	W. Nutting, F. Werner
Sonoita Cr., 2 mi. S.W. Patagonia	3950′	VII-15-55	5	F. Werner, G. Butler
		VI-27-61	4	P. H. Johnson
		III-9-63	Colony	W. L. Nutting
Peña Blanca Spring	3700′	VII-10-61	1	W. Nutting, F. Werner
Madera Can., Sta. Rita Mts.	5000′	VI-19-22-62	5, 1, 1, 6	F. G. Werner
*Sta. Rita Mts.	>5000′?	VII		F. H. Snow

PIMA CO.				
Brown Can., Baboquivari Mts.	4050′	VII-4-56	1	W. Nutting, F. Werner
*Sabino Basin, Sta. Catalina Mts.	ca. 2700′	VII-8-20		Lutz and Rehn
*Edgar Can., Sta. Catalina Mts.	<5000′?	VII-3-14	Colony	M. Chrisman
GRAHAM CO.				
Safford	2900′	VI-23-54	2	F. G. Werner
		VIII-5-54	1	F. G. Werner
Noon Cr., Pinaleno Mts.	5150′	VIII-1-57	2	G. Butler, C. O'Brien
*Galiuro Mts.		III-22-1897	Colony	H. G. Hubbard
PINAL CO.				
*Florence	1500′	VIII		Snow and Biederman
Peppersauce Can., Sta. Catalina Mts.	4650′	VII-8-61	1	P. H. Johnson
GILA CO.				
Six Shooter Can., Pinal Mts.	4000′	VII-10-49	1	W. Nutting, F. Werner
Globe	ca. 3600′	VII-13-56	4	S. R. Webb
Workman Cr., Sierra Ancha	5500′	**VII-9-64**	9	J. F. Burger
COCONINO CO.				
Oak Creek Can., vic. Sedona	4300-4900′	VII-27-56	1	G. Butler, P. Gerhardt
Oak Creek Can., vic. Sedona		VI-26-57	2	F. Werner, G. Butler
Oak Creek Can., vic. Sedona		VII-23-58	22	C. W. O'Brien
YAVAPAI CO.				
*Clemenceau	3400′		Colony	(Emerson, 1933)
NEW MEXICO				
*Las Cruces, Doña Ana Co.	3900′	II-11-1893	Colony	C. H. T. Townsend

Table 1. Distributional and flight data for *Zootermopsis laticeps*. An • indicates a previously published record (See Banks and Snyder, 1920).

LOCALITY	ELEVATION	DATE	NO TAKEN IN FLIGHT	COLLECTOR
COCHISE CO.				
Turkey Cr., Chiricahua Mts.	5000′	VII-22-49	7	W. Nutting, F. Werner
Pinery Can., Chiricahua Mts.	5300′	VIII-17-49	1	W. Nutting, F. Werner
•Douglas	ca. 4200′	VIII		Snow and Biederman
Cochise Stronghold, Dragoon Mts.	5000′	VII-29-57	1	G. D. Butler
		VII-7-58	1	A. Ross
	4150′	X, XI-63	3 colonies	W. L. Nutting
Hereford, S. Pedro River	5500′	VIII-11-55	1	G. Butler, Z. Noon
Ramsey Can., Huachuca Mts.	4000′	VI, VII		C. R. Biederman
•Garcia (=Garces?, see Granger, 1960)		VII		C. R. Biederman
•Palmerlee (=Garces, see Granger, 1960)	5000′	VII-4, 5-46	?, 6	(Light and Weesner, 1948)
•Miller Can., Huachuca Mts.	ca. 5600′	VII-13-56	1	R. B. Willey
Cave Can., Huachuca Mts.				
SANTA CRUZ CO.				
Canelo (Flying B Ranch)	5100′	VII-10-54	2	G. D. Butler
		VII-12-57	1	G D. Butler
W. Slope Patagonia Mts.	ca 4600′	VII-27-49	1	W. Nutting, F. Werner
Sonoita Cr., 2 mi. S.W. Patagonia	3950′	VII-15-55	5	F. Werner, G. Butler
		VI-27-61	4	P. H. Johnson
		III-9-63	Colony	W. L. Nutting
Peña Blanca Spring	3700′	VII-10-61	1	W. Nutting, F. Werner
Madera Can., Sta. Rita Mts.	5000′	VI-19-22-62	5, 1, 1, 6	F. G. Werner
•Sta. Rita Mts.	>5000′?	VII		F, H. Snow
PIMA CO.				
Brown Can., Baboquivari Mts.	4050′	VII-4-56	1	W Nutting, F. Werner
•Sabino Basin, Sta Catalina Mts.	ca. 2700′	VII-8-20		Lutz and Rehn
•Edgar Can., Sta. Catalina Mts.	<5000′?	VII-3-14	Colony	M. Chrisman
GRAHAM CO.				
Safford	2900′	VI-23-54	2	F. G. Werner
		VIII-5-54	1	F. G. Werner
Noon Cr., Pinaleno Mts.	5150′	VIII-1-57	2	G. Butler, C. O'Brien
•Galiuro Mts.		III-22-1897	Colony	H. G. Hubbard
PINAL CO.				
•Florence	1500′	VIII		Snow and Biederman
Peppersauce Can., Sta. Catalina Mts.	4650′	VII-8-61	1	P. H Johnson
GILA CO.				
Six Shooter Can., Pinal Mts.	4000′	VII-10-49	1	W. Nutting, F. Werner
Globe	ca. 3600′	VII-13-56	4	S. R. Webb
Workman Cr., Sierra Ancha	5500′	**VII-9-64**	9	J. F. Burger
COCONINO CO.				
Oak Creek Can., vic. Sedona	4300-4900′	VII-27-56	1	G. Butler, P. Gerhardt
Oak Creek Can., vic. Sedona		VI-26-57	2	F. Werner, G. Butler
Oak Creek Can., vic. Sedona		VII-23-58	22	C. W. O'Brien
YAVAPAI CO.				
•Clemenceau	3400′		Colony	(Emerson, 1933)
NEW MEXICO				
•Las Cruces, Doña Ana Co.	3900′	II-11-1893	Colony	C. H. T. Townsend

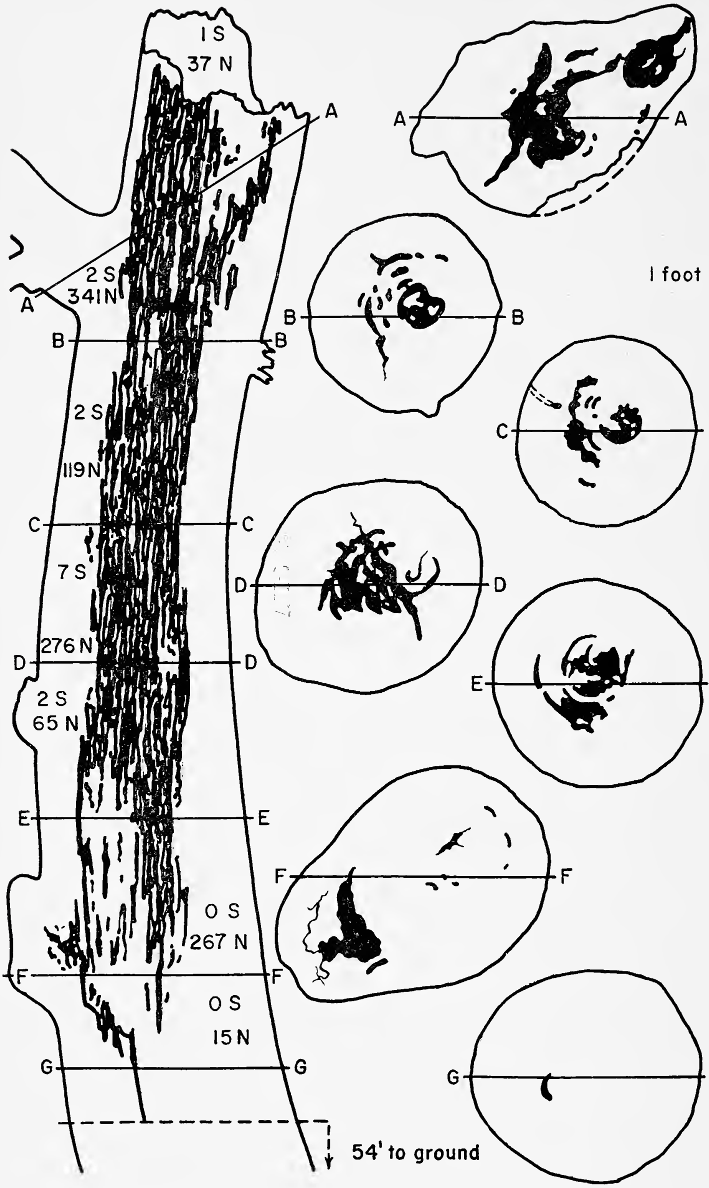
1 S
37 N
A
A
2 S
341 N
B
B
2 S
119 N
C
C
7 S
276 N
D
D
2 S
65 N
E
E
0 S
267 N
F
F
0 S
15 N
G
G
54' to ground
A
A
1 foot
B
B
C
C
D
D
E
E
F
F
G
G

Figure 2

relative humidity taken that evening at Peña Blanca — 92° and 33% at 6:30 P.M., and 78°F and 44% at midnight, following a typical warm day with showers in the vicinity during late afternoon. This pattern of flight behavior is considerably more restricted than the evening flights of *Z. angusticollis* which have been reported during every month of the year (Castle, 1934). The more even temperatures in the coastal regions may be more conducive to a longer flight period than the seasonal extremes common to the desert Southwest.

Nesting site. Colonies have previously been reported in Fremont cottonwood (*Populus Fremontii* Wats.) (Townsend, 1893; Emerson, 1960, *in litt.*), alder (probably *Alnus oblongifolia* Torr.) and willow (*Salix* sp.) (Banks and Snyder, 1920). Cazier (1962) has mentioned exposing portions of colonies in burls on living sycamores (*Platanus Wrightii* Wats.) in Cave Creek Canyon between Portal and the Southwestern Research Station. Three colonies described in this report were found in willow (probably *Salix Gooddingii* Ball). Velvet ash (*Fraxinus velutina* Torr.), Arizona walnut [*Juglans major* (Torr.) Heller] and perhaps netleaf hackberry (*Celtis reticulata* Torr.) would also appear to provide suitable nesting sites for this termite. In each case colonies have been found in unhealthy trees or in those which have contained at least some dead portions.

The impregnability of the nesting site is dramatically illustrated by the first colony which was taken in a large Fremont cottonwood, on the flood plain 100 yards from Sonoita Creek and about two miles southwest of Patagonia. Fortunately the tree had been blown down, probably within six months or so, since it still bore many dried leaves. It measured at least 90 feet high and 6 feet in diameter at chest height. A few large nymphs of *Z. laticeps* were first discovered in a burl formed around the base of a broken branch on one of the main limbs. This limb, at the trunk, was 18 inches in diameter 40 feet above the ground and had been broken off at 23.5 feet, apparently some years before. The wet, fibrous bark was easily stripped off and the limb was then sawed into two-foot lengths starting from the broken tip. It was later sawed into shorter lengths, tracings were made of the cross-sectional cuts (Fig. 2), and finally each section was carefully split and the entire colony removed. The colony was thus

Figure 2. Longitudinal section shows a reconstruction of the galleries of *Zootermopsis laticeps* in a cottonwood limb from Patagonia, Ariz. The actual numbers of nymphs (N) and soldiers (S) are indicated in each segment. Cross sections represent tracings of the galleries in the seven cuts AA to GG.

found to occupy the terminal six feet of the limb, ending approximately 54 feet above the ground.

Figure 2 shows the extent and character of what must have been several years' work by this well-established and vigorous colony. The configuration of the galleries indicates that the colony had originally extended farther up the limb and probably weakened it sufficiently to result in the break during a windstorm. The very large and extensive central galleries in the upper half of the colony were almost completely filled with hardened masses of fecal pellets, while the same situations were filled approximately 50 percent to within 18 inches of the lower end. It is apparent that this species often takes advantage of the softer spring wood in driving new galleries (note cross sections in Fig. 2), but through continued working these concentrically arranged chambers may be developed into cavities three or four inches in diameter and much more in length. The surface of the galleries has a coarse, velvety finish, characteristic of the other species of *Zootermopsis*. Cottonwood is fairly soft and light but very fibrous and tough. At the time the limb was cut, it was so wet from recent winter rains that water was squeezed out by the wedges used in splitting the sections. Although no other insects had penetrated the wood, the termites had followed shrinkage cracks in several places, particularly in the burls. The extremely tough and contorted grain of the burls seemed to be especially attractive. Four burls in the limb were extensively worked and each contained tunnels to the outside which were plugged with fecal material. One other tunnel, just below section C-C (Fig. 2) was driven directly to the outside. These openings measured about 3 × 5 to 6 mm. and were presumably used as exits for the alates and perhaps also for dumping fecal pellets. It is interesting to note that the galleries of *Z. angusticollis* are predominantly peripheral in logs and stumps and that long, slit-like openings are made for the escape of the alates (Castle, 1934).

Three other colonies were found in willows along the bank of the San Pedro River at Hereford. The second complete colony was taken from a living tree approximately 30 feet high and 12 inches in diameter at the base. Individuals of this colony were discovered in damp, fermenting wood at the base of a broken branch six inches in diameter and four feet above the ground. The tree was felled and handled in the same way as the limb from Patagonia. As shown in figure 3, the galleries extended about two feet below the crotch of the snag in a pattern similar to that in the cottonwood limb. Some large cerambycid larvae had attacked this region prior to the termites, for the latter had driven galleries through the damp and firmly packed

Table 2. Composition of two colonies of *Zootermopsis laticeps*.

NYMPHS					SOLDIERS
Patagonia, Arizona; March, 1963					
no wing pads	pre-alates	small pads	pigmented	unpigmented	
10-13 mm.	10-12 mm.	7-10 mm.	4-7 mm.	ca. 3 mm.	
552	200	162	103	103	22
Hereford, Arizona; November, 1963					
——— no wing pads ———					
10-13 mm.	7-10 mm.	5-7 mm.	4-5 mm.	ca. 3 mm.	
232	200	431	155	40	26

detritus in the larval burrows. The willow had also been invaded, apparently at the base of the broken branch, by a bracket-fungus [*Fomes igniarius* (L. ex. Fr.) Kickx., kindly identified by Paul D. Keener of the Dept. of Plant Pathology]. The termites had restricted their galleries entirely to the column of softer, fungus-infected wood extending below into the base of the tree. It is probable that the cottonwood limb from Patagonia had been completely invaded by such a fungus but that the lack of contrast with any uninfected wood caused this point to go unnoticed. Unidentified Basidiomycetes and several other fungi have been isolated from colonies of *Z. angusticollis* and later experiments indicated that fungi play an essential role in its natural diet (Hendee, 1933, 1935). Only one obvious tunnel to the outside was found one foot below the crotch, its opening (sealed) in a deep furrow of the bark.

A third colony was also located, but not taken, at Hereford in a medium-sized, three-trunked willow. Superficial galleries, containing a few large nymphs, were exposed by chopping into the partly healed stub of a branch three inches in diameter and three feet above the ground. The utility of a trail-laying mechanism (reported in *Z. nevadensis:* Stuart, 1961) may be envisioned in the existence of a colony inhabiting galleries as extensive and complex as those described above.

Founding of the colony. A single incipient colony was found in the stub of a broken branch three inches in diameter and six feet from the ground on another small willow at Hereford. The de-alated king and queen had carved out a cell approximately 5 × 10 × 25 mm. in the sap-soaked, splintered wood at the base of the branch. The pair had probably flown between late June and early August, 1963, and by this date (Oct. 26) had produced a single nymph, three mm. long. This colony was maintained in a room varying between 55° and 70°F and six eggs were produced during early March, 1964, when observations had to be discontinued.

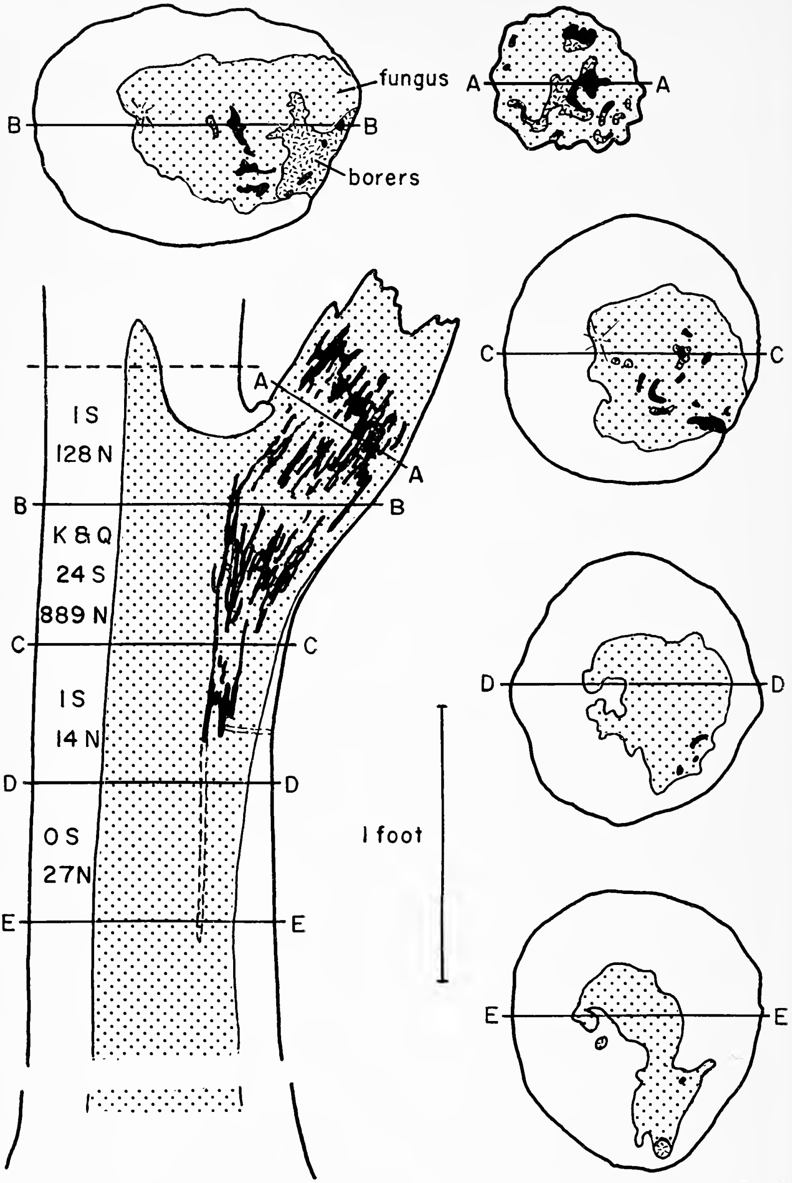
fungus
borers
B
B
A
A
A
A
B
B
C
C
C
C
D
D
D
D
E
E
E
E
1 S
128 N
K & Q
24 S
889 N
1 S
14 N
0 S
27N
1 foot

FIGURE 3

This example, together with data accompanying the collections of other colonies, demonstrates what is probably the usual way in which this termite initiates its attacks on living trees. Several of the larger trees commonly suffer mutilations by windstorms, particularly cottonwood and willow. These open wounds may then provide focal points for the colonizing alates. This approach is reminiscent of the method by which *Neotermes tectonae* Damm. attacks living teak trees via dead branches, snags and wounds (Kalshoven, 1959). It remains to be determined, however, whether odors of freshly exposed wood or fermenting sap are actually attractive, and whether a fungous invasion is a prerequisite for the establishment of a colony.

Colony size and soldier-nymph ratio. Table 2 summarizes the composition of the two colonies which were investigated in detail. Since they were both established in laboratory nests, the individuals were quickly sorted into rough size-classes and counted; no attempt was made to determine the number of instars represented. The king and queen were not found in the Patagonia colony and no eggs were found in either colony. Although supplementary reproductives have been reported to be common in colonies of the other two species (Castle, 1934), none were found here. In the Patagonia colony, three months before the flight period, nymphs with wing pads of three different lengths were conspicuous: 200 pre-alates or nymphs in the penultimate instar and 162 with wing pads of short and intermediate lengths. The total number of alates eventually produced by this colony in the laboratory was not determined. The colony contained a total of 22 soldiers (2 small) and 1120 nymphs, with a soldier-nymph ratio of 1 to 51. In the colony from Hereford, three months after the flight period, none of the nymphs bore conspicuous wing pads. This colony contained 26 soldiers and 1058 nymphs, making a soldier-nymph ratio of 1 to 41. These counts are only one third to one-half the maximum colony size reported for *Z. angusticollis,* allhough the soldier-nymph ratio is about the same (Castle, 1934).

Insects associated with the colony. Among many miscellaneous insects and mites found within the galleries of the two large colonies, two deserve mention because the association may be more than casual. At least 19 small (2-5 mm.) cockroaches were found fairly evenly distributed through the galleries in the limb from Patagonia. Ashley

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Figure 3. Longitudinal section shows a reconstruction of the galleries of *Zootermopsis laticeps* in the trunk of a living willow, Hereford, Ariz. The actual numbers of nymphs (N) and soldiers (S) are indicated in each segment. Cross sections represent tracings of the galleries in the five cuts AA to EE.

B. Gurney (Insect Identification and Parasite Introduction Research Branch, U.S.D.A.) has informed me that the specimens appear to be nymphs of *Compsodes schwarzi* (Caudell). Practically nothing is known of this insect although Ball *et al.* (1942) reported that a winged male was taken in an ant nest in the Santa Rita Mountains.

Fifty-two syrphid larvae (4-15 mm. long) were taken near the center of the colony from Hereford. Of several larger larvae which were set aside, one eventually pupated and developed into an adult. Willis W. Wirth (Insect Identification and Parasite Introduction Research Branch, U.S.D.A.) kindly identified the specimen as *Tenthredomyia tridens* (Loew). At least one member of this genus has been recorded "breeding" in the wounds of large trees (Wirth, 1964, *in litt.*). The presence of so many larvae, closely applied to the walls of the galleries containing the highest concentrations of the termites, is indeed puzzling. A few of the cockroaches and larvae were put into the large laboratory termite colonies, but it was impossible to observe anything beyond the fact that all three insects appeared to be indifferent to each other.

Additional collections of *Z. laticeps* are planned so that these associations can be studied further. In co-operation with Gordon B. Castle of Arizona State University, biological studies on laboratory colonies of the termite are also in progress.

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The illustration on the front cover of this issue of Psyche is a reproduction of an unpublished drawing by W. M. Wheeler of *Cephalotes atratus* (Linnaeus). [Courtesy of Miss A. E. Wheeler].

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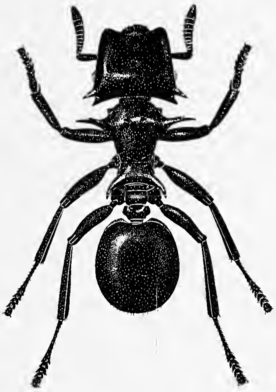
A JOURNAL OF ENTOMOLOGY

Vol. 72 June, 1965 No. 2



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The March, 1965 Psyche (Vol. 72, no. 1) was mailed June 25, 1965.

THE LEXINGTON PRESS. INC., LEXINGTON, MASSACHUSETTS

PSYCHE

Vol. 72 June, 1965 No. 2

OBSERVATIONS ON *MICROTUS* NESTING IN ANT MOUNDS[1]

By Gerald Scherba
California State College at San Bernardino

A large number of different kinds of organisms inhabit social insect nests and their relationship to their host varies from simple sheltering during winter, through predation, to complex interactions involving specialized secretory glands and other structures. There is a rich literature describing these myrmecophiles and termitophiles and an elaborate terminology defines each of the kinds of relationships between symbiont and host.

The overwhelming majority of these nest inhabitants are arthropods, especially beetles of the family *Staphylinidae* and allied families. However, vertebrates also inhabit social insect nests. Nichols (1940) reported the synbranch eel *Synbranchus marmoratus* Block from moist cavities within nests of the leaf-cutting ant *Atta sexdens* in South America. In Illinois the author has observed wood frogs, *Rana sylvatica* overwintering in nests of *Formica ulkei.* Donisthorpe (1927) recorded the slow-worm *Anguis fragilis L.* within *Formica fusca* mounds in England; the blind lizard *Amphisbaena* within *Atta* nests on the Amazon; the legless lizard *Caecilia annulosa* within fungus growing ant nests in Guiana; and several species of snakes living with ants in Australia. The Nile Monitor *Varanus niloticus* (Linn.) incubates its eggs within the termitaria of *Nasutitermes* in South Africa (Snyder, 1929; Cowles, 1930). Snakes, lizards, and geckos use termite nests for egg-laying in Jamaica. These animals occupy cavities within the termite nest that were originally excavated by Parakets (Hindwood, 1959).

Among the birds, at least 8 species are known to breed in arboreal or terrestrial nests of termites, or in some cases, ants. The list includes 23 species of kingfishers, 13 species of parrots, 4 species of

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[1] Project 80 of the Jackson Hole Biological Research Station, supported by funds from the National Science Foundation, Grant No. G-23423.

Manuscript received by the editor March 14, 1965.

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woodpeckers, 4 species of trogons, 2 species of puffbirds, 1 species of jacamar and 1 species of cotinga (Von Hagen, 1938; Hindwood, 1959; Hardy, 1963). Most of these species hollow out a portion of the nest, and the termites seal the exposed portions so that there is no contact between bird and termite. However, the Rufous Woodpecker, *Micropternus brachyurus,* which nests in active *Crematogaster* carton nests, feeds upon the ants which run all about the bird's nest and over the young, without apparent harm.

The Gartered Trogon of central South America nests within wasp nests, but eats the adult wasps before hollowing a nest cavity (Hindwood, 1959).

Among the mammals, the aardvark *Orycteropus* is predatory upon termites and lives within the termitaria (Bequaert, 1921, and Alfred E. Emerson, personal communication). The dormouse *Claviglis* has been found nesting with young in a cavity in the side of an arboreal termite nest in the Belgian Congo (Chapin, 1939). The following description adds to the scant record of mammals which inhabit social insect nests.

During observations of a western mound building ant, *Formica opaciventris* Emery in 1962, the author found the meadow vole, *Microtus montanus nanus* (Merriam) living within these mounds and both adults and young animals entering and leaving their burrow frequently. This report will describe the burrow system and detail an attempt to define the relationship between vole and ant.

The study area is located in western Wyoming, one mile east of Jackson Lake, near the townsite of Moran, and at an altitude of 2065 meters. The ant nests are located on a mesic silver sagebrush, *Artemisia cana,* meadow. The soil is a clay loam with an abundant ground cover of herbaceous vegetation.

The nests of *Formica opaciventris* are earthen mounds with a light covering of thatch. The mounds vary in height to 0.7 meters with basal diameters as large as two meters. The ants are "aggressive," and when disturbed bite readily, exuding droplets of formic acid. There are approximately 400 mounds at the study site and these nests have been under observation since 1957 (Scherba, 1961, 1963, 1964).

In the Jackson Hole area *Microtus montanus* has been captured from these habitats: alpine meadow, subalpine meadow, lush grass-forb meadow, wet sedge meadow, willow savannah, timothy meadow, aspen forest, sage-grass community, and willow-alder streamside community. Findley (1951) and Negus and Findley (1959) state that "this is one of the most versatile mammals . . . from the standpoint of habitat selection."

While there are no data available on the *Microtus* population density changes at the study site, casual observation suggests that population levels fluctuate greatly from year to year. The voles are seldom seen during some summers, while they are abundantly evident moving on the ground during other years. 1962 was such a year of apparently high vole density in Jackson Hole.

THE BURROW SYSTEM

Multiple openings of tunnels are apparent at the base of a large number of the mound nests. Nest 434, a moderately active mound, had eight such openings and this nest was selected for examination (Fig. 1).

The tunnel entrances measured 3.0 to 3.8 cm. in diameter. Excavation indicated that two of the tunnels on opposite slopes led downward, then inward, below the soil surface level, then upward, terminating in an oval chamber 12.2 cm. in length and 4.6 cm. high. Other tunnels ended blindly within the mound, joined this chamber after a circuitous path or entered a second, larger, chamber described below. The floor of this first chamber, which was 16.8 cm. below the mound apex, consisted of fine soil and numerous particles of short green and dried plant stems, especially the rush *Juncus* which grows as a fringe on the mound exterior.

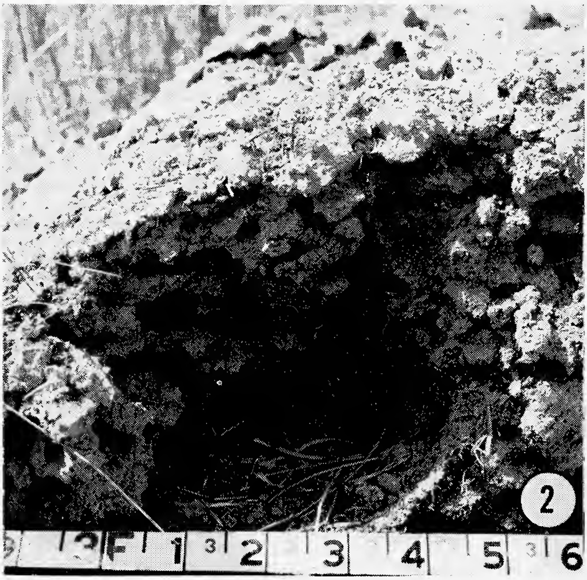
The second chamber, larger and deeper than the one described above, was abundantly lined with soft dried grasses and was accessible by three tunnels which entered it internally from the North, South, and West. These tunnels terminated, eventually, in openings at the ant nest surface. The chamber measured 13.7 cm. in length, 10.7 cm. in heighth, and its floor was located 13.7 cm. below the level of the soil surface and beneath the center of the mound apex. (See Fig. 2). Presumably this chamber serves as the bedding site for *Microtus*.

Excavation of a second, more active ant mound, nest 460, revealed seven tunnel entrances with tunnels extending circuitously into the mound for distances of several centimeters. All of these tunnels terminated blindly.

In summary, *Microtus* activity results in a series of tunnels opening at or just above the level of the soil surface. These tunnels, turning frequently, either end blindly or lead into lined chambers or cavities located within active ant mounds.

POSSIBLE RELATIONSHIPS

The unexpected presence of a rodent living within active ant nests prompts the inquiry: Are the voles adapted to living within the mounds, either by virtue of being protected from ant bites, or because of avoidance of the voles by the ants? Further, are the ants serving



Scherba — Microtus

as a source of food as well as providing shelter for *Microtus?*

A *Microtus* was live trapped and placed in an observation box 60 cm. long by 30 cm. wide by 30 cm. high. A full shovel of nest contents and ants from the same nest as the *Microtus* was added to the box.

Observations under these circumstances indicate that the worker ants did not avoid *Microtus,* but instead would attack it whenever the *Microtus* came into contact with the ants. When contacted by an ant, the *Microtus* responded by hopping quickly a few centimeters away. Ants which began biting a limb or the tail were usually quickly dislodged by flicking the leg or tail, or by cleaning the leg with the teeth. Some workers were not easily dislodged from the tip of the tail or nares. When bitten in these places, *Microtus* appeared to be "in distress." On another occasion, a newborn *Microtus* was seen writhing when attacked by *opaciventris.*

It, therefore, seems evident that the ants do not avoid *Microtus* and that *Microtus* is not insensitive to, or completely protected against, ant bites.

Content analysis of three stomachs examined under a dissecting microscope revealed only freshly chewed bright green plant parts. No recognizable insect fragments were found.

DISCUSSION

Clearly, *Microtus* exhibits few of the adaptations one might expect of a rodent which inhabits ant mounds. On this basis, we might speculate, as Professor Negus (personal communication) suggests, that for *Microtus montanus* ant mounds form a marginal microhabitat utilized only after other, more suitable, sites are already occupied. In a year of apparent high *Microtus* density, this explanation appears reasonable.

We may categorize the relationship of this vole to the ant as that of a myrmecocole. (Park, 1929).

ACKNOWLEDGEMENTS

Mr. Norman Heryford, Smithsonian Institution, ably assisted this work and his contribution is acknowledged with pleasure. Professor Norman Negus, Tulane University, kindly provided the determination of the species of *Microtus* under discussion.

Explanation of Plate 7

Figure 1 — External openings of *Microtus montanus* tunnels at the base of *Formica opaciventris* mounds. A covering of vegetation has been removed. Note forceps for scale.

Figure 2 — Cross section of mound showing large central *Microtus* nest chamber. Dense, soft nesting material of plants has been removed. Note tunnel into chamber at rear.

The author wishes to express his appreciation to the National Park Service for permission to carry out this investigation within the boundaries of Grand Teton National Park.

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OBSERVATIONS ON THREE SPECIES OF *PHIDIPPUS* JUMPING SPIDERS (ARANEAE: SALTICIDAE)*

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The large, brightly colored jumping spiders of the genus *Phidippus* are among the most conspicuous American spiders. In many ways, they are ideal subjects for behavioral studies: the spiders are diurnal in habit and are highly responsive to visual stimuli, they pursue prey actively and the males perform elaborate courtship displays.

The present paper compares the behavior and the taxonomy of three *Phidippus* species that are found in the same fields in the vicinity of Reno, Nevada. The behavioral description emphasizes *Phidippus coccineus*, as this species is being used in the laboratory for experiments which continue a previous line of investigation on hunting responses (Gardner, 1964). The other two species of *Phidippus, P. apacheanus* and *P. opifex*, were collected and maintained in the laboratory for comparative observations.

The diagnostic features for the three species have been illustrated (Figs. 1-10) since there are few records other than the original description of each species. A modern taxonomic revision of the genus would be of considerable value in helping research workers determine specimens and in stimulating comparative studies.

HABITAT

Phidippus coccineus Peckham and Peckham, 1909, occurs in the sagebrush community of the Great Basin desert. These large jumping spiders are found on bushes such as the sagebrush *(Artemesia tridentata)*, the rabbitbrush *(Chrysothamnus nauseous)*, and the four-winged saltbrush *(Atriplex canescens)*. *Phidippus coccineus* prefers bushes that grow on slopes with thin, stony soils, and appears to avoid conifers and moist habitats (e.g., the proximity of irrigation ditches). In the same habitat, often on the same bush, two other *Phidippus* species are found: *P. apacheanus* Chamberlin and Gertsch, 1929, and *P. opifex* (McCook, 1883).

DESCRIPTION

The total size of adult *P. coccineus* ranges from 7-11 mm (median = 9 mm) for males and from 10-12 mm (median = 10.5 mm) for females. Both males and females have blue-green irridescent cheli-

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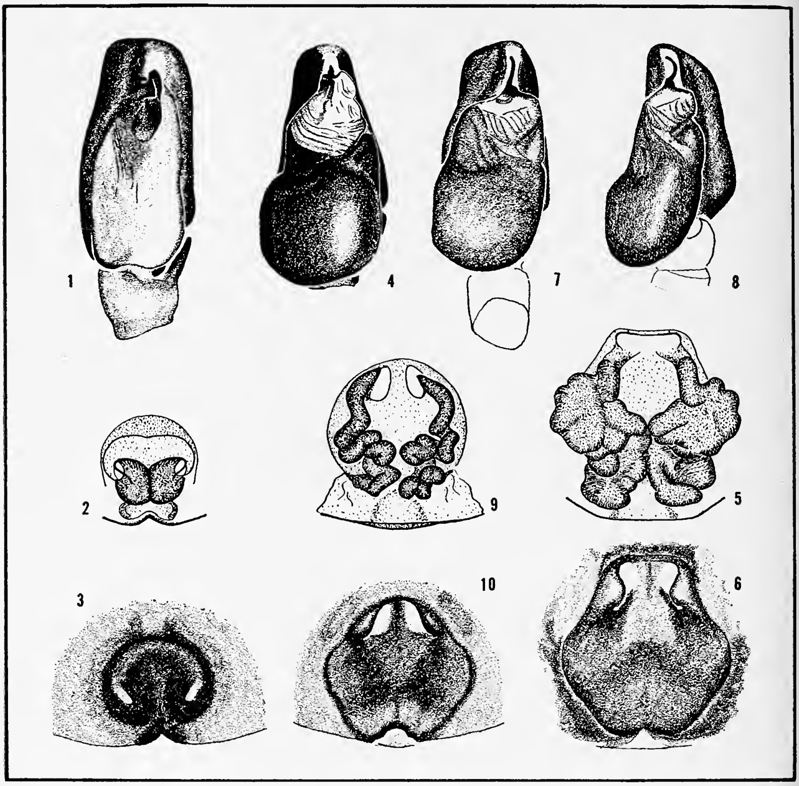
**Manuscript received by the editor February 3, 1965*



Figs. 1 - 3. *Phidippus opifex* (McCook). 1. left palpus. 2. Female genitalia, dorsal view. 3. Epigynum.

Figs. 4 - 6. *P. apacheanus* Chamberlin and Gertsch. 4. left palpus. 5. Female genitalia, dorsal view. 6. Epigynum.

Figs. 7 - 10. *P. coccineus* Peckham and Peckham. 7, 8. Left palpus. 7. Ventral view. 8. Ectal view. 9. Female genitalia, dorsal view. 10. Epigynum.

cerae, a black cephalothorax and black limbs, and a bright red abdomen with a median black stripe. There are two pairs of minute white spots between the black and red areas on the posterior part of the dorsum of the abdomen. At the sides of the abdomen there are light diagonal bands, and there is also a light transverse anterior band on the dorsum. These markings vary in conspicuousness: the bands and spots may be only a somewhat lighter shade of red than the remainder of the abdomen, while the median black stripe may be so reduced in width and length that the abdomen appears solid red. Sometimes, the basic color is orange rather than red, and very old spiders may even be yellow. In this species, the adult males and the adult females are similar in coloration, and this is also true of *P. apacheanus*. It is more usual for the males of *Phidippus* to have irridescent chelicerae and a distinctive adult coloration while the females of this genus remain similar to the immature spiders (e.g., *P. clarus* Keyserling, *P. opifex, P. whitmanii* Peckham and Peckham).

From the second instar on, *Phidippus coccineus* spiderlings have a brownish-gray cephalothorax and limbs, and a red abdomen with markings limited to the posterior portion. These consist of a pair of black stripes, each bearing two conspicuous white dots, separated by a light region. The light region may be gray, white, or even golden; immediately anterior to the black stripes it is enlarged into a conspicuous light dot. While the abdomen of very young spiderlings appear bronze, the red color of the abdomen is striking in later instars. In one of the later instars, the 5th or perhaps the 6th, a red cap appears in the eye region, but this marking disappears in the following molt. The light basal band and side bands of the adult are also present in immature spiders, and, in the two instars preceeding maturity, the chelicerae are also irridescent.

METHODS OF COLLECTION

Phidippus coccineus can be collected by sweeping bushes with an insect net. These hunting spiders are active from mid-morning until dusk, and can be seen in bushes running along branches or poised near their tips. Running is interrupted frequently: the spider stops, turns to one side and then the other, apparently scanning its surroundings. In the laboratory, the spiders are active between 10 A. M. and 4 P. M., and are still in a closely-woven retreat at other times.

Adults and large immatures are found on heavier branches near the center of the brush, and are not accessible to the sweeping net. Certain characteristic aspects of their escape behavior can be used in capturing them. When approached slowly by a forefinger or a pencil, the spider backs away while facing the oncoming object, and will back right into a collecting tube held behind it on the branch. However, once the spider backs sufficiently far from the object (about 8 cm), it turns away. Then it will run a short distance along the branch, attach a thread of silk, and plunge down toward the leafy debris at the base of the bush, where it becomes extremely difficult to find.

Phidippus coccineus can also be collected in its retreat, or nest. The spiders will be found within a slightly flattened tube of silk, which is surrounded by guy-lines that attach it to the twigs or leaves of the bush. The molting nest and the nest that houses the female and her cocoon of eggs are of the same basic shape as the sleeping nest, but much more silk is used in their construction. Such prominent white webs are found under stones at the base of the bush. Usually, the spider places its nest under one of the few stones that remains shaded from the strong desert sun even at mid-day. Occasionally, *P. coccineus* builds nests inside or under cardboard containers dumped in their habitat. *Phidippus opifex* makes frequent use of the insulation provided by these cardboard boxes; alternatively, and unlike *coccineus, opifex* builds a large and prominent nest among the branches of a bush to souse its egg cocoon.

LIFE HISTORY

The breeding season of *P. coccineus* appears to be a very early one. In 1964, six adult males, nine adult females, and about 90 immature spiders of this species were collected near Reno, Nevada. The males were found first, even before the final snowstorms of early June; adult males were found from early April to early July, adult females, from early May to mid-July. All but one of the females collected in May were already gravid and laid eggs within the following fortnight; all females obtained later in the summer (mainly, in July), were found in a nest with an egg cocoon. Two spiders in the penultimate instar were found in late May, and these became mature in the laboratory toward the end of June. But from mid-July on, only immature spiders could be found and none of these attained maturity during the summer or fall of 1964, though they have molted as many as four times since coming to the laboratory. It is of some interest to note that the females survived the males by almost two months when kept under identical conditions in the laboratory, and that, for each sex, all the adults died within a short span of time (e.g., all the females between 18 Sept. 1964 and 6 Oct. 1964).

The early breeding season of *P. coccineus* contrasts with that of *P. opifex* and *P. apacheanus* found in the same habitat. Adult males, adult unmated females, and females in the penultimate instar of *P. opifex* were collected in the first half of July; the nests containing the egg cocoons of this species were abundant in the sagebrush late in August. *Phidippus apacheanus* had the latest breeding season among the three species: while immature spiders of this species were abundant throughout the spring and summer, adults were only found after the third week of September. Six immature *P. apacheanus* kept in the laboratory since early July molted three times and became mature around the end of October (see Table I).

The seven *P. coccineus* females kept in the laboratory during the summer of 1964 laid either two or three successive batches of eggs, each batch containing fewer eggs. A median of 44 spiderlings hatched from the first batch of eggs, 30 from the second, and three from the single third batch that did hatch. By contrast with females that

Table I
The 1964 breeding season for the three species of *Phidippus* at Reno, Nevada

Collection dates for:*	*P. coccineus*	*P. opifex*	*P. apacheanus*
juveniles in penultimate instar	Oct. - June	? - July	(Aug.) - Oct.
adult males	April - July	July - Aug.	Sept. - Oct.
adult females:			
unmated	May	July	Oct.
gravid	May - July	?	Oct., Nov. - ?
w. egg coccoon	July	Aug. - Sept.	(Dec. - Jan.)**

*Parentheses indicate that field collection dates are unavailable and dates for spiders maintained in the laboratory have been used.

**Possibly, abnormally early. In the laboratory, warmth and abundance of prey during the winter produces anomalies, e.g., penultimate *P. coccineus* juveniles become mature in Dec. - Jan.

bear only one batch of eggs, such as *P. clarus* Keyserling of the northeastern United States, *coccineus* females came out of their nests to capture the prey that were offered daily. *Phidippus clarus* remains with the egg cocoon continually, and generally dies within a few days of the spiderlings' emergence from the nest. For *P. coccineus,* the median time from oviposition to hatching was 21 days. The young remained in the web through a first molt some 16 days later, and emerged from the nest 21 days after hatching. These times show little variation: for 11 batches of spiderlings the range of time from egg-laying to emergence from the nest was 37-46 days.

The spiderlings were self-sufficient when they left the nest. If moved to an individual glass vial, almost all spiderlings built a miniature of the adult sleeping nest within two days. Flightless *Drosophila* placed in the vial are soon captured: for one batch of 24 spiderlings, the median catching time was 3.7 min. and all but two of these spiderlings had caught their first prey within 60 min. However, it is not easy to rear the spiderlings: only 30 of almost 180 young, kept in individual vials over wet cotton wicks and fed every two days, have survived to date (i.e., approximately five months and four post-emergence molts). Most of the losses occurred in the first fortnight after leaving the nest; later deaths generally occurred while the spider was molting.

Courtship

Method of observation

Complete mating behavior can be observed by placing the male together with a female reared in the laboratory from the penultimate instar to maturity, that is, a female known not to have mated previously. In such cases, courtship is likely to be very brief: the female will accept the male after 30-60 sec. of courtship. The initial phase of mating behavior, the courtship dance, can be observed with a wider variety of partners: females laden with eggs, females that have laid eggs, females of a different *Phidippus* species, females in glass vials, and even simple models of females such as hemispheres of modelling clay with a pair of wires as appendages (Drees, 1952). When a previously mated female is used, courtship is not likely to last long and may end violently: the female will run away from the male or jump at him as she does at prey. Prolonged courtship can be seen with females confined in transparent vials, and with models of the female.

A glass or plastic hemisphere 15 - 20 cm in diameter provides a suitably-sized observation chamber in which the spiders are always in full view. The chamber should have a rough textured floor as adult *P. coccineus* refuse to move or move unnaturally on a slippery surface. It is possible to use the spider's preference for moving upward to introduce animals into the chamber with a minimum of disturbance: the spider climbs into a vial placed over it in the home jar, and climbs into the chamber when the open end of the vial is fitted into a hole in its floor. As the spider is likely to orient toward the observer when he is moving, it is advisable to shield writing movements and to observe from a constant position, with a light intensity differential to further obscure the observer. The Dazor Floating Magnifier unit, which combines a wide-angle lens and fluorescent light, is very suitable for this purpose.

Results

The courtship display of various *Phidippus* males *(apacheanus, clarus, coccineus, opifex)* has a common basic pattern. The male begins his display by holding the carapace very high, shifting the abdomen to one side, and raising the first pair of legs. In this position, he moves before the female, stopping after each few steps. The male advances in a zig-zag pathway, shifting his abdomen to the other side at the end of each oblique approach. Throughout, the dancing male flicks his forelegs up and down, holding them wide apart at first and bringing them closer and closer together as he nears the female. Then, with forelegs held almost parallel before him, he touches the female cautiously once or twice. If the female remains still at this

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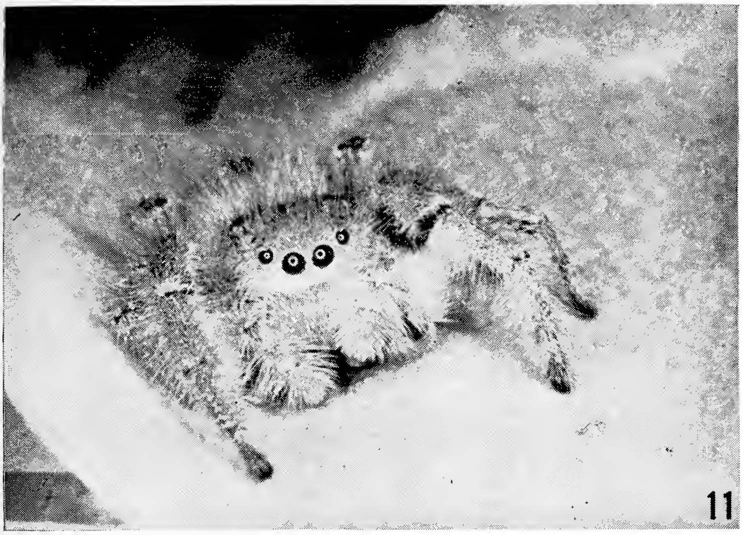
EXPLANATION OF PLATE 8

Figs. 11 - 12. *Phidippus opifex* (McCook), female, total length 14 mm. The female is tan, the male is black with light gray dorsum of carapace and abdomen. (The white rings in the eyes are reflections of the light used.)



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Gardner — Phidippus

stage, the male climbs over her, and uses the forelegs to help turn her abdomen to the side. When the genital pore, which lies on the ventral abdomen, is thus exposed, the male inserts his palpus. After 2-3 min., the male withdraws this pedipalp, turns the female's abdomen in the other direction, and inserts the other pedipalp (fig. 2010, Kaston, 1948).

Raising the forelegs and holding the abdomen to one side are by no means specific to courtship. This display occurs to a wide variety of objects that are approaching too close to the spider: other spiders — regardless of sex (Crane, 1949), houseflies or other large prey, models of prey that are about the size of the spider, such as 9-12 mm spheres, or even the end of a finger or a pencil. In these situations, however, the spider with its forelegs raised and waving backs off while facing the moving object and, when 5-8 cm away, turns away and flees. In intraspecific encounters, the effect of raising the forelegs is to bring the other spider to an abrupt halt, whether it be a wandering cagemate, a courting male preparing to touch the female, or a female stalking or about to jump at the male. Indeed, raising of the forelegs appears to have this 'stop-sign' effect even in encounters between congenerics of the three *Phidippus* species. Drees, working with female *Salticus scenicus*, was able to initiate hunting behavior by moving a black dot along a white wall, and to stop the pursuing spider by moving wires projecting from the side of the model through an angle that imitated the waving of the forelegs (Drees, 1952).

Female *P. coccineus* and *P. apacheanus* are unusual in that they perform an acceptance dance just before the male touches them. With forelegs high and wide apart and abdomen bent to the side, the female sways before the male, sometimes with a few steps to one side and then the other. In other *Phidippus* species, the female rejects the male by extending the first pair of legs whenever he approaches too closely, and merely fails to ward him off when she is ready to accept him.

Differences in the display of the three *Phidippus* species remain to be investigated. At this stage, it is apparent that subtle quantitative differences are involved. For example, while *P. apacheanus* moves his forelegs both closer and higher as he nears the female until the

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EXPLANATION OF PLATE 9

Figs. 13 - 16. *Phidippus apacheanus* Chamberlin and Gertsch. 13. Juvenile, total length 9 mm. 14. Adult male below, female above, total length of each 11.5 mm. Both male and females are black with bright orange dorsum of carapace and abdomen, and with iridescent green chelicerae. 15. Male signalling female. 16. Male signalling and facing female.

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13


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GARDNER — PHIDIPPUS

tips touch in a circle above his head, *P. coccineus* keeps his forelegs in the same vertical plane while bringing them together; again, *P. apacheanus* is only 5 to 8 cm away from the female when he begins to dance, and hence performs less extensive side-to-side movements than does *P. coccineus* (or *P. clarus*). There are also variations in the tempo of flicking the forelegs, and in the synchrony of the two forelegs, but further study is needed to sort out individual, drive-level, and species differences.

As was previously noted, the adult *apacheanus, coccineus,* and *opifex* appear in the same habitat at different times, so that the time at which each species was courting did not overlap in the summer of 1964. However, adults of one species were kept in the laboratory until adults of the species succeeding them in the fields were collected. In the few relevant observations, the male courted the female of a different species as eagerly as his own (indeed, more eagerly if she were larger, as in the case of *P. opifex* females), while the female ran away or initiated hunting behavior as soon as she was released from the transparent vial.

HUNTING

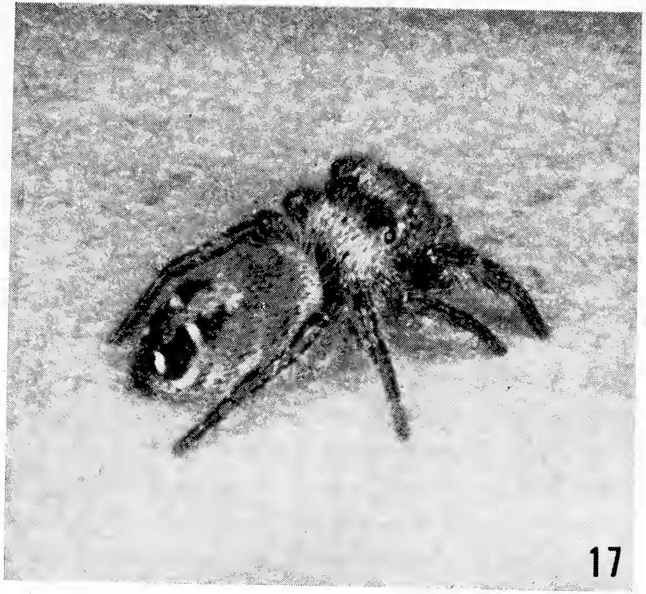
Method of observation

Investigation of hunting behavior depends on techniques for controlling the hunger-level of the spider and the stimuli received from the prey.

As would be expected of a predator notorious for withstanding long fasts, the three *Phidippus* spp. will molt, reproduce, and survive many months in the laboratory, whether offered prey daily, bi-weekly, or once a week. To control hunger-level, a behavioral criterion for satiation was used: the spider was presented with successive *Drosophila* until it failed to accept a fly within 10 min. of its presentation. Hunting was then tested at a specifiable level of food deprivation; tests at 1, 7, and 12 days deprivation yielded considerable variation in the intensity of hunting behavior (Gardner, 1964).

EXPLANATION OF PLATE 10

Figs. 17 - 18. *Phidippus coccineus* Peckham and Peckham. 17. Juvenile, total length 5 mm. The color is gray except for the abdomen. The abdomen dorsum has a white basal band and the reddish area is separated posterior by black bands broken by white spots. 18. Female, total length 10.5 mm. Both males and females are black with bright red dorsum of the abdomen and iridescent blue-green chelicerae. The longitudinal black stripe on the abdomen is more distinct in females. The males (not illustrated) have a mean total length of 9 mm.



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GARDNER — PHIDIPPUS

In hunting, as in courtship, visual stimuli are the most important, and complete hunting behavior can be observed with live prey in transparent containers, dead prey dangled by means of an attached fine gauge wire (or otherwise made to move), and simple models of prey, such as moving dots or spheres. In hunting, the spider is essentially tracking a moving target, and full control over the stimuli received from the prey is possible with a moving model whose speed, distance, and angular displacement can be regulated (Drees, 1952; Precht, 1952). The main difficulty in working with actual prey lies in the highly variable movements of living animals. To some extent, this can be overcome: flightless *Drosophila* mutants with a uniform manner of locomotion have obvious advantages over a prey that can fly, and hence sporadically disrupts an ongoing bout of hunting behavior by an abrupt change in angle and distance from the spider. It is important to arrange a situation in which the prey is not sometimes moving and sometimes still, as the spider seldom initiates hunting behavior to still prey, and interrupts ongoing hunting behavior when the prey ceases to move. Curly-type *Drosophila melanogaster* are suitable for this purpose as they crawl upward on a vertical surface and move continually until they have reached the top. The pathway of the prey in relation to the predator can also be made uniform. Jumping spiders will readily climb a slender pole, and position themselves, facing down, near the top; the curly-type *Drosophila* also climb such a pole, moving continually and at a constant speed straight toward the spider. With such a technique, the distance at which the spider initiates hunting can be measured, and can be compared for different species or for different periods of deprivation.

Results

Hunting behavior in salticid spiders can be described as a sequence of stimuli and responses: the spider performs a given response until there is some crucial change in the stimuli received from the prey which then evokes the succeeding response. Thus, when introduced into a hemispherical testing chamber, the spider generally climbs to the top. A few seconds after the prey enters, the spider *orients* by turning so that the large frontal eyes come in line with the prey, and this relative position is maintained throughout the remaining hunting responses. Once lined up, the spider *pursues,* moving rapidly at first but more slowly as it comes near the prey. When *P. coccineus* is within 5 cm of the prey, the spider presses its body close to the ground, and draws the legs in toward the body. At about 1.5 cm, the spider becomes still in this *crouched* position, attaches a thread of silk to the substratum, and *jumps* at the prey. Somewhat more elaborate tracking occurs when a small *P. coccineus* pursues a much larger prey, such as a blue-bottle fly: the spider may take a curved course so that the final jump is from behind the prey.

It is possible to vary the frequency and duration of each hunting response by withholding the stimuli for the succeeding response (Drees, 1952; Precht, 1952; Gardner, 1964). For example, if the model is kept about 10 cm from the spider by moving it at the same speed as the pursuing predator, pursuit is prolonged far beyond its normal duration as the next response, crouching, requires a very small distance between prey and predator. Again, a model moving slowly within a transparent tube 2.5 cm in diameter seldom evokes jumping for the crouched spider cannot get close enough, while with a narrower tube jumping occurs readily.

Having captured the prey, the spider settles in one spot and does not move again until it has discarded the undigestible hard remains of the prey — a small mass in the case of the *Drosophila,* or the perfect empty shell of a large prey such as *Calliphora.* The time required to consume the prey reflects the relative size of the spider and its prey. For example, a group of small (4-6 mm) immature *P. coccineus,* tested at 7 days food deprivation, required a median time of 29.0 min. to consume a *Drosophila,* while larger individuals (8-10 mm) required only 8.6 min. Even the large adult females required almost one hour to consume large prey such as *Musca domestica.* For *P. coccineus* (and *P. clarus* as well), consuming time increases reliably with days of food deprivation. Thus, the same group of small spiders required only 21.8 min. to consume a *Drosophila* when tested at 1 day food deprivation.

Hungry *P. coccineus* will readily capture more than one prey at a time, provided the second prey comes very near (the spider will not move away from the place at which it has settled with the first prey). This situation was explored with the pole technique and perhaps it is common in the natural counterpart of the pole — the branch tips where hunting *Phidippus* can be found. The spiders accepted several pairs of prey on the pole, but as they became satiated, it was much less likely that they would accept the second prey. Instead, the spiders responded by extending the forelegs toward the *Drosophila* — once again using the ubiquitous display that occurs in courtship, intraspecific encounters, etc.

Given the choice between two prey that differ in size, such as *Musca* and *Drosophila* or *Calliphora* and *Drosophila, P. coccineus* chooses the large prey less consistently than does *P. opifex* and *P.*

apacheanus. In the field, both *opifex* and *apacheanus* have been seen pursuing huge prey, such as grasshoppers and bees. A difference in preferred size of prey is also found between smaller and larger *P. coccineus* — although a 4 mm spiderling that pursued and caught a 9 mm housefly provides a notable exception. Both these factors would reduce competition for food among the three *Phidippus* species. At the present time, preferred size of prey is being investigated with models (spheres 3, 6, 9 and 12 mm in diameter, moving at 8mm/sec.).

NEST BUILDING

As *Phidippus* spends the daylight hours wandering from branch to branch while hunting prey, it seems likely that a new nest is built every evening. In their laboratory containers, *P. coccineus* only occasionally built more than one nest; ordinarily, the spiders returned to the same nest, night after night. If however, the nests are removed in the morning, the spiders will build a new nest late that afternoon. On a typical test day, 19 spiders had their nests removed and were exposed to natural light conditions. Of these, 16 built a nest within the next 24 hrs. All nest building began in the afternoon, at a median time of 55 min. before sunset. (Such a generalization is limited to the sleeping nests of immature *P. coccineus*, for the molting nest is begun much earlier in the day, and the adult often lets many days pass without building.)

The spider begins to build by moving within a limited area in the angle formed between the sides and top of the container. As it moves, it attaches a framework of threads of silk, each about two or three times its own length. Suspended within these lines, the spider starts to weave by moving the abdomen from side to side so that the spinnerets describe an arc of a circle. Moving forward and back a step at a time, sometimes suspended on its back and sometimes on its venter, the spider spins about itself a closely woven tunnel, roughly one and one-half times its own length. Once started, weaving continues uninterrupted, and by 30 min. after sunset most of the builders are quiet in their nests. The roles of light and temperature in the choice of nest-site and in the rather precise timing of this distinctive diurnal behavior are presently being investigated.

DISTRIBUTION OF THE SPECIES

The male and female syntypes of *P. coccineus* came from Claremont, California and are kept in the Museum of Comparative Zoology. As far as known the species occurs in southern and eastern California and western Arizona. *Phidippus opifex* came from San

Bernardino, California, the type should be in the Academy of Natural Sciences, Philadelphia but could not be found. Its distribution is in the southwestern United States. The male holotype of *P. apacheanus* came from Black Rock, Utah; it is common in the southwestern United States across the southern states to Kansas, Louisiana and possibly to the east coast.

ACKNOWLEDGEMENTS

Dr. W. J. Gertsch provided the distribution data and identified *P. opifex,* Dr. Herbert W. Levi identified the other two species by comparing to the types and prepared the diagnostic illustrations. Jane E. Thompson, an NSF undergraduate research participant, made available her data on nest building. The photographs of *P. apacheanus* displaying are by Dr. G. P. Ginsburg; all other photographs are by Dr. Herbert W. Levi. The research was in part supported by Public Health Service Research Grants MH-07200 and MH-08938 from the National Institute of Mental Health.

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NEW SPECIES OF CHILOCORINI (COLEOPTERA: COCCINELLIDAE)*

By Edward A. Chapin
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In the course of a study of the genera of this tribe a few undescribed species were found and are herein named. It was found desirable to elevate *Zagreus* Mulsant from subgeneric to generic rank because of certain structural differences that exist between that group and *Exochomus Redtenbacher*. It seems likely that *Zagreus,* with eight-segmented antennae, has replaced *Exochomus,* whose antennae are ten-segmented, in the New World south of Panamá.

Zagreus costalimai n. sp.
(Fig. 2)

Length: 3.2-3.5 mm. Similar to *Z. jordani* (Mulsant) (Fig. 1) but slightly larger and with two additional subapical sutural spots common to the two elytra. Head pale yellow (male) or piceous black (female), finely and sparsely punctulate, sparsely set with fine short pubescence, the surface between the punctures alutaceous. Pronotum yellowish with a large blackish spot which extends over five-sixths of the basal margin and which fails narrowly to reach the anterior margin. The surface sculpture similar to that of the head but without pubescence. Scutellum small, triangular, black. Elytra yellowish with three common sutural spots and each with two others; the first and largest of the sutural spots lies in the basal half of the conjoined elytra, is almost quadrate and in length along suture is two-sevenths of the total length of the beetle. It is flanked on either side by large subtriangular spots, each slightly smaller than the sutural spot. In the apical half of the elytra there are the second and third sutural spots, each smaller than the preceding. On either side of the second sutural spot is an almost oval spot which is about two-thirds as large as the sutural spot. Both lateral spots are separated from the lateral margin by a distance equal to the separation between the lateral and sutural spots. The apical sutural spot is about half as long and half as broad as the second sutural. Under parts pale yellow, except for the blackish metasternum and first and second abdominal sternites. Metacoxal arcs complete. Elytral epipleura not foveolate. Legs pale except that the femora (posterior in male, all in female) are partially dark.

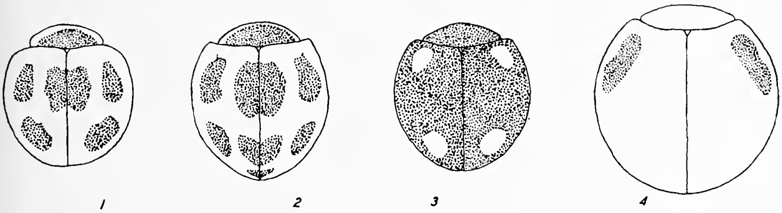
**Manuscript received by the editor January 26, 1965*

Type: a male, U. S. N. M. No. 67801, from Brazil, Rio de Janeiro Province, Campo Grande, July 31, 1957, P. A. Berry. Two female paratypes with same data as type.

I name this species in honor of the late Dr. A. da Costa Lima, in recognition of his many contributions to our knowledge of South American entomology.

Zagreus tetraspilus n. sp.
(Fig. 3)

Length: 3.0-3.2 mm., superficially resembling *Exochomus bisbinotatus* Gorham but larger, black with bluish reflections and with all spots smaller and the basal spots smaller than the apical spots. Head pale yellow (male) or black except for the clypeal margin and genal extensions which are brown (female), surface finely alutaceous and very finely and rather sparsely punctulate, pronotum twice as wide as length on median line, black except for the very narrow brown anterior and lateral margins, surface as described for head but with stronger and slightly denser punctulation. Scutellum black, polished. Elytra black with two yellow spots on each. The one on humeral callus is oval and reaches from the basal margin backward and outward a distance equal to the length of the pronotum at the point adjacent to the spot. The apical spot is more nearly circular, is slightly larger than the basal spot and fails to reach either lateral or sutural margins. Surface as described for head but with much stronger punctation. Inner half of epipleura yellow. Thoracic sternites and most of the first two abdominal sternites of female piceous black, rest of abdomen and legs brownish-yellow, the legs slightly darker; sternites of pro- and mesothorax and side pieces of metathorax, sides of first two abdominal sternites and rest of abdomen and legs brownish yellow in male.



Figures 1-4. 1. *Zagreus jordani* (Mulsant). 2. *Zagreus costalimai* n.sp. 3. *Zagreus tetraspilus* n.sp. 4. *Phaenochilus renipunctus* n.sp.

Type: a male, U. S. N. M. No. 67802, from Colombia, Int. Chocó, Istmina, Aug. 21, 1940. L. M. Murillo No. 5335. Two female paratypes from type locality, same data as type.

Exochomus bisbinotatus Gorh. from Mexico to Guatemala is a smaller species (2 mm.) with proportionately larger spots and with the lateral margins of the elytra yellow.

Exchomus bisbinotatus Gorham is not known to me in nature but only from the original description and figure in the Biologia Centrali-Americana. Therefore I am not sure that the species does belong to *Exochomus*. However I have not yet seen a species of *Zagreus* from a mainland locality north of Panamá. Since *E. bisbinotatus* is recorded from Mexico, British Honduras, and Guatemala it is probably not a *Zagreus*. The most northerly species of Zagreus is *Z. ritchiei* (Sicard) from the island of Jamaica. *Exochomus jamaicensis* Sicard, also from Jamaica, is correctly placed as to genus.

Curinus colombianus n. sp.

Length: 4.3-4.8 mm. Similar in dorsal coloration to *C. coeruleus* Mulsant but with the under parts and legs entirely pale reddish yellow. Head steel-blue above, piceous beneath and around mouthparts, surface finely alutaceous, finely, moderately, and evenly punctulate. Pronotum slightly more than twice as wide as length on median line (male) or twice as wide as long (female), median third steel-blue with lateral thirds reddish-yellow. Surface sculpture same as that of head except that the sides become more densely punctulate toward lateral margins. Scutellum small, black and polished. Elytra uniformly steel-blue above, the epipleura piceous. Surface sculpture same as that of median area of pronotum except toward apices where the punctulation becomes so minute as to be almost invisible under high magnification. Under parts pale reddish-yellow, shining and very sparsely punctulate, the punctures slightly coarser toward sides and apex of abdomen. Metacoxal arcs as in *C. coeruleus* Muls. Fifth sternite of male broadly and shallowly emarginate, the sixth with a V-shaped notch at apex; that of female evenly rounded at apex.

Type: a male, U. S. N. M. No. 67803, from Colombia, Dept. Valle del Cauca, Palmira, taken May 18, 1939, by L. M. Murillo (5020). Paratypes (54) from type locality: same data as type (22); Oct. 29, 1943, F. R. Fosberg (25); April 1942, B. Losada (1); April 1943, B. losada (3); August 1943, B. Losada (1); Feb. 1944. B. Losada (2).

Other specimens seen: Colombia. *Valle del Cauca.* Cali, 1939, B. Losada; Cauca Valley, 1937, F. L. Gallego; Buga, Feb. 3-7, 1941, Murillo (14, 32, 5409). *Antioquia.* Valle Medellín, May-

Nov., 1943, 1944, 1945, Gallego; Venecia, July 1942, 1943, Gallego; Segovia, Sept. 1944. Gallego; El Picacho, May 1942, Gallego; Sopetrán, July 1943, Gallego. *Cundinamarca.* Gachetá, Aug. 27, 1941, Murillo (5220). *Boyacá.* Guayatá, Oct. 18, 1940, Murillo (5297). *Santander.* San Vicenti de Chucurí, June 8, 1935, Murillo (83).

While *Curinus coeruleus Mulsant* does occur in Colombia, it seems to be quite rare and it is generally replaced by *C. colombianus,* which has a wide distribution in the country. Large specimens of *C. colombianus* can be immediately distinguished from small specimens of *C. coeruleus* by the uniform reddish-yellow color of the underside. In addition to the Colombian material listed above, one specimen believed to have come from Costa Rica, and one specimen from British Honduras, Belize, Sept. 1959, N. L. H. Krauss have been seen.

Phaenochilus renipunctus n. sp.

(Fig. 4)

Length: 3.7 mm. Upper surface pale yellowish-brown, each elytron with a piceous black, oblique, reniform spot just behind the humeral callus. Under surface and legs pale yellowish brown except for the metasternum which is somewhat darker. Front of head slightly concave between the large eyes, finely and sparsely punctulate near eyes, impunctate medially. Pronotum polished, very finely and shallowly punctulate, basal angles obsolete, lateral margins near obtuse frontal angles finely reflexed. Scutellum very small, triangular. Elytra with lateral margins broadly reflexed, surface polished, finely, shallowly and sparsely punctulate, the punctures near sutural and lateral margins deeper and more evident than those on disc. The reniform spot is two and a half times longer than its width at midpoint; it commences two-thirds its least width behind the basal margin and extends backward and outward toward but not reaching the reflexed portion of the elytron. Elytral epipleura shallowly but distinctly foveolate for reception of femoral apices of second and third legs. Abdomen with five visible sternites (female), metacoxal arcs strong, running backward and outward nearly to margin of sternite, then following sternite margin toward lateral margin of abdomen. Fifth sternite (female) evenly rounded. Tibiae each with a sinuate denticle much as in *Chilocorus.* Tarsal claw with elongate, triangular basal tooth which is two-thirds as long as the apical half of claw.

Type: a female, M. C. Z. No. 31143, from Morotai I., Indonesia, Sept., 1944, P. J. Darlington.

TECHNIQUES FOR THE STUDY OF SPIDER GENITALIA

By Herbert W. Levi *
Museum of Comparative Zoology

In response to many inquiries, I want to describe the techniques used for studying genitalia in the spider family Theridiidae. These procedures are not original, but have been adapted from methods used by several colleagues and students. One technique used in the family Araneidae is new and, I hope, helpful to students of that family.

I would like to urge strongly against making permanent microscopic slides of genitalia. Most slides are not permanent; even balsam may crystallize after fifty years. In dehydration, sclerotized parts may warp and, as the slide dries, the cover glass may crush anatomical structures. The slides often become separated from the parts of the specimen kept in alcohol and are lost. However, mounting the genitalia of common species on slides often saves time in their study. The medium found most useful is Hoyer's fluid (Baker and Wharton).

Luckily, most male spiders have two palpi. One, usually the left, is removed so that it can be turned to the desired angle. Palpi should always be examined completely submerged in 75 to 90% alcohol, never dry. Drying shrinks and distorts softer parts; partial submersion produces undesirable reflections. To prevent the parts from floating away in convection currents caused by the heat of the microscope light, the light is equipped with heat absorbing glass and the pedipalpus anchored in a piece of fibrous paper tissue at the bottom of the dish. Vaseline, sometimes recommended to keep the palpus in position, may cling to it, smear over it, and is difficult to remove. Examination is by binocular dissecting microscope, at magnifications of 150 to 240 times.

Small, translucent, weakly sclerotized palpi are common among theridiid spiders. A transfer to glycerine, after blotting off alcohol, may help to make visible the borders of transparent structures. A temporary slide mount in glycerine may be made for examination under a compound or phase microscope. The palpus should always be returned to alcohol in a microvial (4×10 mm) stoppered with cotton, to be kept with the spider in a larger vial (Fig. 1). A permanent mounting generally ruins the palpus for study, as sclerites become too transparent, may become distorted, and can not be turned

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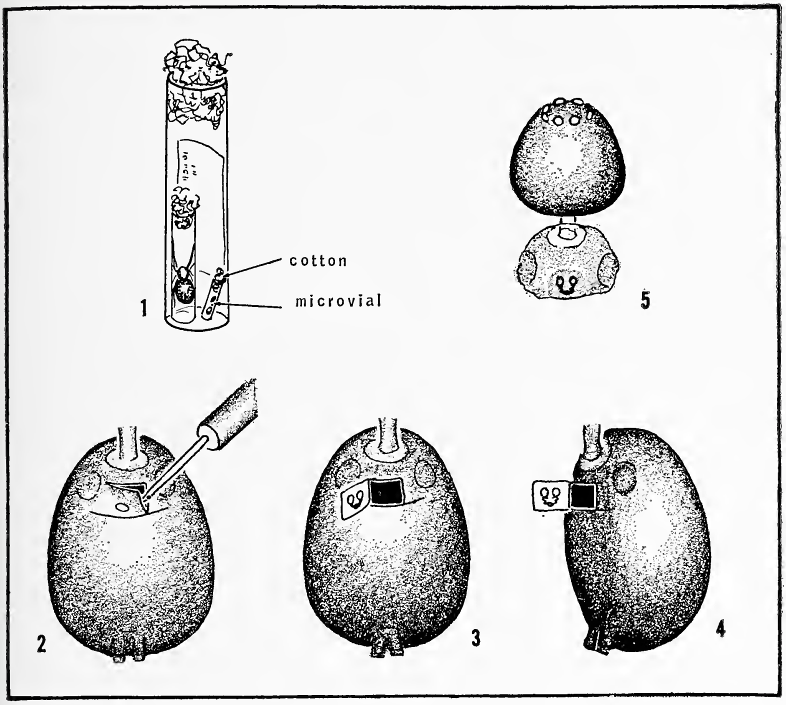
* *Manuscript received by the editor November 4, 1964*



Figures 1-5. Techniques for the Study of Spider Genitalia. Fig. 1. Vial containing two smaller vials, all stoppered with cotton. Fig. 2. Abdomen, showing place of incision. Fig. 3. Abdomen with genital area bent over. Fig. 4. Abdomen positioned for drawing internal genitalia. Fig. 5. Part of cephalothorax with pedicel and abdomen integument including genitalia.

and placed conveniently. I have examined a few such slides of genitalia of holotypes only twenty years old; they were almost useless.

Expanding the palpus to examine the position of sclerites is of value in phylogenetic studies, but is rarely useful for descriptions intended to facilitate species recognition. After the alcohol is blotted off, the palpus is brought to boiling in 10% NaOH solution. Then the palpus is transferred directly to distilled water where the hematodocha rapidly expands. The palpus can then be transferred to alcohol for storage. Unfortunately, boiling in NaOH warps, distorts and damages sclerites. Full strength lactic acid can be substituted for sodium hydroxide. Sclerotized palpi must be boiled longer than soft ones.

The epigynum of holotypes or rare species should not be removed from the body of the specimen. In many small spiders, especially if the epigynum is weakly sclerotized, the whole spider can be dropped into clove oil, after first blotting to remove excess alcohol. This procedure is satisfactory for routine examination of *Clubiona, Dipoena* and other small spiders having little pigment. After a few minutes' clearing, the ducts can be seen; longer clearing makes them too transparent. In these two genera, specific determination is based on characteristics of the duct that loops between the seminal receptacle and the external plate. In other genera the ducts are behind the seminal receptacles. For description of new species, a more careful examination is necessary. After removal from clove oil, the spiders are again blotted and returned to alcohol for storage.**

The procedure used for more careful examination is to make two cuts around the genital area (Fig. 2). The tools used are mounted, sharpened insect pins (minuten nadeln). The epigynal plate with seminal receptacles is folded back (Fig. 3) before or during submersion in clove oil. The specimen is then anchored on fibrous paper tissue for examination (Fig. 4). After examination the genitalia are bent back, like closing a door. In poorly preserved specimens the structure sometimes breaks off. In that case it should be stored in a microvial. On very small spiders it is advantageous at times to separate cephalothorax and abdomen, but the epigynum and neighboring integument should remain attached to the pedicel (Fig. 5). Sometimes a temporary slide can be made of the whole cephalothorax with genitalia.

If there are numerous specimens and difficulties in their study, it is best to make a *temporary* microscope slide of the epigynum with its accompanying structures. The epigynum is first cleared in clove oil and then, with a medicine dropper, it is transferred in a drop of clove oil to a microscope slide and covered with a coverglass. This preparation can be examined under a compound or phase microscope and the parts later returned to alcohol to be stored in a microvial. But there may be difficulties in this procedure. In *Helvibis* (Levi, 1964) it was possible to follow the course of the tortuous (but diagnostic) epigynum ducts in only two species: one because the ducts were short and simple, the other because I could destroy one of the numerous specimens available and tease the ducts apart with needles.

**Prof. M. E. Galiano informed me that examination under oil may damage iridescence or structural colors.

Boiling the female genitalia in 10% NaOH may be necessary to clear heavily sclerotized parts, but this method invariably distorts and warps structures, swelling softer parts. It should only be used as an additional method if there are many specimens.

Among the numerous difficulties of taxonomic research in the family Araneidae (= Argiopidae) is the problem of matching males and females. They are often collected separately and may be different in appearance. Abalos recently (1963) observed, in his study of reproductive behavior of spiders, that during the mating of many species the tip of the male palpal embolus, presumably carrying sperm, breaks off and remains in the female genital ducts. Though this had been noticed before in black widows, it appears to be widespread in theridiid spiders and orb weavers. The reason it has been overlooked is that the majority of males collected are virgin, in search of a female; the tip of the embolus is therefore still attached in most males preserved in collections. Because they die soon after mating, mated males are rarely collected. On the other hand, probably the majority of females collected have mated. In the genus *Argyope,* now being studied, and presumably in other argiopids, the tip of the male embolus can readily be "fished out" of the epigynum by jiggling the projecting parts with a needle. Among related species of the genus *Argyope,* these tips differ strikingly in structure, athough the female genitalia are quite similar. An illustration of a broken off tip was supplied by Petrunkevitch (1930) with the hope of finding a male to match it. These tips not only permit matching males with females, but facilitate identification of females that have similar epigyna. Of course, the assumption is made that the male chose a mate of his own species. But the same method, applied to species in which the female is as easily determined as the male, may provide some data on the frequency of mating between species in nature.

I would like to thank Dr. A. M. Chickering, Mr. Jon Reiskind and my wife for editing, and Miss Vida Kenk and Mr. F. Vuilleumier for translating the summary. The investigations were supported by Public Health Service Research Grant AI-01944.

Resumen

Preparaciones microscópicas permanentes de los palpos y epiginios de arañas son desvantajosas ya que, al deshidratar las partes esclerozadas se tuercen, se pueden destruir al secarse, y a menudo la preparación es separada del resto del espécimen guardado en alcohol y se pierde. Es mejor guardar los genitales en tubos pequeños (micro-

vials) (Fig. 1), con el espécimen. En especies comunes con numerosos ejemplares, las preparaciones pueden hacerse usando Hoyer o un medio de montaje similar para Acari (Baker and Wharton).

Para ilustrar un palpo, a veces es necesario separarlo de la araña a objeto de orientarlo mejor. En tal caso debería examinarse completamente sumergido en etanol de 75 a 95%. Al secarse las partes blandas se dañan. El palpo se fija en el fondo del recipiente con un pedazo de papel fibroso. El examen se hace con un microscopio binocular de disección entre 150 y 240 aumentos. Los palpos pequeños y transparentes pueden estudiarse transladándolos a glicerina o, si se desea examinarlos con el microscopio compuesto o de fase, a un montaje *temporal* en glicerina; pero el palpo debe siempre volverse a guardar en alcohol.

Para dilatar el palpo, se hierve por unos minutos en NaOH al 10%, entonces se transfiere a agua destilada, y luego se guarda en alcohol. Sin embargo, los escleritos se tuercen y se dañan cuando se hierven en NaOH. Por el momento yo uso ácido láctico en vez de NaOH.

No se debe quitar el epiginio de los ejemplares raros. En especímenes pequeños puede estudiarse sumergiendo todo el animal en aceite de clavo. Dos incisiones (Fig. 2) permiten doblar la región de los genitales hacia atrás (Fig. 3) y, entonces, puede estudiarse después de orientara cuidadosamente (Fig. 4). Más tarde la "puertecita" puede volver a cerrarse. En las arañas pequeñas, el cefalotórax puede separarse a veces con el epiginio todavía fijo al pedicelo (Fig. 5). Algunas veces, en ejemplares que no están bien preservados, los genitales se desprenden o es necesario separarlos para examinarlos en detalle. En tal caso, el epiginio se guarda en un tubo pequeño (Fig. 1).

Cuando se trata de preparaciones transitorias, el cefalotórax entero y el epiginio (Fig. 5) pueden montarse en aceite de clavo; o, una preparación temporal del epiginio, para su examen bajo un microscopio compuesto o de fase, puede hacerse con una gota de aceite de clavo cubierta con un cubre-objeto. Para el estudio detallado de especies comunes es necesario, algunas veces, sacrificar un ejemplar y separar con agujas los conductos genitales. Luego, los genitales vuelven a guardarse en alcohol. Solo epiginios con estructuras muy esclerozadas pueden hervirse en NaOH al 10%. Este método deforma las estructuras e hincha las partes blandas.

Los machos y las hembras de Araneidae son a menudo muy distintos en tamaño y apariencia. Abalos (1963), observó que en muchas especies el extremo del estilo del palpo del macho se desprende durante la cópula. El extremo del estilo palpal puede separarse del epiginio de la hembra para aparejar machos y hembras de la misma especie. Este método se aplica con buen éxito en el género *Argyope*, en el cual la mayor parte de los machos colectados están todavía vírgenes, pues los machos mueren poco despues de la cópula, y la mayor parte de las hembras están fecundadas. Por lo tanto, es muy importante ilustrar cuidadosamente éstos extremos de los estilos masculinos.

Resumé français

Les préparations microscopiques permanentes sur lame de palpes et épigynes d'araignées ne sont pas désirables. Les parties sclérifiées se déforment par déshydratation et peuvent être écrasées par assèchement et il arrive souvent que la lame soit séparée du reste du spécimen conservé en alcool et se perde. Il est préférable de garder palpes et épigynes dans de petits tubes (4 × 10 mm) avec le spécimen (Fig. 1). Pour les espèces communes dont on a de nombreux exemplaires on peut monter des lames en utilisant la solution de Hoyer ou bien des solutions semblables pour Acari (Baker et Wharton).

Il se peut qu'on doive séparer un palpe de l'araignée si l'on veut l'orienter correctement pour une illustration. Dans ce cas il faut l'examiner complètement immergé dans de l'éthanol 75 à 90%. Le dessèchement abîme les parties molles. On attache le palpe au fond de la cuvette au moyen d'un morceau de papier fibreux. On procède à l'examen avec une loupe binoculaire grossissant de 150 à 240 fois. Les palpes de petite taille et transparents peuvent être étudiés après être transvasés dans de la glycérine ou bien après montage *temporaire* sur lame, en glycérine, pour examen au microscope optique ou au microscope à contraste de phase. Le palpe doit cependant être remis en alcool pour conservation.

Pour étendre le palpe on le fait bouillir quelques minutes dans NaOH 10%, puis on le transpose dans de l'eau distillée, et enfin on le met dans l'alcool pour conservation. Cependant l'ébullition dans NaOH déforme et endommage les sclérites. J'emploie maintenant l'acide lactique à la place de NaOH.

L'épigyne ne doit pas être détaché des spécimens rares. Il peut être étudié sur les petits exemplaires en submergeant l'araignée entière dans de l'huile de girofle. Deux incisions (Fig. 2) permettent de courber en arrière la region génitale (Fig. 3), qu'on peut étudier aprés l'avoir soigneusement mise en place (Fig. 4). Par la suite on peut fermer la "porte" ainsi pratiquée. Chez les petites araignées on peut parfois détacher le céphalothorax avec l'épigyne encore fixé au pédicule (Fig. 5). Quelquefois l'épigyne de spécimens mal conservés se casse, ou doit être enlevé pour une étude ultérieure plus détaillée. On conserve ensuite l'épigyne dans un petit tube (Fig. 1).

Pour des préparations microscopiques temporaires sur lame on peut monter le céphalothorax et l'épigyne entiers dans l'huile de girofle. On peut aussi préparer une lame temporaire en recouvrant l'épigyne avec une goutte d'huile de girofle; une telle préparation protégée par une lamelle peut être alors examinée au microscope optique ou à contraste de phase. Pour les espèces communes dont on fait une étude détaillée il se peut que l'on doive sacrifier un spécimen afin d'écarter les conduits des génitalia au moyen d'aiguilles. On remet ensuite les génitalia en alcool pour conservation. On ne peut faire bouillir l'épigyne dans NaOH 10% que si les structures sont fortement sclérifiées. Cette méthode abîme les structures et fait gonfler les parties molles.

Abalos (1963) a observé que dans de nombreuses espèces l'extrémité de l'embolus du mâle se casse pendant l'accouplement. L'extrémité de l'embolus palpal peut être enlevé de l'épigyne femelle pour assortir mâles et femelles (Chez les Araneidae les males et les femelles sont souvent très differents de taille et d'aspect). Ceci se fait maintenant avec succès pour le genre *Argyope*, chez lequel la plupart des mâles récoltés son vierges, car les mâles meurent peu après l'accouplement, et la plupart des femelles sont accouplées. Par conséquent il est important d'illustrer ces extrémités de l'embolus mâle.

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SCOLYTOIDEA (COLEOPTERA) 5: NOTES ON NEOTROPICAL PLATYPODIDAE, MAINLY FROM CENTRAL AMERICA

By Hans Reichardt*

The present paper, fifth in a series of contributions towards the knowledge of Neotropical Platypodidae (see Reichardt, 1964b, for previous papers), deals mainly with the Platypodidae I was able to study in the Museum of Comparative Zoology, Cambridge, Mass. In this collection I recognized a new species from British Honduras, along with interesting new distributional records of some previously known species. The new data are summarized in a map (fig. 9), together with the records available in the literature. The result is a fairly good summary of the distribution of the genus *Tesserocerus* in Central America. It is discussed below, under that genus. *Platypus pini* Hopkins, previously known only from the type, is redescribed, figured, and assigned to another species group within the genus.

One specimen of *Tesserocranulus nevermanni* Schedl, interesting not only for the rareness of material of this genus but also for the locality, was kindly loaned for study by its collector, Dr. A. Prosen, Argentina, to whom I am greatly indebted. To Dr. O. L. Cartwright, United States National Museum, I am grateful for having made the type of *Platypus pini* available for study. Finally I am also indebted to Prof. P. J. Darlington, Jr., after whom I name the new species described below, for his assistance during my studies at Harvard University.

Genus *Platypus* Herbst, 1793.

"caudati" group.

Platypus pini Hopkins, 1905.

(figs. 1-2).

Platypus pini Hopkins, 1905, Proc. Ent. Soc. Wash., 7:71. Holotype, ♂, Chalco, Mexico, United States National Museum; examined.

Male: head with flat front, with big, areolate punctures; vertex with scattered normal punctures; covered with some long hairs. Antennae normal for the group. Prothorax with big, sparse punctures over its surface; median sulcus well marked in the posterior third; femoral grooves normally developed. Elytra punctate-striate, with all striae formed by a single row of punctures; base forming a sharp

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*Departamento de Zoologia, Secretaria da Agricultura, São Paulo, Brazil; presently at Harvard University. *Manuscript received by the editor January 22, 1965* carina, running from suture to fifth interstice; interstices normally convex; base of third slightly wider, with a few granules (3-4). Interstices alternate on the last third of elytra; first one ending at declivity, without formation of tooth or spine, but with some few granules; third with long spine at declivity; fifth and seventh with very much shorter spines, the fifth being the longest of the two; even interstices and ninth ending like the first, with a few granules at beginning of declivity. Lateral margin prolonged posteriorly to form the outer projection of the declivity; between this and the suture, another projection, triangular in shape. Abdomen normal.

Measurements: total length, 4.9 mm.; maximum (elytral) width, 1.54 mm.; elytral length, 3 mm.; pronotal length, 1.3 mm.; maximum pronotal width, 1.45 mm.

Examined material: 1 ♂, collected 7 miles north of San Cristobal Las Casas, Chiapas, Mexico (altitude: 2,100 m.; Km. 1,152 of Pan American Highway), 2. VIII. 1964, by J. Shetterly.

Hopkins did not assign his new species to any of the groups in which the genus was divided by Chapuis; Strohmeyer (1912, Coleopterorum Catalogus, Pars 44), lists *P. pini* as a member of the *"trispinati"* group, and to this group it has been referred since. The study of the type and the present specimen, however, showed that *P. pini* is a member of the *"caudati"* group. By the presence of two posterior projections on each elytron, this species is easily distinguished from all the other members of the group. Both localities where *P. pini* has been collected (Chalco, Mexico — misspelled Chaleo by Hopkins — and San Cristobal Las Casas, Chiapas) are situated at or above 2,100 m., suggesting that the species may be restricted to higher altitudes.

"costellati" group

Platypus pulchellus Chapuis, 1865.

Platypus pulchellus Chapuis, 1865, Monogr. Platyp. :230, fig. 134. Holotype ♂, San Juan Baptista (Villa Hermosa), Tabasco, Mexico; Blandford, 1896, Biol. Centr. Amer., Col., 4(6):112. Allotype ♀, El Zapote, Guatemala.

This species is widespread over Central America, and one record is known from Venezuela (Schedl, 1960b). It has already been recorded from several localities (summarized on fig. 9) in Mexico

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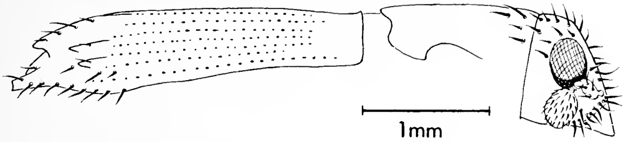
Explanation of Plate 11

Fig. 1, *Platypus pini* Hopk., lateral view; fig. 2, *P. pini* Hopk., dorsal view; fig. 3, *P. darlingtoni,* n. sp., lateral view; fig. 4, *P. darlingtoni,* n. sp., dorsal view; fig. 5, *T. nevermanni* Schedl, lateral view; fig. 6, *T. nevermanni* Schedl, dorsal view.



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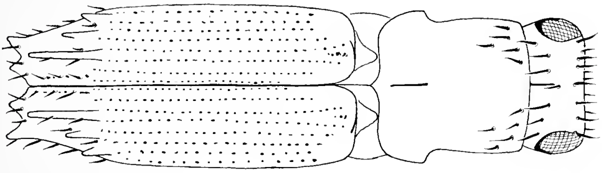

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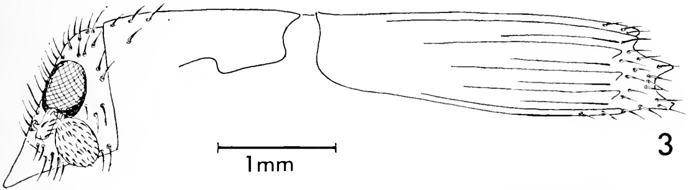

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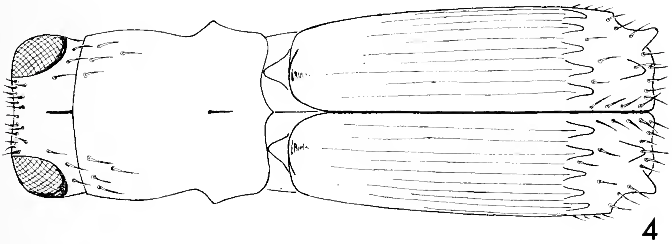

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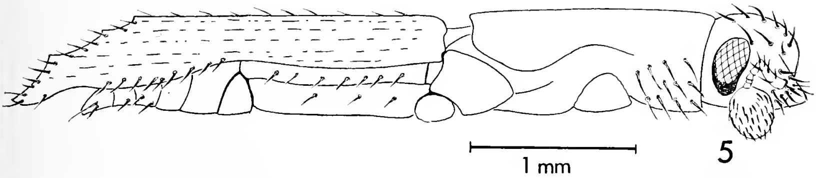

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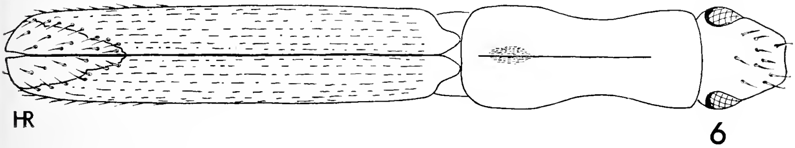

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Reichardt — Platypodidae

(Schedl, 1940; 1956; 1963), Guatemala (Allotype), Costa Rica (Schedl, 1933).

New records from the Museum of Comparative Zoology collection are: 1♂, Toledo District, British Honduras, 20. IX. 1906, Peck col.; 2♂, 1♀, Lancetilla, Tela, Honduras, Stadelmann col.

Platypus darlingtoni, n. sp.
(figs. 3-4).

Male: head with front slightly concave in the middle, densely rugose on all its surface; vertex as rugose as front; with few scattered hairs. Antennae of the typical form of the *"costellati"* group. Prothorax densely and finely punctured all over its surface; femoral grooves well developed; median sulcus well marked in the posterior third. Elytra: base raised to form sharp ridge, running from suture to fifth interstice; interstices carinate in the posterior third of elytra; sulci regularly and finely punctured from base to beginning of declivity; uneven interstices ending on the upper margin of the declivity in blunt spines, the first and third being the longest and best developed, subequal in length; the fifth, seventh and ninth less well developed, also subequal in length; the even interstices end on upper limit of the declivity, without formation of blunt spines; posterior margin of declivity with a well developed tooth on the latero-posterior angle; declivity rugose and setose, with an additional tooth between the third interstice and the posterior margin. Last abdominal sternite with two well developed teeth. Anterior tibiae with 5-7 transverse carinae.

Measurements: total length, 5.5 mm.; maximum width, 1.75 mm.; elytral length, 3.2 mm.; pronotal width, 1.4 mm.; pronotal length, 1.5 mm.

Holotype, 1♂, from Toledo District, British Honduras, 20. IX. 1906, Peck col., in the Museum of Comparative Zoology (M.C.Z. n. 31147).

Platypus darlingtoni, n. sp., is the second species of the *"costellati"* group to be recorded from Central America. It is readily distinguished from the other species, mentioned before, which occurs at the same locality, by its larger size (*P. pulchellus* Chapuis is barely 3 mm. long), and by its differently shaped and armed posterior declivity.

Genus *Tesserocerus* Saunders, 1836.

This genus has a typical Neotropical pattern of distribution, with its main dispersal center in South America. Of the 22 known species, only five occur in Central America (only two of them endemic). It appears that the limits of the genus in the Mexican Nearctic-Neotropical transition zone lie in the State of Vera Cruz on the Atlantic side, and in the State of Nayarit on the Pacific side. However, the records are not continuous on the Pacific side: none is yet known between the Tehuantepec Isthmus and Nayarit. Of the five Central American species, three are represented in the Museum of Comparative Zoology, as follows.

Tesserocerus belti Sharp, 1880.

Tesserocerus belti Sharp, 1880, Ent. Monthl. Mag., 17:112. Types, ♂ and ♀, Chontales, Nicaragua.

Besides the type-locality, this species is known from several localities in Costa Rica (Schedl, 1933; 1941) and Quito Ecuador (Schedl, 1941), as shown in fig. 9.

New records from the Museum of Comparative Zoology collection are: 1 ♂, 1♀, Esquinas, near Golfito, Dept. Puntarenas, Costa Rica, 1948, P. & D. Allen col.

Tesserocerus ericeus Blandford, 1896.

Tesserocerus ericeus Blandford, 1896, Biol. Centr. Amer., Col., 4(6):115-116. Types, ♂ and ♀, from several localities in Mexico, Guatemala and Panama

In describing the female of this species, Blandford points to the fact that it is almost indistinguishable from *T. linearis* Chapuis, a species described from a single female collected in Spain, and which Chapuis guessed had been imported from Brazil. In his revision of Chapuis' types of Platypodidae, Schedl (1960a) was unable to locate the type of *linearis*. Its real identity remains to be cleared. It may actually correspond to Blandford's species, since the locality given by Chapuis for *linearis*, Brazil, as said above, is based on pure guess.

T. ericeus is known only from Central America, from several localities in Mexico (Schedl, 1940), Guatemala (Blandford, 1896), Costa Rica (Schedl, 1933), and Panama (Blandford, 1896), as summarized in fig. 9.

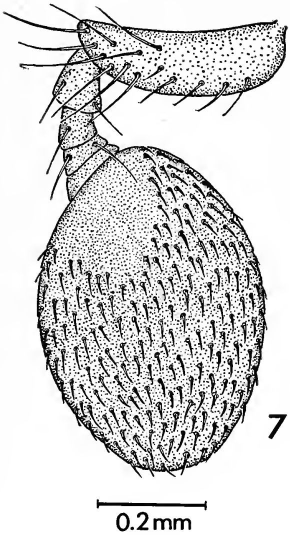
New records from the Museum of Comparative Zoology collection are: 1 ♂, Lancetilla, Tela, Honduras, Stadelmann col.; 1♀, Barro Colorado Island, Canal Zone, Panama, 1924.

Tesserocerus dewalquei Chapuis, 1865.

Tesserocerus dewalquei Chapuis, 1865, Monogr. Platyp. :300, fig. 184. Types, ♂ and ♀, Ega, Amazonas, Brazil.

Tesserocerus aubei Chapuis, 1865, l.c.:301, fig. 185. Types, ♂ and ♀, Santa Catarina, Brazil.

Tesserocerus dejeani Chapuis, 1865, l.c.:303, fig. 187. Types, ♂ and ♀, Colombia, Mexico.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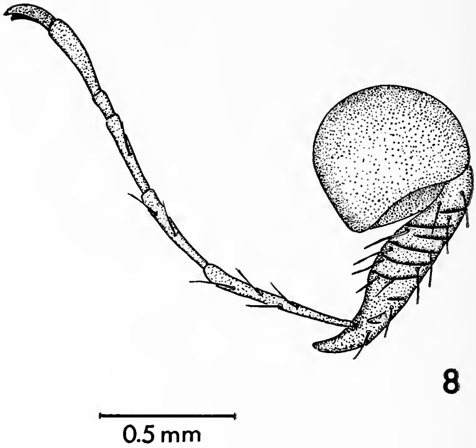
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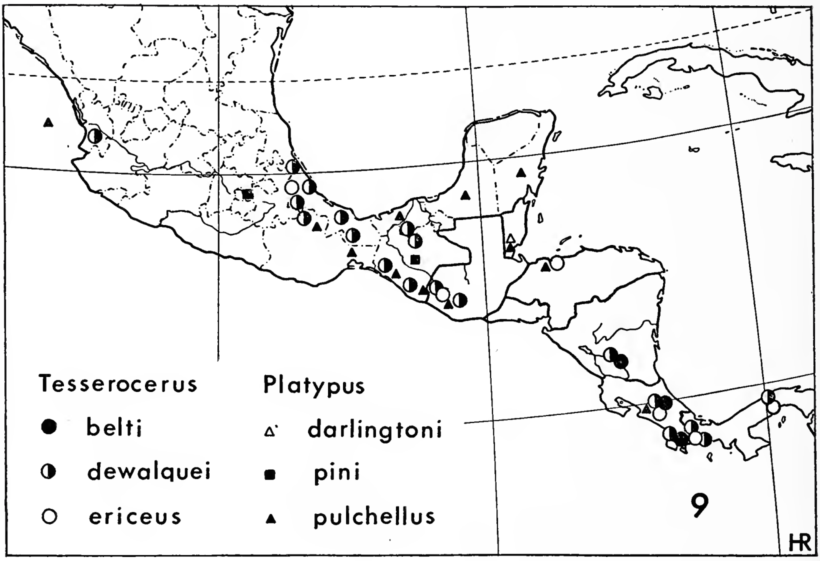
Tesserocerus
● belti
◑ dewalquei
○ ericeus
Platypus
△ darlingtoni
■ pini
▲ pulchellus
HR

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T. dewalquei is widely spread over South and Central America. Chapuis' *T. dejeani* has been recognized as a junior synonym of *dewalquei* by Schedl (1960a); the same author (1963), has subsequently used *dejeani* for Mexican specimens. Having seen specimens from South and Central America, I believe these species must be considered synonyms, as originally proposed by Schedl.

In Central America, *T. dewalquei* (recorded always as *dejeani*) is known from several localities in Mexico (Blandford, 1896; Schedl, 1933; 1940; 1952; 1960a; 1963), Guatemala and Nicaragua (Blandford, 1896), Costa Rica (Blandford, 1896; Schedl, 1933), and Panama (Blandford, 1896); as shown in fig. 9.

New records from the Museum of Comparative Zoology collection are: 2 ♂, Barro Colorado Island, Canal Zone, Panama, 24. VII. 1924, W. M. Wheeler & Nathan Banks col.; 1 ♂, Esquinas, near Golfito, Dept. Puntarenas, Costa Rica, 1948, P. & D. Allen col.

Genus *Tesserocranulus* Schedl, 1933.

Very little is known about this genus. Only very few specimens from wide apart localities have been studied; both sexes are known only in *T. nevermanni*, type of the genus. It seems, however, basically South American in distribution, with at least one of the three species (*T. nevermanni* Schedl) reaching into Central America. *T. flexibilis* Schedl, known only from females, was recently redescribed and illustrated (Reichardt, 1964a). Study of additional material, especially of males, may necessitate removal of this species from *Tesserocranulus*. The female, at least, has very peculiar antennal structure and head shape. *T. ornatus* Schedl, based on one female, from an unspecified locality in Brazil, is known only from the type.

Tesserocranulus nevermanni Schedl, 1933.
(figs. 5-8).

Tesserocranulus nevermanni Schedl, 1933, Rev. Ent., 3:164-165. Holotype ♂, Hamburgfarm, Costa Rica; 1935, Ent. Nachrbl., 9:151. Allotype ♀, Cayenne.

Examined material: 1 ♂, Espejo, Santa Cruz, Bolivia, II. 1962, A. F. Prosen col. (Prosen collection, n. 23440).

T. nevermanni, previously known only from the two original localities, is now recorded from Bolivia. This record extends the range of the species far to the south, and may indicate that *never-*

Explanation of Plate 12

Fig. 7, *T. nevermanni* Schedl, antenna; fig. 8, *T. nevermanni* Schedl, anterior leg; fig. 9, distribution of some species of *Tesserocerus* and *Platypus* in Central America.

manni is distributed throughout the Amazonian Basin and adjacent areas. The original description seems detailed enough to permit identification of the species. I have not therefore prepared a new description of the available specimen, which is illustrated. The antenna (fig. 7), which is strikingly different from that of *T. flexibilis* (see Reichardt, 1964a, fig. 5), shows an interesting small hairless patch on the club, around the funicle insertion point. This character has not yet been observed in any other genus of Platypodidae. It is also absent in *T. flexibilis*.

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PICROCRYPTOIDES: A NEW GENUS OF THE TRIBE MESOSTENINI FROM SOUTHERN SOUTH AMERICA (HYMENOPTERA, ICHNEUMONIDAE)*

By Charles C. Porter
Biological Laboratories, Harvard University

The ichneumonid genus *Trachysphyrus* Haliday and its close relatives within the huge tribe Mesostenini are found in almost every part of the world. With one exception, however, the greatest number of these species seems limited to the Holarctic region. This exception is temperate and subtropical South America.

The ancestors of the present-day South American *Trachysphyrus* fauna appear to have entered the southern continent from the north. In tropical countries, such as Ecuador and Perú, they radiated only at high altitudes in the Andes (approximately 8,000 to 14,000 feet) and, to a lesser extent, in the coastal desert and foothills on the west. None, so far as known, penetrated the tropical cloud-forest and rainforest at lower elevations to the east. In the temperate regions of central and southern Argentina and Chile, on the contrary, this generic group of north-temperate extraction found a more suitable area in which to expand and produced a very complex radiation of close to 100 species, probably more than occur in any area of similar size and, certainly, in greater variety than in any other region which the *Trachysphyrus* Group inhabits.

Among this Argentine and Chilean radiation are many species-groups which depart more or less radically from the customary definition of the genus *Trachysphyrus.* Some, although superficially bizarre in aspect, are not clearly to be distinguished from the main genus, to which they are often connected by species of intermediate character. Much of the group is still evolving rapidly and generic lines are not always clearly defined. Other series, however, present a combination of unusual features which so isolates them from their relatives that it would seem natural and convenient to place them in separate genera. One such group, the new genus *Picrocryptoides,* is diagnosed below together with a description of its two known species.

Picrocryptoides, new genus

Antenna: unusually short and stout: in ♀ subtly enlarged and slightly flattened below toward apex, first flagellomere about 3.2 to 3.8 times

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**Manuscript received by the editor April 19, 1965*

as long as wide apically, segments in apical half of flagellum only slightly or not distinctly longer than wide; in ♂ also unusually stout but considerably tapered toward apex, first flagellomere about 2.4 to 2.6 times as long as wide apically. *Ocellar-area:* very strongly swollen and prominently raised above level of rest of vertex. *Clypeus:* strongly assymmetric blunt-pyramidal in profile, the long basal face gently sloping, the short apical face abruptly declivous; apical margin almost truncate to weakly convex on median 2/3, more strongly convex toward sides; corners not reflexed. *Malar-space:* unusually long, in ♀ about 1.5 to 1.8 times as long as basal width of mandible, in ♂ about 1.2 to 1.5 times as long. *Fore tibia:* not at all inflated. *Pronotum:* epomia produced above into a broad, conspicuous lappet-like plate. *Mesoscutum:* notauli reaching about apical 2/3 to 3/4, strong and rather deep throughout or shallower and reduced to a line of large punctures for much of their length. *Wing-venation:* areolet very large and broad, intercubiti parallel, slightly convergent or a little differentially inclivous above; radial cell unusually short and broad, ending distally at a point distinctly less than half the distance from second intercubitus to tip of wing; nervulus interstitial to somewhat antefurcal; disco-cubitus only slightly angled near middle; ramellus rather long to completely absent; second recurrent a little reclivous on lower ¾, straightened out or a bit curved or angled above; mediella straight except near base; nervellus broken far below middle, upper part more than twice as long as lower; axillus, over most of its length, a little closer to sub-mediella than to hind-margin of wing. *Propodeum:* in ♀ rather elongate and gently curved in profile without strong discontinuity between dorsal and apical faces, a little bulging and sphereoid in shape; often with a weak rectangular area-basalis and fine but distinct basal and apical trans-carinae, the latter slightly broadened into low, elongate sublateral cristae, areolation frequently much weaker or entirely absent; in ♂ longer and lower in profile with the areolation only weakly suggested; spiracle long oval. *First gastric segment:* ♀: a stout, triangular expansion near base; ventro-lateral carina strong and sharp throughout; dorso-lateral carina distinct, sometimes weaker toward base; dorsal carinae

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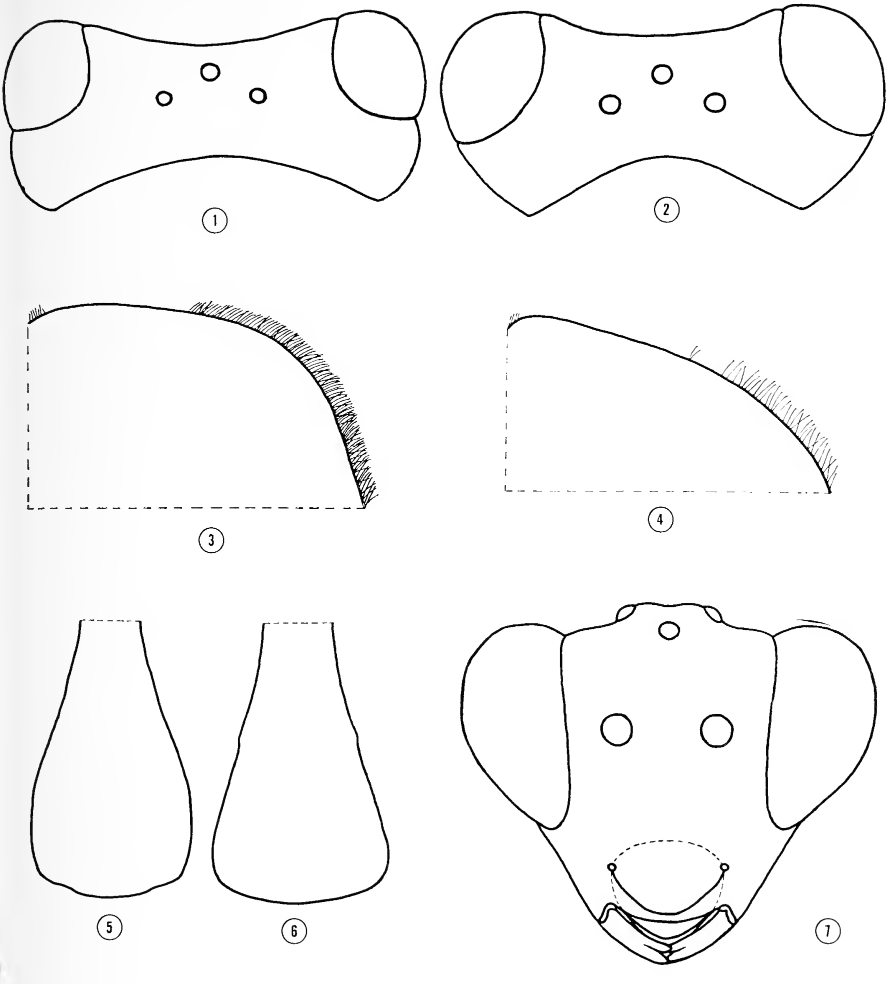
EXPLANATION OF PLATE 13

Figures 1, 4, and 6. *Picrocryptoides hesperios* n. sp. male. 1. Dorsal view of head. 4. Propodeal profile. 6. Dorsal outline of postpetiole and apex of petiole. Figures 2, 3, 5, 7, and 8. *Picrocryptoides willinki* n. sp. 2. Dorsal view of head in male. 3. Propodeal profile of male. 5. Dorsal outline of postpetiole and apex of petiole in male. 7. Anterior view of head of female. 8. Lateral view of apex of ovipositor. *Scale:* Figures 1 to 7, × 28; figure 8, × 52.

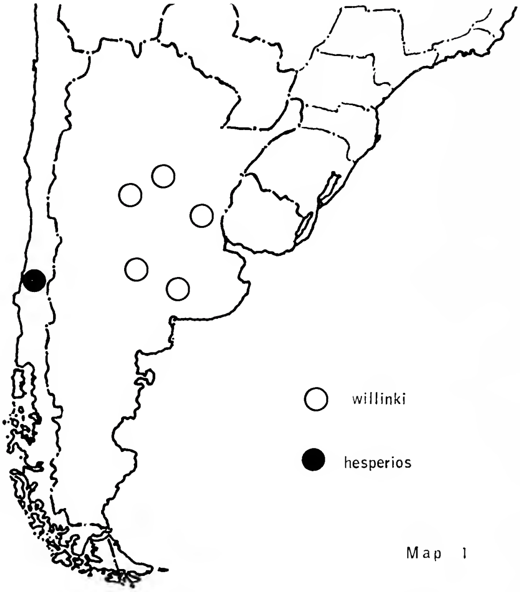


PORTER — PICROCRYPTOIDES

variable, usually traceable but not sharp toward apex of petiole and on base of postpetiole; postpetiole broadly expanded; ♂: basal expansion as in female or a little blunter; ventro-lateral carina becoming very weak on petiole; dorso-lateral carina not clearly defined; dorsal carinae absent; postpetiole moderately expanded. *Second gastric tergite:* ♀: mostly covered with dense, strong adjacent to subadjacent punctures emitting abundant short setae; lateral margin carinate and somewhat reflexed, especially toward base; ♂: smooth and shining with many well-separated medium-sized to large more or less superficial punctures emitting long and conspicuous but not extensively overlapping setae. *Ovipositor:* straight, stout, scarcely compressed; dorsal valve without nodus or notch, straight in profile to near apex, then gently decurved to tip; ventral valve considerably depressed, especially toward apex, its ridges strong and approximately vertical; sheathed portion about 0.28 to 0.30 times as long as fore wing.

TYPE SPECIES: *Picrocryptoides willinki* n. sp.

AFFINITIES: *Picrocryptoides,* because of its very large areolet, elongate propodeal spiracle, straight mediella, and the broad postpetiole of the female is a typical member of the *Trachysphyrus* Group of the tribe Mesostenini. Within this category it is distinguishable from



MAP 1. Distribution of *Picrocryptoides.*

all other genera most conspicuously by the following combination of characters: the strongly-raised, pyramidal, nose-like clypeus; the inflated ocellar area; the broad, lappet-like dorsal prolongation of the epomia; the unusually short radial cell and the strong basal expansion of the petiole. Other characteristic features, restricted however to the female, are the very long malar space, grossly punctate second gastric tergite, and the short, stout ovipositor without nodus or notch. Various other groups may have one or two of these characters but none approaches having the whole series. Indeed, *Picrocryptoides,* although obviously a derivative of *Trachysphyrus,* combines so many distinctive features that it occupies an isolated position within its generic group.

GENERIC NAME: *Picrocryptoides* is derived from the Greek adjective *pikros* or *sharp* and from *cryptoides* or *Cryptus*-like, in reference to the pointed clypeus and to *Cryptus,* a generic name which has commonly been used for many species of the *Trachysphyrus* Group.

SPECIES: Two species, both new, are available in the material before me. These are described below.

1. **Picrocryptoides willinki** n. sp.
Figures 2, 3, 5, 7, and 8; map 1.

TYPES: *Holotype:* ♀, Córdoba, Argentina, Davis. In Museum of Comparative Zoology, Cambridge, Massachusetts. MCZ. No. 31165. *Paratypes:* (4 ♂ ♂ and 9♀♀) from República Argentina (Córdoba: Cosquín, Sierra de Córdoba, March 1-9, 1920, Cornell University Expedition; Dto. San Martín, January 22, 1950, D. Lopez; Yac. Calamuchita, January 17, 1958, A. Willink; Argüello, November 14, 1955, A. Giorgetta; Capital, December 1955, A. Giorgetta; *San Luis:* San Martín, January 31 to February 3, 1958, Willink and Tomsic; *Santa Fe:* Rosario, Davis; *Buenos Aires:* Felipe Sala, January 1954, F. H. Walz; *La Pampa:* Macachia, January 1951, F. H. Walz); in Museum of Comparative Zoology, Cambridge, Massachusetts; Cornell University Collection, Ithaca, New York; Townes Collection, Ann Arbor, Michigan; Instituto Lillo, Tucumán, República Argentina.

FEMALE: Color: head, thorax, coxae, propodeum, and gaster dull metallic blue-green with scattered obscure purple reflections; antenna dark blackish-brown, becoming somewhat paler toward apex, especially below; apex of mandible brownish-piceous; trochanters shining-black, narrowly brownish apically; fore- and mid-legs bright, pale orange, tarsi brownish or blackish-stained; hind-femur bright pale orange, hind tibia and tarsus moderately dark brown to blackish; wings rather dark, with metallic reflections. *Length of fore-wing:* about 7.3 to 9.0 mm. *Temples:* smooth and shining with moderately large, shallow subadjacent punctures above, which become much sparser below; setae prominent, considerably longer than the interspaces of the punctures above; strongly, a little roundedly, receding behind eyes, about 0.40 to 0.50 times as long as eye in dorsal view. *Occipital carina:* rather broad and flange-like above, narrower on temples, especially toward junction with the narrowly flange-like hypostomal carina. *Mesopleuron:* speculum smooth and shining with a variable number of large, deep punctures; surface otherwise almost uniformly and rather finely and granularly reticulo-punctate, ridges separating punctures a little more broad-crested and shining above, sharper below. *Metapleuron:* uniformly a little more finely reticulo-punctate than mesopleuron. *Propodeum:* surface rather finely and granularly reticulo-punctate, often with a patch of much finer granulation medially just back of area-basalis, usually more shining basad of basal trans-carina, where punctures are more widely separated by polished intervals. *First gastric segment:* postpetiole with strong adjacent to subadjacent punctures laterally and subapically, a narrow apical band smooth and polished and the central area between the dorsal carinae smooth with some scattered large punctures and often with fine longitudinal wrinkling, especially behind.

MALE: *Color:* much as in female; metallic sheen less strongly greenish, more nearly shining black; antenna blackish, scarcely paler toward apex. *Length of fore-wing:* about 7.0 to 8.6 mm. *Antenna:* first flagellomere about 2.2 to 2.6 times as long as wide apically; tyloides linear, on flagellomeres 9 to 17, sometimes last three absent, none of tyloidiferous segments excavated at base. *Malar Space:* about 1.3 to 1.5 times as long as basal width of mandible. *Temples:* about 0.50 to 0.60 times as long as eye in dorsal view; strongly receding, a little rounded-off. *Meso- and metapleuron:* punctures a little more widely spaced than in female, polished interspaces distinct throughout. *Propodeum:* elongate; dorsal face rather high, gently sloping basally and then more strongly curved to meet the more or less clearly discrete but not sharply differentiated apical face; with strong, dense punctures like those of metapleuron, but about basal ¼ to ½ smooth and shining with only irregularly scattered punctures; laterally, toward apex of dorsal face, and on apical face with long, bushy, erect, dark setae. *First gastric segment:* postpetiole moderately and gradually expanded, sides, in dorsal view, gently and evenly curved or almost straight in outline from spiracle to apex, strongly convex above, smooth and shining with a few widely scattered small, shallow punctures emitting long, conspicuous setae, a few larger punctures grouped above spiracle.

REMARKS: There is considerable variation in the female with regard to development of the propodeal carinae and in the sculpture of the postpetiole. These characters are not themselves correlated nor are they related to other possible distinguishing features. There is thus no basis for recognizing more than one species in the material at hand.

SPECIFIC NAME: This species is named in honor of Dr. Abraham Willink of the Instituto Lillo of the Universidad Nacional de Tucumán, Tucumán, Argentina in thanks for his kind and expert help during my visit to Argentina in November and December of 1964 and in recognition of his valuable series of monographs on the neotropical Hymenoptera.

2. **Picrocryptoides hesperios** n. sp.

Figures 1, 4, and 6; map 1

TYPES: Holotype: ♂, Concepción, Chile, 3/12/1908, P. Herbst. In Museum of Comparative Zoology, Cambridge, Massachusetts. MCZ No. 31166. *Paratypes:* (2♂♂): Concepción, Chile, 1903 and 10/11/1908, P. Herbst. In Museum of Comparative Zoology.

MALE: *Color:* Head, thorax, coxae, propodeum, and gaster dull metallic blue-green, becoming almost black on head and dorsum of thorax; antenna dull blackish-brown; mandible tipped with brownish-piceous; trochanters shining blackish-piceous, narrowly brownish on apices; fore-femur brown, broadly marked with pale testaceous toward apex; hind-femur bright pale orange, a little stained with brown at base and apically above; tibiae and tarsi brownish-black, fore-tibia broadly testaceous below; wings rather dark, with metallic reflections. *Length of fore-wing:* about 7.4 to 7.6 mm. *Antenna:* first flagellomere about 2.4 times as long as wide apically; tyloides linear, on flagellomeres 9 to 17. *Malar Space:* about 1.2 to 1.3 times as long as basal width of mandible. *Temples:* rounded-off, scarcely receding, about 0.76 to 0.78 times as long as eye in dorsal view. *Propodeum:* lower and flatter in profile than in *P. willinki,* dorsal face more steeply sloping and more smoothly merging with apical face; mostly smooth and shining with some large adjacent or subadjacent punctures laterally and on apical ¼; with prominent long, erect setae, which are conspicuously sparser than in *P. willinki,* laterally and toward apex. *First gastric segment:* postpetiole moderately expanded, sides, in dorsal view, almost straight for more than half the distance from spiracle to apex, then rather abruptly rounded-off; a little less strongly convex above than in *P. willinki.*

REMARKS: This species is intimately related to *P. willinki* but differs especially in the scarcely receding temples and in the much more broadly polished and shining, more sparsely setose, lower and more strongly sloping propodeum. It is possible that future collecting will show that *P. hesperios* is a geographic race of the Argentine species, particularly since there is a wide overlap of the Argentine and Chilean insect faunas from about the latitude of Concepción southward. On the other hand, the distinguishing characters are of a type that generally has specific value in the *Trachysphyrus* Group so that the most reasonable course at present seems to be the recognition of two distinct species.

SPECIFIC NAME: Hesperios is a Greek adjective meaning *western.*

Resumen

El autor describe *Picrocryptoides,* un género nuevo argentino y chileno de la tribu Mesostenini de la familia Ichneumonidae (Hymenoptera). *Picrocryptoides* es muy parecido a *Trachysphyrus* Haliday (*Cryptus* auctorum) pero se diferencia de *Trachysphyrus* por tener el clípeo elevado en forma de una pirámide asimétrica, la área ocellar elevada y ensanchada, la epomia prolongada hacia arriba en forma de una placa ancha, por tener la celda radial de la ala anterior inusitadamente corta, y por la expansión triangular de la base del pecíolo. Se describen dos especies, ambas nuevas: *P. willinki* de Argentina y *P. hesperios* de Chile.

STUDIES ON NORTH AMERICAN CARBONIFEROUS INSECTS.

4. THE GENERA *METROPATOR, EUBLEPTUS, HAPALOPTERA* AND *HADENTOMUM**

By F. M. Carpenter
Harvard University

The four genera treated in this paper, belonging to three different orders, have only one feature in common: all have been very difficult to interpret and to classify. *Metropator,* originally placed in the Palaeodictyoptera by Handlirsch (1906a), has subsequently been regarded as protorthopterous by some investigators and as mecopterous by others; *Eubleptus,* also placed by its author in the Palaeodictyoptera, has been made the type of a new order, Eubleptidodea, by Laurentiaux (1953); *Hapaloptera* and *Hadentomum,* originally designated by Handlirsch 1906a) as types of two new orders (Hapalopteroidea and Hadentomoidea), have subsequently been either assigned to these orders or placed with uncertainty in the Protorthoptera. Unfortunately, all of these genera are known only by their type-species, which are still represented solely by the unique type-specimens. From my study of these fossils, I am convinced that the species are not nearly so peculiar as has formerly been thought and that to a large extent their puzzling nature is the result of Handlirsch's unsatisfactory figures and descriptions. I believe that *Metropator* was based on the hind wing of a species of the order Miomoptera, that *Eubleptus* is very close to the family Spilapteridae of the order Palaeodictyoptera, and that *Hapaloptera* and *Hadentomum* are near relatives of other genera in the order Prothorthoptera. In the following account I have first redescribed the fossils in the taxa to which I consider them to belong and then have given the reasons for my conclusions on their affinities.

I am deeply indebted to Dr. G. A. Cooper of the U. S. National Museum for placing these type-specimens at my disposal on the several occasions during the past ten years when I have found it necessary to examine them. They have been studied under optimum conditions, with various types of illumination and with the use of alcohol-glycerine and with ammonium chloride, which has proven to be of the greatest

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*This research is aided by Grant No. GB 2038 from the National Science Foundation. The previous part in this series was published in Psyche, 71: 117-124.

aid in working out venational details. I am also grateful to Dr. Jarmila Kukalová, of Charles University in Prague, who studied these fossils with me during her visit to Harvard University in 1964 and who prepared several of the drawings which are included in the present paper.

ORDER MIOMOPTERA MARTYNOV

This is an order of small insects, apparently related to the Protorthoptera. The fore wings were membranous and the hind wings, which lacked an expanded anal area, had the media arising from the cubitus and had CuA and CuP anastomosed for their entire lengths, forming a strong concave vein. The order is known from Upper Carboniferous and Permian strata.

Family Metropatoridae Handlirsch

Metropatoridae Handlirsch, 1906, Proc. U.S.N.M., **29**: 681
Metropatridae Martynova, 1962, Osnovy Paleont. :286[1]

Related to the Archaemiopteridae and Palaeomanteidae. Hind wing nearly oval; Sc short, weakly developed and close to R, as in Palaeomanteidae; Rs forking before mid-wing, forming 6 terminal branches; MA arising independently of CuA at the base of the wing and forked almost to the level of origin of Rs; CuA + CuP with short terminal fork. Fore wing and body unknown.

Genus *Metropator* Handlirsch

Handlirsch, 1906, Proc. U.S.N.M., **29**: 682

Hind wing: R4 + 5 more deeply forked than R2 + 3; R3 with a deep fork, R2 with a very shallow one; M1 + 2 forked distally, M3 + 4 forked twice. Type-species: *Metropator pusillus* Handlirsch

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[1] The generic name *Metropator* is obviously derived from the identical Greek word for "maternal grandfather". The genitive of this is *Metropatoros*, providing the root *Metropator-* and, therefore, the family name *Metropatoridae.*

In changing the name to Metropatridae, Dr. Martynova was apparently misled by the normal Greek word for father *(pater)*, which ordinarily has the stem *patr-; pater*, however, as used in the compound *metropator*, does not follow *pater* in declension, although it means the same thing and is merely a collateral form of that word. Since Handlirsch used the generic name *Metropator*, there is no question about the root or the spelling of the family name. I am indebted to Mr. Charles C. Porter for providing me with this etymological information.

Metropator pusillus Handlirsch

Figure 1

Handlirsch, 1906, Proc. U.S.N.M., **29**: 682, fig. 8; 1906, Foss. Ins. :112, pl. 12, fig. 12.
Tillyard, 1926, Amer. Journ. Sci., **11**: 161, fig. 19.
Martynova, 1962, Osnovy Paleont., Arthropoda: 286, fig. 892.

This species is based on a unique specimen (type no. 38731, U.S.N.M.), consisting of an isolated wing, 7 mm. long and 3 mm. wide. It was collected near the Altamont Colliery, anthracite region, Pennsylvania (Namurian age). The preservation is fair; most of the main veins are clear, but the basal part of the wing is missing. Since this is one of about a dozen insects known from the lower part of the Upper Carboniferous, the oldest strata in which unquestionable insects have been found, its structure and affinities are of unusual interest. Some diversity of opinion exists about both aspects of the fossil. Handlirsch, who originally placed *Metropator* in the Palaeodictyoptera, believed that the anterior margin of the wing was broken away, the front edge of the wing as preserved being the subcosta; he apparently reached that conclusion because he was unable to discern the subcosta as a submarginal vein. Tillyard in 1926, following his examination of the type specimen, concluded that the anterior margin of the wing was actually preserved and that Sc was discernible as a distinct vein between R1 and the wing margin. In his description he points out that the subcosta is very faintly indicated, and that he could follow it out only with care by examining the fossil in a good oblique light. He also described and figured the cubito-median "Y-vein", this being much more strongly developed than most of the other veins of the wing. His conclusions were that *Metropator* was a mecopteron, closely related to the Permopanorpidae. He did not discuss the detailed evidence for this, but simply asserted that the mecopterous affinities could readily be seen at once from the figures. His view of the position of *Metropator* has been generally accepted subsequently, and it is the one presented in the Osnovy Paleontologii (Martynova, 1962).

The drawing included in figure 1 represents my own interpretation of this fossil and shows only those structures which I confidently believe are present. From my studies I am convinced that Tillyard was correct in his conclusion that the costal margin of the wing is actually present in the fossil, but I am also convinced that he was incorrect in his interpretation of the subcostal and cubital areas. The subcosta is discernible near the base of the wing, as noted by Tillyard, but that is the entire length of the vein; it extends only a short distance beyond the origin of Rs. The ammonium chloride preparation brings this vein out clearly enough so that it is visible in photographs. On the other hand, the supposed branch of the media, which Tillyard showed as one arm of the cubital-median "Y-vein" and which was an important factor in his conclusions on the affinities of the fossil, cannot be seen — at least not by any techniques used by me. The cubital vein itself (labelled Cu1 in Tillyard's drawing) is, as mentioned by Tillyard, a distinct one, which stands out more strongly than any of the others excepting R1. It is, however, clearly *concave* in the fossil. This is important, since the supposedly homologous vein (CuA) in the mecopterous wings is strongly *convex.* I am convinced, therefore, that the venation of *Metropator* only superficially resembles that of the Mecoptera and that it does not have the essential features of the mecopterous venation.

I believe the type-specimen of *M. pusillus* can much more readily be interpreted as a hind wing of a miomopteron. In these wings the subcosta is very short (see figure 2), Rs arises close to the base of the wing, and CuA and CuP are completely coalesced, forming a strong *concave* vein. These are the outstanding features of *pusillus.* Unfortunately, since the base of the wing is missing in the type of *pusillus,* the precise relationship between Cu and M cannot be determined; however, there is no reason to assume that M does not join Cu near the basal part of the wing. The venation of *pusillus* shows more extensive branching than in the miomopteron illustrated in figure 2 [*Palaeomantis minuta* (Sellards)] but in other genera of Miomoptera (e.g., *Stefanomioptera* Guthörl and *Permonika* Kukalová) the radial sector has more branches than in *Palaeomantis.* It seems to me, therefore, that the available evidence, such as it is, indicates that *Metropator* is more likely a miomopteron than a mecopteron. The occurrence of several genera of Miomoptera in the Carboniferous deposits of Europe supports this probability. The Mecoptera, on the other hand, are otherwise unknown from beds earlier than the Permian and since these are endopterygote (holometabolous) insects, evidence for their presence in the lowest strata of the Upper Carboniferous should be really convincing before such a conclusion is reached. At present I believe the evidence points to a very different conclusion.

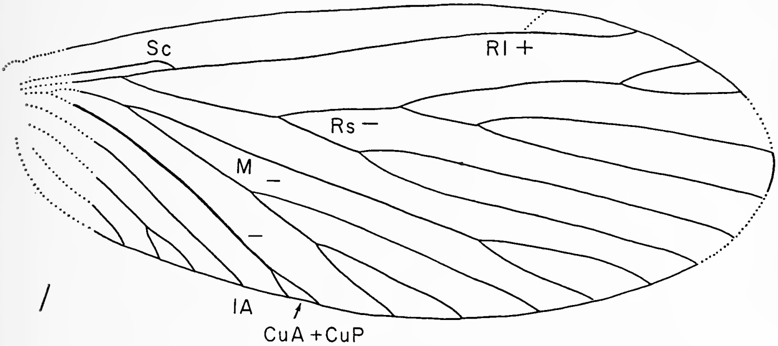
ORDER PALAEODICTYOPTERA GOLDENBERG

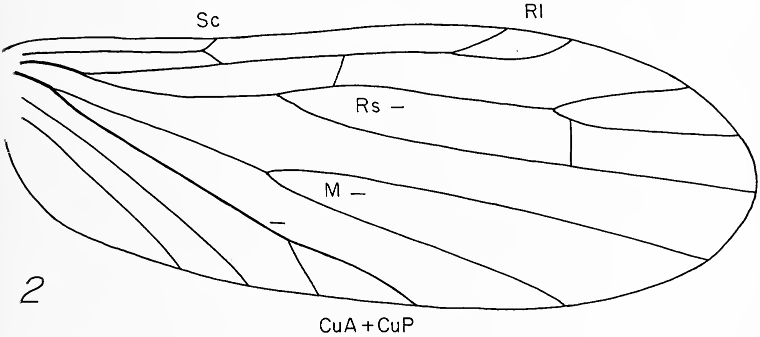
Family Eubleptidae Handlirsch

Handlirsch, 1906, Proc. U.S.N.M., 29: 679 (Order Palaeodictyoptera).
Laurentiaux, 1953, *In* Piveteau, Traité de Paléontologie. 3: 423 (Order Eubleptidodea).

Fore wing: subcosta extending at least nearly to the wing apex; Rs with 4 terminal branches; MA forked, MP with at least 3 terminal branches; CuA with a short terminal fork; CuP more extensively developed, with a deep fork shortly after its origin; several anal veins; cross veins distributed generally over the wing, not arranged in rows; anterior margin of the fore wing nearly straight, at most very slightly concave. Hind wing: little-known; slightly broader than fore wing. Body structure: prothoracic lobes present; abdomen slender.

This family seems closely related to the Spilapteridae, from which it differs in having a less developed Rs and CuA. Lack of knowledge





Figures 1 and 2. Miomoptera. Figure 1. *Metropator pusillus* Handlirsch. Drawing of holotype, no. 38731, U.S.N.M.; hind wing (original). Figure 2. *Palaeomantis minuta* (Sellards), hind wing (original). Lower Permian, Kansas. Lettering: Sc, subcosta; R1, radius; Rs, radial sector; M, media; CuA, anterior cubitus; CuP, posterior cubitus, 1A, first anal vein; +, convex veins; —, concave veins.

of the hind wings prevents more definite determination of the affinities, but all available evidence indicates that this is a group which fits readily within the Palaeodictyoptera; eventually the family may turn out to be inseparable from the Spilaptaridae.

Genus *Eubleptus* Handlirsch

Handlirsch, 1906, Proc. U.S.N.M., 29: 680

Fore wing: Rs arising slightly beyond mid-wing; M forked before the origin of Rs, and Cu forked even nearer the wing base; Rs forked and each of its branches forked; 1A simple, 2A forked. Type-species: *Eubleptus danielsi* Handlirsch.

Eubleptus danielsi Handlirsch

Figure 3

Handlirsch, 1906, Proc. U.S.N.M., 29: 680

Length of fore wing, as preserved 13 mm.; estimated total length 17 or 18 mm.; width of fore wing, 4 mm.; maximum width of hind wing (as preserved), 4.8 mm. Type no. 35576, U.S.N.M., collected near Morris, vicinity of Mazon Creek, Illinois (Westphalian age).

This species was originally based by Handlirsch on a single specimen consisting of obverse and reverse; the obverse specimen, according to Handlirsch's description, was contained in the Daniel's collection and the reverse in the U. S. National Museum. The counterpart in the National Museum has been studied in connection with the present account and is depicted in figure 3; the specimen in the Daniel's collection has not been found.

Handlirsch's figure, which has been reproduced many times in subsequent publications and which has been the basis for all discussions of the relationships of this fossil, was probably based to some extent on the counterpart in the Daniel's collection; at any rate the position of the body in Handlirsch's figure is the reverse of that in the counterpart in the National Museum. The Daniel's specimen presumably showed parts of the cerci, which are entirely missing in the National Museum fossil; also the Daniel's specimen probably showed a little more of the apical regions of the fore wings than the reverse half. The venation in the National Museum fossil is distinctly preserved and can be brought out even more clearly by the use of ammonium chloride. As shown in figure 3, it is only slightly different from that given in Handlirsch's figure; there are some differences in the positions of branches of the veins, but in general the patterns are very similar. Handlirsch apparently did not observe the basal connection between CuA and CuP, although this is clearly distinguishable in the National Museum specimen. His figure of the abdomen is about as I have observed it, although this seems somewhat broader in the fossil than his drawing shows. As noted above, the National Museum specimen does not include the end of the abdomen and therefore lacks the cerci. Handlirsch's representation of the meso- and metothoracic segments is in agreement with mine; of course, considerable distortion undoubtedly occurred in the fossil and only the general form is indicated. The major difference between Handlirsch's figure and mine is in the structures which are anterior to the mesothoracic segment. Handlirsch was of the opinion that two large globular eyes could be distinguished, these being separated from the mesothorax by a structure which he interpreted as the prothorax. His figure in this area is slightly out of proportion; the structures which he shows as eyes are actually much closer to the mesothorax than indicated in his drawing. Furthermore the structures themselves do not have the regular, globular appearance which he depicts and they do not give any indication of being compound eyes. On the other hand, there are clearly visible radiating lines similar to those which occur on the paranotal lobes of many Palaeodictyoptera. The location of these structures and their details have convinced me that they are in fact small paranotal lobes. Between them and the mesothorax is a short segmented appendage, almost certainly a part of one of the legs; this is shown also in Handlirsch's figure.

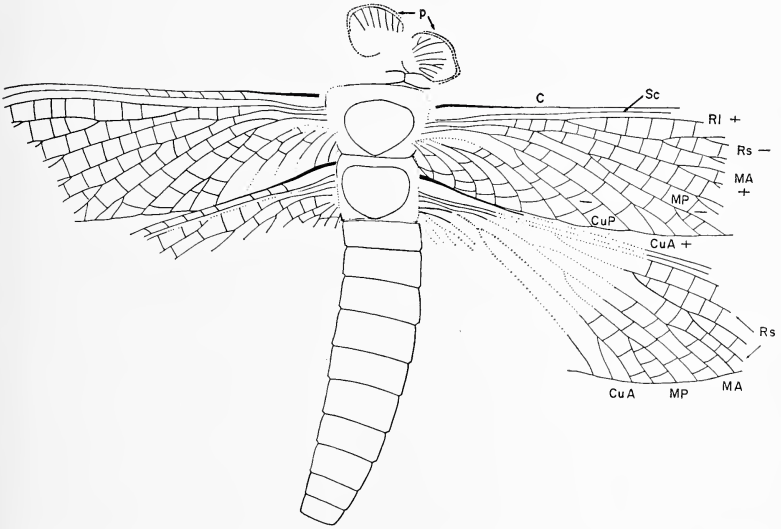


Figure 3. *Eubleptus danielsi* Handlirsch. Drawing of holotype, no. 35576, U.S.N.M. (original). p, paranotal lobes; other lettering as in figure 1.

The venation of the wings is actually typical of that of many Palaeodictyoptera, especially that of some of the Spilapteridae. The convexities and concavities of the veins, which are well preserved, have been marked in figure 3 in the usual manner. Perhaps the most distinct feature of the venation is the reduction of CuA to a single vein having a marginal fork; in the Spilapteridae this vein tends to be somewhat more extensively developed. There is a slight difference between the right and left wings so far as CuP is concerned; in one, CuP2 is forked but in the other it is unbranched. The anal veins are slightly recurved, having the arched form occurring in many Palaeodictyoptera. The venation of the hind wing is very little-known but it appears to show no marked differences from the pattern in the fore wing; however, the wing itself is obviously somewhat broader than the fore wing.

Although the specimen of *Eubleptus* in the National Museum does not, presumably, show as much of the apical region of the wings as the counterpart in the Daniel's collection, I think there is no question that Handlirsch's figure is incorrect in showing the wings as very broadly and bluntly rounded. In that figure the left fore wing is completely restored, the apex being represented by dotted lines; but the drawing of the right wing shows an irregularity of the apex, which suggests that this is not the actual margin of the wing itself. In all probability, the apical region of the wing was shaped like that of spilapterids.

Handlirsch originally described *Eubleptus* in the Eubleptidae, as a palaeodictyopteron. However, his figure and description emphasized several peculiar features which actually do not exist in the fossil (such as the supposedly large eyes and the bluntly rounded wings). As a result of this, various workers on fossil insects who have not examined the type specimen have come to regard *Eubleptus* as a more peculiar and aberrant insect than it actually is. Martynov, in 1938, although placing the family Eubleptidae in the Palaeodictyoptera, stated that it could well belong to a distinct order; and in 1953 Laurentiaux established the order Eubleptidodea for it. He failed to indicate any characteristics by which he separated the order from the Palaeodictyoptera, although he referred to the eyes and the absence of lobes on the prothorax. In the Osnovy Paleontologii, Rohdendorf placed the Eubleptidae in a separate order, which he termed the Eubleptodea, presumably accepting Laurentiaux's ordinal status for the group although no reference is made to Laurentiaux's publication or to the change of spelling of the name.

However, in view of the structure of *Eubleptus danielsi,* as it now seems to be, there is no justification for the isolation or separation of

Eubleptus into a distinct order or even into a distinct suborder. It is, in fact, difficult to find significant differences in the venational patterns of the Spilapteridae and the Eubleptidae; ultimately these two families may turn out to be synonomous. However, I have not indicated such synonomy at this time since the name Eubleptidae would have priority, and to synonomize Spilapteridae with Eubleptidae seems inadvisable until the evidence for this is conclusive.

ORDER PROTORTHOPTERA HANDLIRSCH

Family Hapalopteridae Handlirsch

Handlirsch, 1906, Die fossilen Insekten: 304 (Order Hapalopteroidea).

Fore wing: similar to that of the Cacurgidae but having fewer branches on the main veins and having CuP forking much further from the wing base; CuP1 not branched except for forking at wing margin; cuticular swellings apparently absent. Hind wing unknown.

Genus *Hapaloptera* Handlirsch

Handlirsch, 1906, Proc. U.S.N.M., 29: 694

Fore wing: Sc extending nearly to wing apex; costal veinlets unbranched; Rs with four branches, MP forked to about mid-wing; CuA with a terminal fork only; cross veins numerous, weakly formed. Type-species: *Hapaloptera gracilis* Handlirsch.

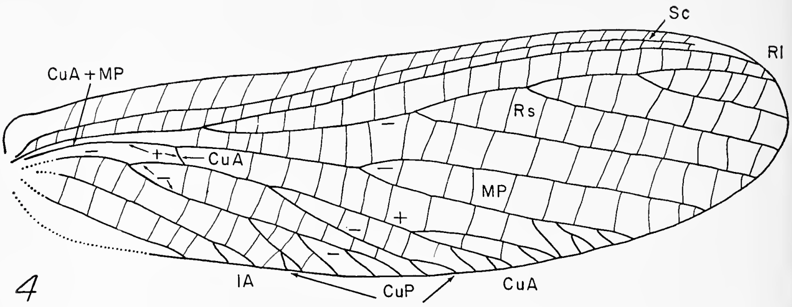
Hapaloptera gracilis Handlirsch

Figure 4

Handlirsch, 1906, Proc. U.S.N.M., 29: 694

Fore wing: length 14 mm., width 4.5 mm.; membranous and delicate; costal margin slightly concave, apex broadly rounded; R2 forked, R3, R4+5, MP1 and MP2 unbranched; cross veins tending to be irregular, but not branched or forming a network. The holotype specimen, no. 38731, U.S.N.M., was collected at Sharp Mountain Gap, near Tremont, Pennsylvania (Stephanian age). The details of the venation are shown in figure 4.

This fossil consists of a fore wing, very nearly complete, with portions of a second wing. The venation is not distinct but use of ammonium chloride brings out most details clearly. Handlirsch had difficulty interpreting the venation, mainly because he failed to note that actually two wings are superimposed; his figure shows some veins which are in reality on the second wing. The distal part of the costal margin of the second wing can be clearly seen near the end of Sc of the complete wing, and part of its hind margin appears in the region of the end of MP. Handlirsch correctly recognized that



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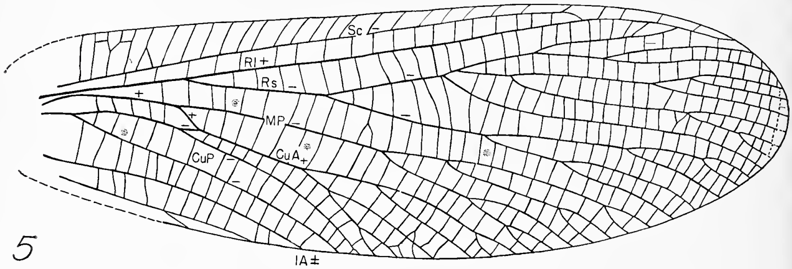

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Figures 4 and 5. Protorthoptera. Figure 4. *Hapaloptera gracilis* Handlirsch. Drawing of holotype, no. 38731, U.S.N.M. (original) Figure 5. *Heterologus langfordorum* Carpenter. Drawing of holotype, Illinois State Museum (original). Upper Carboniferous, Illinois.

something was amiss with the venation for he represents one vein by a dotted line, which crosses over the basal part of another vein. With the use of ammonium chloride the actual venation of the upper wing becomes distinct and the pattern turns out to be very close to that of *Heterologus,* from the Upper Carboniferous of the Francis Creek Shales (Mazon Creek), Illinois (See figure 5). In *Hapaloptera gracilis,* as in *Heterologus,* the stem of CuA (which is strongly convex) is anastomosed with MP, but diverges away at about the level of the origin of Rs and then anastomoses with the concave CuP, only to separate again a short distance further. The main feature which distinguishes *Hapaloptera* from *Heterologus* and other Cacurgidae is the late forking of CuP and the absence of a long basal branch on CuP1. My first thought on examining the fossil was that the wing membrane was extensively wrinkled but further study indicated that the wrinkles are in most cases actual cross veins between the veins. Although only a few cross veins are shown in Handlirsch's figure, they are almost uniformly distributed over the wing.

Handlirsch placed the family Hapalopteridae in a separate order, Hapalopteroidea, although only one species, *H. gracilis,* was known at the time. His decision to establish this "provisional" order was undoubtedly the result of his misinterpretation of the venation of the unique specimen on which *gracilis* was based. In 1922 he placed another family, Emphylopteridae Handlirsch, in the order; this group was based on another monospecific genus, *Emphyloptera* Pruvost, from the Upper Carboniferous of Europe. The assignment of this genus to the Hapalopteridae obviously resulted once again from Handlirsch's misinterpretation of the venation of the type of *Hapaloptera.* Quite clearly, *Emphyloptera* shows no affinities with *Hapaloptera,* as now understood, and it is here assigned to family Incertae Sedis, order Protorthoptera, until the fossil on which it is based can be studied further. The genus *Ampeliptera* Pruvost (1927) from the Upper Carboniferous of Holland was placed in the Hapalopteroidea by Pruvost but removed to another extinct order, Protocicadida, by Haupt in 1941. The fossil on which *Ampeliptera* was based was studied by Kukalová (1958), who found that it was an unquestionable protorthopteron of the family Paoliidae.

As to the genus *Hapaloptera* itself, there is nothing known about it which eliminates it from the Protorthoptera. In fact, as noted above, it is very close to the Cacurgidae. Bolton (1934) described two species in the genus *Hapaloptera* from the Upper Carboniferous of South Wales. Neither of these fossils, however, has affinities with *Hapaloptera,* as can readily be seen from an examination of his figures; both of the species are known only from fragments of wings which, far from belonging to the same genus, represent at least separate families and may represent even separate orders. The order Hapalopteroidea is accordingly now placed in synonymy with the order Protorthoptera.

Family Protoperlidae Brongniart

Brongniart, 1893, Recherches l'histoire insectes fossiles: 407 [*nom. correct.* Lameere, 1917, p. 197 (*pro* Protoperlida Brongniart, 1892)]
= Palaeocixiidae Handlirsch, 1919, Denkschr. Acad. Wiss. Wein, 92: 29
= Fayoliellidae Handlirsch, 1919, ibid: 48
= Hadentomidae Handlirsch, 1906, Die fossilen Insekten: 303 (Order Hadentomoidea)

Fore wing: costal area with numerous, simple veinlets; Sc extending well beyond mid-wing; R1 unbranched; Rs arising at least slightly before mid-wing, unbranched; M forked; MP usually weaker than MA; CuA extensively branched; CuP straight or nearly so, unbranched; cross veins well developed; no reticulation but rarely two rows of cells in a few areas. Hind wings (known only in *Protoperla*): Rs arising nearer the wing base than in the front wing; CuA fused with the very base of M; anal area expanded to form a distinct lobe.

From a study of the type material of *Protoperla, Palaeocixius, Fayoliella* and *Hadentomum,* I am convinced that these genera belong to one family, for which the oldest name is Protoperlidae. This family is now known from Upper Carboniferous deposits in Europe and North America.

Genus *Hadentomum* Handlirsch

Handlirsch, 1906, Proc. U.S.N.M., 29: 693

Fore wing: similar to that of *Palaeocixius* but having a coarse reticulation between R1 and Rs. Hind wing: incompletely known, but probably with a small, distinct anal lobe, as in *Protoperla.* Type-species: *Hadentomum americanum* Handlirsch.

Hadentomum americanum Handlirsch

Figure 6

Handlirsch, 1906, Proc. U.S.N.M., 29: 693, fig. 19-21.

Length of fore wing, 23 mm.; width of fore wing, 7.3 mm. Length of hind wing, 23 mm. Type, no. 35579, U.S.N.M., collected near Morris, Illinois (Westphalian age).

This species was based on a unique specimen consisting of the obverse, in the Daniel's collection, and the reverse in the U.S. National Museum. Since the location of the Daniel's collection is unknown, I have been able to study only the specimen in the National Museum. The preservation of this fossil is not very satisfactory; the two wings on one side, as shown in Handlirsch's figure, overlap in such a way as to interfere with the determination of the venational pattern. However, by tracing on photographs the veins of one wing with ink of a certain color and the veins which are apparently not related to that wing with ink of another color, I have found it possible to work out the venational patterns of the two wings saisfactorily. My interpretation of the wings is shown in figure 6. In most respects, the figure of the fore wing agrees with that of Handlirsch. However, the base of M, which Handlirsch shows fused with R, is distinctly free and independent; also, the fork of Cu is clearly preserved in the fossil, although it is not represented in Handlirsch's figure. The origin of R4+5 is not visible in the National Museum specimen; possibly it was preserved in the Daniel's specimen. The convexities and concavities of the veins are clearly preserved and are marked in figure 6. It will be noted that Rs is concave, the media is neutral (±), CuA

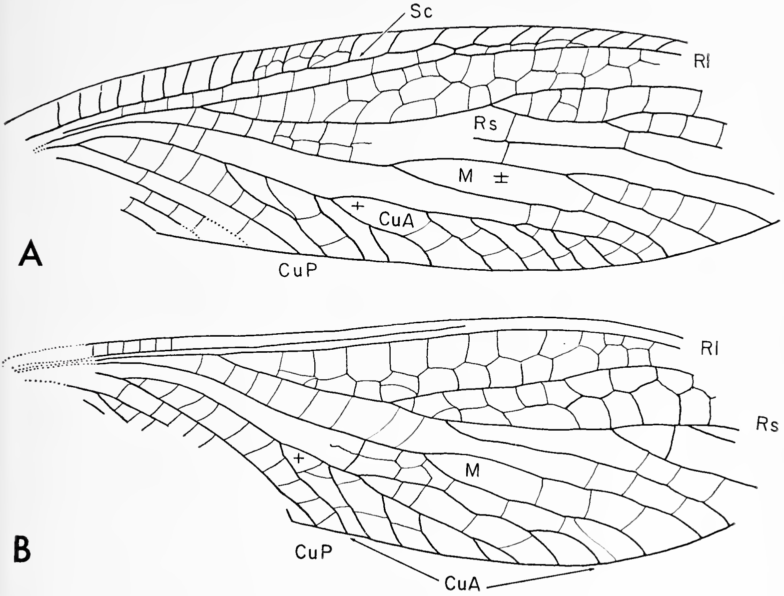

Figure 6. *Hadentomum americanum* Handlirsch. Drawing of fore wing (A) and hind wing (B). Holotype, no. 35579, U.S.N.M. (original).

strongly convex and CuP concave. Since there is no indication of a distinctly convex MA or concave MP, I have designated the media here simply as "M". It is possible that the vein that has been designated R4 + 5 is actually MA, which may be fused basally with the radial sector; however, there is no indication of the free basal part of such a vein.

The anterior margin of the hind wing, which is not shown in Handlirsch's figure, can be made out without difficulty in the fossil by the use of ammonium chloride. The most significant difference between Handlirsch's interpretation of the hind wing and mine is in the nature of the hind margin of the wing. Handlirsch shows the hind margin continuing to the base with the uniform curvature of the apical region of the wing — that is without an anal lobe. This is particularly important, since the absence of an anal lobe would virtually eliminate the species from the Protorthoptera. However, the National Museum specimen does not show the hind margin basally of the termination of Cu1; it is clearly broken away at this point. There is no reason, therefore, to assume that the anal lobe was absent, and in view of the affinities of the fossil as indicated by the fore wing, there is every reason to assume that the anal lobe was present.

The body is only faintly indicated in the specimen of *americanum*. Handlirsch's figure depicts the abdomen and the thorax as they seem to me to be in the fossil, except that the prothorax is slightly shorter and somewhat broader than he has drawn it. I see no indications of the head as it was drawn by him; there are some irregularities in the rock which may possibly represent part of the head but no definite form can be made out and there are no suggestions of the eyes, so far as I can observe, in the National Museum specimen.

Handlirsch established the order Hadentomoidea (1906, p. 692) for this genus. He gave no definite diagnosis of the order, his account of the group being essentially a description of the individual specimen of *americanum*. However, it is clear from his discussion that he placed much emphasis on the apparent similarity of the fore and hind wings and on his conviction that the hind wing lacked an anal lobe. His conclusion was that the Hadentomoidea were probably closely related to the Embioptera, although showing some affinities with the Perlaria. I believe that his conclusions based on the apparent absence of the anal area are not valid. The reconstruction of *Hadentomum americanum*, which Handlirsch included in his account of fossil insects in Schröder's *Handbuch der Entomologie* (fig. 73, p. 143), is highly imaginary, since it shows the legs, antennae and mouth parts, none of which are even suggested in the fossil. The general effect of this figure, of course, is to increase the bizarre appearance of the insect, as conceived by Handlirsch. As a matter of fact, the fore wings of *Palaeocixius* and of *Hadentomum* show striking similarities, which I believe can only be explained by close relationship of these genera, at least to the family level. (See figures 6 and 7) The media seems somewhat more reduced in *Hadentomum* than in *Palaeocixius*, but the vein which is labelled R4 + 5 in the accompanying figure of *Hadentomum* may actually be the anterior branch of the media (i.e., corresponding to the vein labelled MA in *Palaeocixius*). In the orthopteroids and the Perlaria there is much individual variation in the amount of fusion between branches of M and parts of the radial sector. Unfortunately, we do not know the hind wing of *Palaeocixius* or that of any of the other genera which I am now placing in the family Protoperlidae, with the exception of the type-species of *Protoperla* itself. The latter genus is based upon a single species known from the hind wing, which shows a definite anal lobe, although the lobe is not as large as in most of the Protorthoptera. The venation of the *Protoperla* hind wing is difficult to interpret on the basis of the single specimen known. The media is

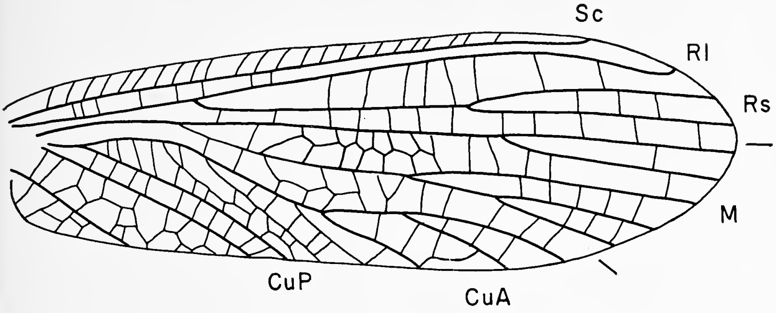

Figure 7. *Palaeocixius antiquues* Handlirsch. Drawing of holotype, in Laboratoire de Paleontologie, Paris, (original). Upper Carboniferous of Commentry, France.

apparently coalesced at least in part with the radius or the radial sector, giving the impression that the radial sector occupies a very large area of the wing surface.

At the present time I believe that all the evidence at hand indicates that *Hadentomum* is a member of the family Protoperlidae, as here conceived. In any event, there is no evidence at hand to justify the retention of the order Hadentomoidea, which is here placed in synonomy with the Protorthoptera.

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The illustration on the front cover of this issue of Psyche is a reproduction of an unpublished drawing by W. M. Wheeler of *Cephalotes atratus* (Linnaeus). [Courtesy of Miss A. E. Wheeler].

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PSYCHE

A JOURNAL OF ENTOMOLOGY

Vol. 72 September, 1965 No. 3

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PSYCHE is published quarterly by the Cambridge Entomological Club, the issues appearing in March, June, September and December. Subscription price, per year, payable in advance: $4.50 to Club members, $5.00 to all other subscribers. Single copies, $1.25.

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The June, 1965 Psyche (Vol. 72, no. 2) was mailed September 25, 1965.

THE LEXINGTON PRESS. INC., LEXINGTON, MASSACHUSETTS

PSYCHE

Vol. 72 September, 1965 No. 3

A REDEFINITION OF *ISCHYROPALPUS,* AND SIX NEW SPECIES (COLEOPTERA: ANTHICIDAE)[1]

By Floyd G. Werner
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The principal features that have been used to distinguish *Lappus* Casey from *Ischyropalpus* LaFerté are the generally smaller size, less densely sculptured forebody and lack of sharp margins on head and pronotum of the former. It has been evident for some time that the division is somewhat arbitrary. Some species are readily assignable to each genus; others don't fit in either very well. One is faced with the choice of establishing a series of poorly defined genera to accommodate the known species or of placing all of them in one. I believe that the second alternative is the better one.

Genus *Ischyropalpus* LaFerté

Anthicus (Ischyropalpus) LaFerté 1848, 106, 141, 314 (Type-species: *Anthicus sericans* Erichson 1834, designated by LaFerté on p. 106). Pic 1911, 30. Blackwelder 1945, 433.

Ischyropalpus: Casey 1895, 656. Bonadona 1961, 150 (designates *Anthicus perplexus* LaFerté 1848 as type-species; designation invalid because of the original designation of *sericans* by LaFerté 1848.)

Lappus Casey 1895, 656 (Type-species *Anthicus nitidulus* LeConte 1851 — NEW DESIGNATION — NEW SYNONYMY.

Anthicus (Lappus): Pic 1911, 30. Leng 1920, 163. Blackwelder 1945, 433.

As here redefined, *Ischyropalpus* is a very isolated genus in the family, with a number of features that are distinctive. The first of these is the form of the mesosternum, as shown in Fig. 1. This structure is slightly expanded, but not as greatly as in *Acanthinus, Baulius, Euvacusus, Formicilla* and *Vacusus* in the New World fauna and some other groups in the Old World. The form of the hind angles is unique. The sides extend obliquely laterally and posteriorly to the level of the edges of the ventral portion of the mesepisterna, meeting the hind margin abruptly and at an acute angle well lateral to the middle coxae. The mesepisterna and mesepi-

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[1] This study was supported by National Science Foundation Grant GB-427. Agricultural Experiment Sta., Dept. Entomology, Journ. Art. #1068.

mera are not visible behind the hind margins of the mesosternum. The sides of the mesosternum are flattened and meet the adjacent flattened portion of the mesepisterna at a slight angle, only a fine groove separating them. There is no fringe of setae along this groove.

Another feature that appears to be unique in the family is the presence of a zone of tiny spines on the bases of the tibial spurs, encircling the spurs. These are present in all of the species of *Ischyropalpus* examined in slide preparations. All other Anthicidae examined have the spurs without spines or have the spines arranged in two longitudinal rows on the surface nearest the tarsus.

Some other external features are apparently quite stable, although not limited to the genus. The tactile setae are short and inconspicuous and the elytral punctures are not arranged in rows. The genus *Anthicus,* s. str., is similar in both these features, although some species have both tactile and normal setae long.

The ♂ aedeagus is distinctive. The tegmen has the parameres separate and sometimes very complex; these are asymmetrical in some species. The apodeme (basal piece) is unusually broad, especially near the attachment of the parameres. The penis is relatively simple, but has an unusually long apodeme, which may extend beyond the end of the apodeme of the tegmen in repose. The penis probably slides freely in the tegmen, because it is sometimes found far extended in dissected specimens. The internal sac is extremely complex and completely unlike this structure in any other genus examined. The entire apical area has transverse ridges or thickenings and there is a pair of plates about half-way along the sac. These have not been seen in any other genus. The plates are absent in the known males of the Eryngii-Group described below, but present in all other members of the genus examined.

The Eryngii-Group also is different in the external feature most easily seen in the rest of the members of the genus. This is the shape of the last segment of the maxillary palpi, which is in the form of a roughly isosceles triangle with the apex at the point of attachment. Many species have this segment extremely broad. But a few, notably *I. sericeus* Bonadona, have the sides of the triangle unequal and the apex rather narrow. The members of the Eryngii-Group have the segment narrowly securiform.

The typical species, not including the Eryngii-Group, have a rather distinctive facies. The prothorax is quite deeply constricted laterally in the basal third, with the sides rounded from there to the collar. The disc is not grooved at the level of the constriction. The large species that made up most of the genus *Ischyropalpus* as previously defined have the head and pronotum deeply sculptured, with the disc somewhat flattened and the base of the head and sides of the pronotum anterior to the constriction ending in a sharp margin that is lenticular in profile.

Uniting *Lappus* with *Ischyropalpus* necessitates a rather large number of recombinations. To this number are added some new generic assignments and synonymy that have resulted from an examination of the types. Bonadona has recently treated most of the species assignable to *Ischyropalpus* as previously defined (1961), and has made the changes necessary for these species. The new combinations, new synonymies, and the previous generic assignments of the species involved are given below, followed by a list of the species known to me, incorporating these changes.

The following are NEW COMBINATIONS: 1. Species described in *Anthicus: amplithorax* (Pic), *anticefasciatus* (Pic), *asphaltinus* (Champion) (= *Anthicus distinctus* Pic, *Lappus thicaniformis* Werner, both NEW SYNONYMY), *aterrimus* (Champion), *baeri* (Pic), *dilatipes* (Champion), *externenotatus* (Pic), *impressus* (LaFerté), *laticeps* (LaFerté), *nigrofemoratus* (Fairmaire and Germain), *parallelus* (Fairmaire and Germain), *subtilissimus* (Pic) (substitute name for *Lappus subtilis* Casey, a junior secondary homonym in *Anthicus*). 2. Species described in *Anthicus* but transferred to *Lappus* by Casey, 1895: *bactrianus* (Champion) (listed by Casey as *backianus,* a typographical error), *nitidulus* (LeConte) (= *Lappus alacer* Casey, *asperulus* Casey, *canonicus* Casey, *cursor* Casey, *nubilatus* Casey, *vigilans* Casey, all NEW SYNONYMY), *obscurus* (LaFerté), *occidentalis* (Champion), *punctipennis* (Champion), *sturmi* (LaFerté) (substitute name for *elegans* LaFerté, a junior primary homonym in *Anthicus*), *tumidicollis* (Champion). 3. Species described in *Anthicus* but transferred to *Anthicus (Lappus)* by Krekich, 1914: *nitidus* (Boheman) (= *Anthicus atomarius* Boheman). 4. Species described in *Anthicus (Ischyropalpus): batesi* (Pic), *hemicyclius* (Heberdey). 5. Species described in *Anthicus (Lappus): dormei* (Pic), *goyasensis* (Pic), *postobscurus* (Pic), *proprius* (Pic), *sipolisi* (Pic), *vagemaculatus* (Heberdey). 6. Species described in *Lappus: lividus* (Casey) (= *Lappus bipartitus* Casey, *ornatellus* Casey, *solivagans* Casey, *vividus* Casey, all NEW SYNONYMY), *pinalicus* (Casey), *turgidicollis* (Casey) (= *Lappus animatus* Casey, NEW SYNONYMY).

Anthicus trigonocephalus LaFerté 1848, described in the subgenus *Ischyropalpus,* is not included here. This species was described from India on the basis of a specimen lacking maxillary palpi. LaFerté placed it in a group separate from the South American species on the basis of head shape. I have not seen a specimen of this species but have never seen a member of the genus from the Old World. Pic (1911) and Bonadona (1961) did not include it as a member of *Ischyropalpus* and there is no reason to believe that it should be retained in this genus.

Anthicus gibbithorax Pic, transferred to *Lappus* by Casey (1895) from the description, does not belong to this genus. It was described as from Texas but I have had an opportunity to examine the type. It is undobutedly an erroneously labelled Old World species, and is not assignable to *Ischyropalpus*.

LIST OF SPECIES — GROUP NAMES

[Names believed valid are in bold-face type]

adstrictus Krekich 1914 — Peru.
alacer (Casey) — see *nitidulus.*
albifasciatus (Pic) 1897 — probably South America.
  var. **argentinus** (Pic) 1904 — Argentina.
alvarengai, new species — Brazil.
amplicollis (Boheman) — see *sericans.*
amplithorax (Pic) 1895 — Brazil.
animatus (Casey) — see *turgidicollis.*
anticefasciatus (Pic) 1910 — Argentina.
argentinus (Pic) — see *albifasciatus.*
asperulus (Casey) — see *nitidulus.*
asphaltinus (Champion) 1890 — Mexico, Guatemala.
  distinctus (Pic) 1897 — Mexico.
  thicaniformis (Werner) 1956 — Mexico.
aterrimus (Champion) 1890 — Guatemala.
atomarius (Boheman) — see *nitidus.*
attenuatus Krekich 1913 — Argentina.
backianus (Casey) — see *bactrianus.*
bactrianus (Champion) 1890 — Mexico, Guatemala.
  backianus (Casey) 1895 — typographical error.
baeri (Pic) 1902 — Peru.
batesi (Pic) 1914 — Colombia.
bipartitus (Casey) — see *lividus.*
boliviensis (Pic) 1909 — Bolivia.
bruchi (Pic) — see *caesiosignatus.*
caesiosignatus (Boheman) 1858 — probably Ecuador.
  bruchi (Pic) 1904 — Argentina.
  var. **mendozanus** (Pic) 1914 — Argentina.

canonicus (Casey) — see *nitidulus.*
catamarcanus (Pic) — see *testaceoguttatus.*
cursor (Casey) — see *nitidulus.*
curtisi (Solier) 1851 — Chile.
  ssp. **wittmeri** Bonadona 1961 — Chile.
decoratus, new species — Brazil.
dentipes Bonadona 1961 — Argentina.
dilatipes (Champion) 1890 — Mexico.
distinctus (Pic) — see *asphaltinus.*
dormei (Pic) 1933 — Brazil.
elegans (LaFerté) — see *sturmi.*
eryngii, new species — Uruguay.
esteroensis (Pic) — see *testaceoguttatus.*
externenotatus (Pic) 1913 — Argentina.
freyi, new species — Venezuela.
goyasensis (Pic) 1904 — Brazil.
hemicyclius (Heberdey) 1937 — Costa Rica.
impressus (LaFerté) 1848 — Colombia.
interamnis (LaFerté) 1848 — Brazil.
jatahyensis (Pic) 1899 — Brazil.
jenseni Krekich 1913 — Argentina.
latereductus (Pic) 1913 — Chile.
laticeps (LaFerté) 1848 — Venezuela.
lividus (Casey) 1895 — U. S. A.
  bipartitus (Casey) 1895 — U. S. A.
  ornatellus (Casey) 1895 — U. S. A.
  solivagans (Casey) 1895 — U. S. A.
  vividus (Casey) 1895 — U. S. A.
maculosus (Fairmaire and Germain) 1860 — Chile.
mapirianus (Pic) 1909 — Bolivia.
  var. **semirufescens** (Pic) 1909 — Bolivia.
  var. **testaceitarsis** (Pic) 1913 — Mexico.
mendozanus (Pic) — see *caesiosignatus.*
nigrofemoratus (Fairmaire and Germain) 1860 — Chile.
nitidulus (LeConte) 1851 — U. S. A.
  alacer (Casey) 1895 — U. S. A.
  asperulus (Casey) 1895 — U. S. A.
  canonicus (Casey) 1895 — U. S. A.
  cursor (Casey) 1895 — U. S. A.
  nubilatus (Casey) 1895 — U. S. A.
  vigilans (Casey) 1895 — U. S. A.
nitidus (Boheman) 1858 — probably Ecuador.

atomarius (Boheman) 1858 — probably Ecuador.
nubilatus (Casey) — see *nitidulus.*
obscurus (LaFerté) 1848 — U. S. A.
occidentalis (Champion) 1890 — Mexico.
ornatellus (Casey) — see *lividus.*
parallelus (Solier) 1851 — Chile.
patagonicus (Pic) 1902 — Argentina.
perplexus (LaFerté) 1848 — Colombia.
pinalicus (Casey) 1895 — U. S. A.
planicollis (Fairmaire and Germain) — see *sericans.*
postobscurus (Pic) 1904 — Brazil.
proprius (Pic) 1904 — Peru.
punctipennis (Champion) 1890 — Mexico to Venezuela.
puteifer, new species — Argentina.
quadriplagiatus (LaFerté) 1848 — Colombia.
semirufescens (Pic) — see *mapirianus.*
sericans (Erichson) 1834 — South America.
  amplicollis (Boheman) 1858 — probably Ecuador.
  planicollis (Fairmaire and Germain) 1860 — Chile.
  var. **trireductus** (Pic) 1928 — Argentina.
sericeus Bonadona 1961 — Argentina.
sipolisi (Pic) 1933 — Brazil.
solivagans (Casey) — see *lividus.*
sturmi (LaFerté) 1848 — U. S. A. (substitute name).
  elegans (LaFerté) 1848 — U. S. A.
subtilis (Casey) — see *subtilissimus.*
subtilissimus (Pic) 1896 — U. S. A. (substitute name).
  subtilis (Casey) 1895 — U. S. A.
tenax (Pic) 1904 — Brazil.
  var. **tenuiculus** (Pic) 1904 — Brazil.
tenuiculus (Pic) — see *tenax.*
testaceitarsis (Pic) — see *mapirianus.*
testaceoguttatus (Fairmaire and Germain) 1863 — Chile.
  catamarcanus (Pic) 1926 — Argentina.
  var. **esteroensis** (Pic) 1928 — Argentina.
thicaniformis (Werner) — see *asphaltinus.*
tibialis, new species — Venezuela.
titschacki (Pic) 1944 — Peru.
trireductus (Pic) — see *sericans.*
tumidicollis (Champion) 1890 — Panama.
turgidicollis (Casey) 1895 — U. S. A.
  animatus (Casey) 1895 — U. S. A.

vagemaculatus (Heberdey) 1938 — Brazil.
venezuelensis (Pic) 1900 — Venezuela.
vigilans (Casey) see *nitidulus.*
vividus (Casey) — see *lividus.*
wittmeri Bonadona — see *curtisi.*

DESCRIPTION OF NEW SPECIES

Ischyropalpus tibialis, new species

(Fig. 2)

2.48 - 3.02 mm, dark piceous, elytra slightly paler, legs and antennae brown. Head and pronotum sparsely and finely punctured, not sharply margined. Pubescence in weak postbasal transverse impression of elytra not oblique or transverse. Hind tibiae of ♂ with a tuft of long setae medially near apex.

Holotype ♂: Length 2.82 mm. Head 0.49 mm long to the distinct frontoclypeal suture, 0.58 wide across eyes, 0.49 just behind, the base short and evenly rounded behind eyes, a line connecting the hind margins of the eyes 0.17 mm from middle. Surface smooth and shiny, the punctures small and 0.03 to 0.04 mm from center to center, the intervals not curving down to them. Disc evenly curved, not very convex, the clypeus on almost the same curve. Pubescence sparse and inconspicuous, decumbent, almost appressed, 0.06 mm long, slightly curved; tactile setae erect, straight, fine, 0.08 mm. Last segment of maxillary palpi 0.20 mm long on outer side, 0.15 on inner, 0.17 across apex, the apical angles well-defined. Eyes large and moderately prominent, 0.26 × 0.19 mm, separated by 0.41, finely faceted, with curved setae ca. 0.01 mm long at intervals in posterior half. Antennae with segment 1 slightly swollen in middle and feebly pedunculate, segments 2-10 widest near apex and becoming more triangular, 11 truncate at base, widest near middle, the sides then curving to a blunt point. Measurements in 0.01 mm: 17/8, 10/5, 13/5, 12/5, 12/6, 12/6, 12/6, 12/7, 12/8, 10/8, 18/8.

Pronotum 0.64 mm long, 0.38 wide at base, 0.31 at the well-defined constriction 0.23 mm from base, 0.54 maximum at 0.44 mm from base, 0.23 at the short but well-defined collar. Basal impressed line distinct. Sides almost evenly rounded from constriction to collar and disc evenly convex from basal impressed line to collar. Surface as on head, the punctures slightly deeper and sparser. Elytra 1.69 mm long, 0.74 wide at the well-marked humeri, 0.90 maximum just before middle, subparallel. Omoplates feebly elevated; postbasal transverse impression feeble, with punctures no denser or deeper than on rest of surface, with setae that are directed backward. Suture elevated in apical half. Surface shiny and smooth, with some very sparse and fine punctulation and small punctures ca. 0.05 mm from center to center, the intervals not curved down to punctures. Pubescence decumbent, almost appressed, sparse, 0.10 mm long, inconspicuous; tactile setae suberect to erect, 0.08 mm.

Sternum 7 flattened, with an inconspicuous median rounded zone of more erect, curved setae, all of which are directed backward. Sternum 8 flattened, its apical margin very shallowly concave. Tergum 8 with sides gradually convergent to apex, which is more abruptly convergent with a short median point; 0.33 mm wide at base of exposed portion. Femora gradually thickened to about apical fourth. Front femur 0.54 × 0.18 mm, front tibia 0.42 × 0.07, hind femur 0.64 × 0.20. All trochanters with a small tuft of setae at outer apical portion. Front and middle tarsi slightly expanded, with a denser pad than in ♀. Hind tibiae flattened and slightly bowed on surface facing tibia, with a conspicuous tuft of setae in apical fourth of median side, the individual setae suberect for 0.08 mm, then quite sharply curved toward apex, then almost straight for ca. 0.05 mm.

The combination of sparsely and finely punctured head, pronotum and postbasal transverse impression of elytra, lack of oblique setae in the impression, and presence of a tuft of long setae near the apex of the hind tibiae in the ♂, appears to be unique in the genus. Some of the males have the tuft of setae on the hind tibiae shorter and barely curved. Females have the legs unmodified.

Distribution: Known from northern Venezuela and the island of Trinidad. Holotype ♂: Maracay, Est. Aragua, VENEZUELA, 29 May 1942, en *Astromelia* (U. Venezuela — Maracay). Paratypes: 44 ♂, 46 ♀, same data (U. Ven. — Maracay and Werner). 4 ♂, 9♀, Maracay, 27 Jan. 1943, R. Araque, en flores *Persea gratissima* (U. Ven. — Maracay and Werner). 2 ♂, 3♀, El Valle, [Est. Aragua], Venezuela, 24 Sept. 1938, on *Mimosa arenosa* Poir.; 3 ♀, 29 Mar. 1938, on *Cordia cylindrostachya;* 2 ♀, 14 Aug. 1939, on *Amaranthus dubius;* all C. H. Ballou (U. S. N. M.). 1 ♂, La Victoria, Est. Aragua, 26 Aug. 1960, C. Bordón (Bordón). 1 ♂, San Antonio de los Altos, Est. Miranda, Venezuela, 30 Aug. 1959; 1 ♂, 1300 m, 6 Sept. 1959; both C. Bordón (Bordón). 1 ♀, Los Angelinos (Los Teques), Venezuela, 27 Mar. 1959, C. Bordón (Bordón). 3 ♂, 5 ♀, Umg. Caracas, Venezuela, Jan. 1954, G. u. H. Frey (Mus. G. Frey, Tutzing, Germany). 3 ♀, Sta. Lucia, Venezuela, May 1922, L. R. Reynolds (F. Psota Coll., C. N. H. M.).

1 ♀, San Esteban, nr. Puerto Cabello, Venezuela, 1-6 Dec. 1939, P. J. Anduze (C. N. H. M.). 1 ♂, Simla, N. TRINIDAD, W. I., 1-9 May 1963; 2♀, 24-30 Apr. 1963; all M. Emsley, light trap (Werner).

The Eryngii — Group

A small number of South American species forms a group that is quite aberrant in the genus. The form of the last segment of the maxillary palpi and of the prothorax are entirely different from those of the typical members. The last segment of the maxillary palpi is narrowly securiform rather than triangular. The prothorax is not at all constricted laterally before the basal impressed line, being more like that of *Anthicus, s. str.,* but unusually enlarged in the ♂ of at least one species.

The members of the group are assigned to *Ischyropalpus* on the basis of the form of the mesosternum, the presence of a zone of small spines around the basal portion of the tibial spurs (seen only in *puteifer*), and on the form of the tegmen and general features of the internal sac of the ♂ aedeagus in *eryngii* and *puteifer,* the only species known from males. The paired plates of the middle of the sac are absent. And the apodeme of the penis is extremely long.

The group is therefore very disinct within the genus. Whether it is specialized or primitive is difficult to say. But it appears to be much more closely related to normal species of *Ischyropalpus* than to any other group, and is most conveniently treated as part of this genus.

Key to Species of Eryngii — Group

1. Pubescence in basal half of elytra cinereous, darker, almost brown, in apical half (as seen in side view with light from front). Dark brown to black with bases of femora and antennae slightly paler, occasionally paler with the region of the post-basal transverse impression of the elytra rufescent. Setae distinctly oblique between and behind the omoplates of the elytra. Uruguay .... *eryngii*

   Elytral pubescence of uniform color, not distinctly oblique in omoplate region .... 2.

2. Elytra dull luteous, brown across base, in a postmedian crescent and in a narrow strip connecting base and crescent, near and parallel to suture. Elytral pubescence fine and moderately dense. Punctures of pronotum slightly confluent longitudinally. Est. Minas Gerais, Brazil .... *decoratus*

   Elytra pale to dark but without dark markings .... 3.

3\. Piceous, the tibiae, tarsi, antennae except apex, labrum and mouth parts pale. Tempora of head extremely reduced, the base almost evenly and gently rounded behind the large eyes. Venezuela .... *freyi*

Elytra brown to luteous. Tempora distinct .... 4.

4\. Head black, prothorax and most of underside brown; elytra, labrum, mouth parts, antennae and legs rufescent. Punctures of forebody sparser but those on head separated by less than half their diameters. 3.26 mm. Pará, Brazil .... *alvarengai*

Brown to rufescent, the head not darker. Punctures of forebody denser, those on head very narrowly separated but not confluent. Prothorax unusually large, especially in ♂, which has a pit on the surface of the front and hind femora facing the tibia. 3.53 - 4.24 mm. N. Argentina and Mato Grosso, Brazil .... *puteifer*

Ischyropalpus eryngii, new species

(Fig. 3)

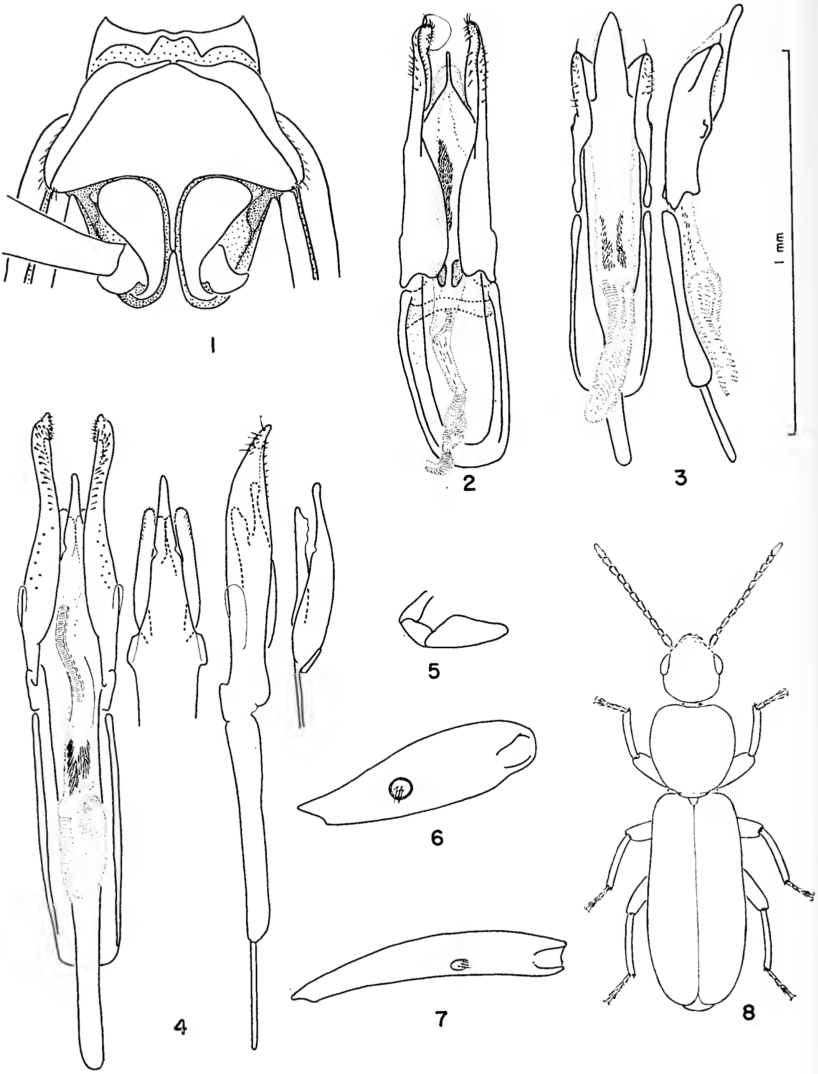
2.76 - 3.28 mm, piceous above, the elytra slightly brownish, the appendages obscurely paler. Elytral pubescence moderately sparse, appressed, that from base to posterior border of weak postbasal transverse impression cinereous, the rest brown. The pale pubescence is much more noticeable, but is no denser than the rest. Sides and base of pronotum also with some cinereous pubescence, that on disc brown. Two large females from Arro. Espinillo are paler, with the elytra pale laterally in the postbasal transverse impression. These have the sculpture and pubescence similar to the more typical specimens, but one of them has the elytral pubescence uniform.

Holotype ♂: Length 2.91 mm. Head subtruncate at base, 0.47 mm long, 0.59 wide across eyes, 0.45 behind, the tempora short, the temporal angles distinct, and the base gently and evenly curved between them. A line connecting the backs of the eyes is 0.15 mm from the middle of the base. Disc slightly flattened, densely covered with sharply defined flat-bottomed punctures, even on frons, the punctures ca. 0.03 mm from center to center, the intervals narrow, less than half the diameter of the punctures, shiny; the punctures not at all confluent. Setae appressed, ca. 0.04 mm long, brown on disc, pale across base; tactile setae erect, straight, ca. 0.04 mm. Frontoclypeal suture barely indicated, the frons on same curve as front and with the same sculpture. Last segment of maxillary palpi narrowly securiform, 0.18 × 0.09 mm. Eyes large, 0.27 × 0.23 mm, prominent, moderately coarsely faceted, with slightly curved setae ca. 0.01 mm long at intervals; separated by 0.38 mm on front and covering most of sides. Antennae brown, with segment 11 obscurely paler, segments 2-10 widest near apex. Measurements in 0.01 mm: 14/7, 9/6, 12/6, 11/7, 12/7, 12/8, 10/8, 10/8, 10/8, 10/10, 17/10. Segment 1 somewhat barrel-shaped, pedunculate, 2-10 widest near apex, becoming more triangular, 9-10 subtruncate at base, 11 truncate at base, tapering to a blunt point from basal 2/5. Setae and tactile setae rather shaggy.

Pronotum 0.64 mm long, 0.41 wide at base, 0.54 maximum, 0.26 at the well-defined collar. Basal impressed line distinct. Sides widest at apical 2/5, curving evenly to collar and almost straight to basal impressed line. Disc slightly flattened; sculpture similar to head but punctures slightly deeper, smaller and denser. Tactile setae longer, ca. 0.05 mm. Elytra subparallel, 1.79 mm long, 0.73 wide at the well-marked humeri, 0.90 maximum, slightly flattened but with suture elevated behind the weak postbasal transverse impression; omoplates feebly elevated. Setae decumbent, straight, 0.05 mm long; tactile setae suberect, slightly curved, 0.04 mm. The setae between and just behind the omoplates are slightly oblique. Surface shiny, with very fine punctulation and slight irregularities; punctures small but sharply defined, ca. 0.03 mm from center to center, the intervals flat.

Sides of mesosternum and ventral portion of mesepisterna smooth and shiny, with a few fine punctures and closely appressed setae. Mesepimera apparently not visible along sides of mesepisterna. Metepisterna and metasternum with fine punctures and feebly microreticulate. Abdomen shiny, with fine punctures. Sternum 7 simple; sternum 8 transversely excavated in apical third, with the apical margin very shallowly concave. The dical excavation does not appear to have any modification of the setae. Tergum 7 with a concave hind margin. Tergum 8 flat, shiny, finely punctured, 0.26 mm wide, the apical portion broadly and evenly rounded. Femora moderately heavy beyond middle. Front femur 0.49 × 0.17 mm, front tibia 0.45 × 0.06, hind femur 0.61 × 0.18. Coxae all dark, trochanters and rest of leg dark rufescent, the trochanters slightly paler. Front tarsi somewhat expanded. Females are almost the same as the males, but have the front tarsi narrower.

Distribution: Known only from Uruguay. Holotype ♂: Maldonado (Cerro Pelado), [URUGUAY], 25.XII.12, sobre *Eryngium* sp., Coll. Tremoleras. Paratypes: 8 ♂, 4 ♀, same data. 1 ♂, Maldonado (Pan de Azúcar), 15.XII.12, sobre *Eryngium* sp., Coll. Tremoleras. 7 ♂, 5♀, Minas — Arro. Espinillo, [URUGUAY], 10.XII.12, sobre *Eryngium* sp., Coll. Tremoleras. Holotype and paratypes in Museo de La Plata.



Werner — Ischyropalpus

Ischyropalpus freyi, new species

Very similar to *eryngii,* differing in the eyes being even larger, the base of the head short and gently, evenly curved behind them, the punctures, of the head especially, smaller and the intervals wider. Elytral pubescence quite sparse, of uniform tan color.

Holotype ♀: Length 2.79 mm. Head 0.46 mm long to the extremely feebly indicated frontoclypeal suture, 0.54 to apex of clypeus, 0.56 wide across eyes, 0.46 just behind. Base very short, almost evenly and gradually curved, the tempora very short and nearly obsolete; a line between the hind margins of the eyes is 0.13 mm from middle of base. Disc slightly flattened. Surface smooth and shiny, with quite small flat-bottomed punctures ca. 0.03 mm from center to center, the intervals flat, and as wide as punctures in most cases. Setae appressed, 0.04 mm long, tactile setae erect, straight, 0.04 mm. Clypeus on same curve as front and similarly sculptured. Last segment of maxillary palpi narrowly securiform 0.15 × 0.08 mm. Eyes very large, prominent, moderately coarsely faceted, separated by 0.36 mm and covering most of sides of head, with curved setae ca. 0.01 mm long at the intervals of the facets. Antennae similar to *eryngii,* bright rufescent at base, gradually darker beyond segment 6. Measurements in 0.01 mm: 14/8, 8/5, 9/5, 8/6, 9/6, 9/6, 9/6, 8/8, 9/9, 8/9, 15/8. Pronotum similar to *eryngii,* 0.64 mm long, 0.38 wide at base, 0.52 maximum and 0.22 at collar. Punctures denser than on head but of similar diameter, separated by less than their diamaters in most cases, slightly oval longitudinally but not at all confluent. Elytra also very similar to *eryngii* except for the unicolorous pubescence, which is nearly longitudinal in the region of the omoplates; length 1.69 mm, width at humeri 0.68, 0.83 maximum. Punctures ca. 0.04 mm from center to center; setae

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EXPLANATION OF PLATE 14

Fig. 1. Ventral view of mesothorax and part of metathorax of *Ischyropalpus caesiosignatus* (Boheman).

Fig. 2. Ventral view of aedeagus of *Isychyropalpus tibialis,* new species, paratype, Maracay, Venezuela.

Fig. 3. Ventral and left lateral views of aedeagus of *Ischyropalpus eryngii,* new species, paratype, Maldonado, Uruguay.

Fig. 4. Ventral and left lateral views of aedeagus and of penis or median lobe of *Ischyropalpus puteifer,* new species, Mojón de Fierro, Argentina.

Figs. 5-7. Details of *Ischyropalpus puteifer,* new species, holotype ♂. Fig. 5. Left maxillary palpus. Fig. 6. Left front femur in ventral view. Fig. 7. Left hind femur in ventral view.

Fig. 8. *Ischyropalpus puteifer* new species, holotype ♂ (× 11). All other figures at scale indicated.

0.05 mm long, tactile setae 0.04. Wings apparently functional. Mesosternum, mesepisterna and legs similar to *eryngii.* Front femur 0.44 × 0.15 mm, front tibia 0.41 × 0.07, hind femur ca. 0.51 × 0.16.

Holotype ♀: Rancho Grande, [nr.] Maracay, [Est. Aragua], VENEZUELA, XI. 1960, G. Frey, in Museum G. Frey, Tutzing, Germany.

Ischyropalpus decoratus, new species

This species, known only from the female holotype, is the only one in the group with a marked color pattern on the elytra. These are dull luteous with the basal area and a crescentric marking behind the middle on each elytron brown, the two connected by a narrow strip that parallels the suture. The suture is pale in a strip 0.17 mm wide, becoming darker at the base but feebly indicated even there. The pronotal punctures are more or less confluent longitudinally and the elytral pubescence is moderately dense, fine and appressed.

Holotype ♀: Length 2.88 mm. Brown, the head slighty darker, the elytra as described above, the antennae, palpi and legs dull luteous also. Head subquadrate, with distinct but short tempora, the base gently curved between the distinct temporal angles. Length 0.49 mm, width across eyes 0.59, behind 0.49. Eyes large, moderately prominent, 0.28 × 0.20 mm, separated by 0.40 on front, extending far down on sides of head. A line connecting their hind margins is 0.15 mm from middle of base. Facets moderately coarse, with curved setae at their intervals ca. 0.02 mm long. Surface of head densely covered with sharply defined flat-bottomed punctures ca. 0.03 mm from center to center, separated by less than half their diameters, slightly sparser on anterior part of frons; intervals smooth and shiny. Setae appressed, fine, ca. 0.03 mm long, tactile setae straight, erect, ca 0.01 mm. Frontoclypeal suture feeble, the clypeus on same curve as front. Last segment of maxillary palpi narrowly securiform, 0.14 × 0.08 mm. Antennae moderately stout, with segments 2-10 thickest near apex, becoming subtrianguler. Measurements in 0.01 mm: 15/6, 8/6, 8/5, 8/6, 8/6, 8/7, 8/8, 8/8, 8/8, 8/8, 13/8. Segment 1 subparallel, feebly pedunculate, 2-3 thickest near apex, 4-10 subtriangular, becoming heavier, 9-10 subtruncate at base, 11 truncate at base, the sides gently curved to the blunt apex from near base. Setae and tactile setae rather shaggy.

Pronotum 0.67 mm long, 0.38 wide at base, 0.56 maximum and 0.26 at the short but well-defined collar. Sides widest at apical 2/5, almost evenly curved to collar and almost straight back to the level of the distinct basal impressed line. Disc almost evenly convex, slightly concave behind middle. Punctures denser and smaller than on head, slightly oval and feebly confluent longitudinally. Pubescence similar to head but tactile setae longer, ca. 0.04 mm. Scutellum pale. Elytra subparallel, 1.73 mm long, 0.69 wide at the well-defined humeri, 0.90 maximum. Surface shiny but very feebly punctulate, the small punctures 0.03 mm from center to center, slightly papillate, especially toward base. Omoplates feebly elevated; suture feebly elevated behind middle. Setae moderately dense, fine, appressed, 0.05 mm long; tactile setae suberect, almost straight, 0.04 mm. The general color of the elytra is dull luteous but the base from humeri to and including omoplates is brown, the suture here narrowly slightly paler. An obscure brown strip extends from near the suture in this brown zone to a crescentric marking on each elytron 0.90 mm from base and ca. 0.26 mm wide. The suture is pale for ca. 0.17 mm between the posterior markings and the strips, the boundaries of this pale zone almost straight. It continues obscurely into the basal area.

Mesosternum and ventral portion of mesepisterna smooth and shiny, the former quite narrow laterally. Mesepimera very narrowly exposed along edges of mesepisterna. Abdomen finely punctured and sparsely pubescent, the first visible sternum shiny, the rest feebly microreticulate. Legs, including front and middle coxae, dull luteous. Front femur 0.46 × 0.15 mm, front tibia 0.41 × 0.05, hind femur 0.56 × 0.17.

Holotype ♀: Paracatu, Minas Gerais, [BRAZIL], VII-1960 - 86/60, Exp. Formosa Col., in Museu Nacional, Rio de Janeiro, Brazil.

Ischyropalpus alvarengai, new species

This species most closely resembles *decoratus* in general appearance, but it lacks elytral markings. The punctures on the pronotum are not confluent and the pubescence on the elytra is longer and coarser. If the single known specimen is typically colored, the coloration is distinctive, as indicated in the key to the species of the group.

Holotype ♀: Length 3.26 mm. Head subquadrate, 0.52 mm long, 0.64 wide across eyes, 0.54 behind, with the tempora short but distinct, the temporal angles well-marked and the base very gently and evenly curved between them. The middle of the base is 0.17 mm from a line connecting the hind margins of the eyes. Disc slightly flattened, evenly covered with flat-bottomed punctures ca. 0.03 mm from center to center, the intervals smooth and shiny, and less than half the diameter of the punctures. The sculpture continues to the frontoclypeal suture, which is fine but well marked, and onto the clypeus, which is on the same curve as the frons. Setae appressed, ca. 0.05 mm long, tactile setae erect, 0.04 mm. All of maxillae and labium rufescent, contrasting with the dark head. Last segment of maxillary palpi narrowly securiform, 0.15 × 0.08 mm. Eyes moderately large and prominent, 0.31 × 0.20 mm, moderately coarsely faceted, occupying much of side of head, with curved setae ca. 0.02 mm long at the intervals of the facets. Antennae of same general proportions as *eryngii* but the intermediate segments stouter, 5-10 being subtriangular and gradually stouter, and subtruncate at base. Measurements in 0.01 mm: 18/8, 8/6, 9/6, 9/6, 9/8, 9/8, 9/8, 9/9, 9/9, 9/8, 14/8.

Pronotum of form of *decoratus,* 0.76 mm long, 0.46 wide at base, 0.68 maximum and 0.28 at collar. Punctures denser than on head, longitudinally oval, narrowly separated. A few of them are slightly confluent longitudinally, but almost all are distinctly separated. The disc is slightly flattened, but almost evenly convex. Elytra suparallel, 1.98 mm long, 0.79 mide at the well-marked humeri, 1.02 maximum, somewhat flattened, with the omoplates and postbasal transverse impression barely indicated and the suture not elevated. Surface as in *decoratus,* the punctures fine and 0.04 mm from center to center; setae appressed but not closely so, slightly curved, 0.05 mm long, noticeably coarser and shaggier than in *decoratus;* tactile setae suberect to erect, 0.04 mm. There is a narrow slightly darkened strip along the suture, ca. 0.18 mm wide and most evident on the middle third. The region of the omoplates is also slightly darkened, but probably because the slightly translucent elytra reveal the top of the thorax. Wings apparently of full length. Underside as in *decoratus,* but mesepimera more distinctly visible. Legs rufescent, the coxae darkened toward base, the hind coxae mostly dark. Front femur 0.49 × 0.18 mm, front tibia 0.44 × 0.08, hind femur 0.64 × 0.20.

Holotype ♀: Cachimbo, Pará, BRASIL, VI-1962, M. Alvarega, in the collection of Col. Moacir Alvarenga, Rio de Janerio, Brazil.

Ischyropalpus puteifer, new species

(Figs. 4-8)

3.53-4.24 mm, brown with the appendages rufescent, to all rufescent; subopaque, moderately slender and flattened. Prothorax, especially of male, unusually large. Front and hind femora of male with a pit on the surface facing the tibia.

Holotype ♂: Length 4.24 mm. Head 0.67 mm long, 0.72 wide across eyes, 0.67 just behind, with short tempora, the base gently and evenly rounded between the poorly defined temporal angles, moderately retrosalient. Disc somewhat flattened, evenly covered with sharply defined flat-bottomed punctures 0.03 mm from center to center even on frons, the punctures only narrowly separated but not all confluent, the intervals ca. 1/2 the width of the punctures and shiny. The surface appears subopaque because of the dense punctures. Setae moderately dense, decumbent, 0.04 mm long, tactile setae suberect, 0.04 mm. Frontoclypeal suture distinct but not deep; surface of clypeus similar to frons. Labrum ogival, shiny. Last segment of maxillary palpi narrowly securiform (Fig. 5), 0.20 × 0.09 mm. Eyes moderately prominent, moderately coarsely faceted, 0.33 × 0.23 mm, separated by 0.51, a line connecting their hind margins 0.26 mm from middle of base. Antennae moderately slender, gradually thicker apically, the segments distinctly separated. Measurements in 0.01 mm: 19/9, 9/6, 13/8, 12/8, 13/8, 10/9, 12/9, 12/9, 12/9, 12/9, 18/9. Segment 1 parallel-sided, feebly pedunculate, 2-10 thickest near apex, gradually more truncate at apex, 6-10 distinctly truncate at base, subtriangular; 11 truncate at base, tapering to a blunt point from basal third.

Pronotum unusually large and broad, 1.13 mm long, 0.59 wide at base, 0.84 at beginning of expanded portion 0.26 mm from base, 1.00 maximum, 0.36 at the short collar. The apical area behind the collar is elevated above the collar, with the border of this elevated area slightly concave. This anterior border meets the sides in an even but rather sharp curve; the sides are then subparallel about half-way to the base, then slightly convergent to another sharp curve, which ends at the level of the distinct basal impressed line. Disc moderately flattened. Surface similar to head but punctures smaller and ca. 0.02 mm from center to center anteriorly and laterally, almost as on head in posterior half of disc. Lateral margins evenly rounded, but in a curve that is about as sharp as the one that joins the front and side margins. Elytra almost parallel, 2.44 mm long, 0.95 wide at the distinct humeri, 1.20 maximum, with the apices gently conjointly rounded and narrowly rounded at suture. Disc almost evenly rounded in transverse section; postbasal transverse impression feebly indicated. Surface with lightly papillate punctures ca. 0.04 mm from center to center, appearing feebly shiny. Setae moderately dense, subappressed, 0.08 mm long, tactile setae subdecumbent, slightly curved, 0.04 mm. Wings well-developed, probably functional.

Mesosternum shallowly punctured and pubesecent medially, shiny and almost smooth laterally, the ventral portion of the mesepisterna similar to the sides. Mesepimera narrowly visible along edges of ventral portion of mesepisterna. Abdomen shiny, finely punctulate and with setae similar to elytra. Sternum 7 not modified, truncate at apex. Sternum 8 with a shallow transverse depression that is only very sparsely punctulate with a few fine setae, deepest near apex and extending most of the way across the segment, which has a subtruncate apex. Tergum 8 flattened, slightly concave longitudinally, 0.41 mm wide, with the apex gently rounded, without any indication of a median angulation. Surface shiny, finely punctulate and pubescent. Ventral sculptured portion flat, with no indication of a median keel.

Femora moderately stout, widest at apical third. Front femur with a deep, slightly margined, roughly circular pit, bearing a few erect setae from the middle of its flat and apparently membranous bottom (Fig. 6), on anterior portion of the side facing the tibia. Hind femur with an elongate pit, which has only the sides elevated (Fig. 7). Middle femur without a pit. Front femur 0.64 × 0.23 mm, front tibia 0.56 × 0.10, hind femur 0.77 × 0.26.

The ♀ has the pronotum less enlarged, with the sides only slightly narrowed behind. The ♀ from Colonia Benítez is 3.71 mm long. The pronotum is 0.92 mm long, 0.56 wide at base, 0.67 at 0.26 from base, 0.77 maximum and 0.31 at collar. The front margin is only slightly higher than the collar and slopes to it; and the disc is almost evenly rounded in section. It is only slightly broader than the head, which is 0.69 mm wide across the eyes. If the elytral length of the holotype were made equivalent, its pronotum would be 1.02 mm long and 0.89 mm in maximum width. The femora of the ♀ are slightly more slender and completely lack the pits of the ♂.

The holotype and most of the paratypes are all brown above, the ♀ from Colonia Benítez rufescent with the elytra brown, and the ♀♀ from Mojón de Fierro and Campo del Cielo all pale rufescent.

Holotype ♂: Colonia Benítez, Terr. Chaco, ARGENTINA, 12.XII. 1948, R. Golbach (Inst. Miguel Lillo). Paratypes: 1 ♀, same data (Inst. Miguel Lillo). 1 ♂, 1 ♀, Mojón de Fierro, Terr. Formosa, Argentina, 25.XII.1948, R. Golbach (Inst. Miguel Lillo). 1 ♀, Campo del Cielo, [Prov. Santiago del Estero, Argentina], I.1934, J. Bosq (Museo de La Plata). 1 ♂, 9 ♀, Cuyaba, Matto Grosso, Brasilien (Chicago Nat. Hist. Mus., from residual collection of Staudinger and Bang-Haas).

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NOTES ON NEOTROPICAL TABANIDAE VI
A NEW SPECIES OF *LEPISELAGA* MACQ. WITH REMARKS ON RELATED GENERA

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The discovery by Dr. Vernon Lee of a new species of *Lepiselaga* in Colombia, provides the opportunity to review the taxonomy of the group and to make some suggestions as to the relationships of the species to each other, as well as to other genera usually considered to be related.

Lutz (1913) erected the subfamily *Lepidoselaginae* to contain *Lepiselaga, Selasoma, Himantostylus,* and *Stigmatophthalmus,* the last two described as new. Lutz accepted Osten Sacken's invalid emendation of *Lepiselaga* to *Lepidoselaga,* but used both interchangeably in this publication. He also stated that the subfamily would contain other unnamed Australian and African species. Enderlein (1925) retained the group as a tribe *Lepiselagini* for 9 more or less unrelated genera, but including *Lepiselaga* and *Himantostylus,* though not *Selasoma* or *Stigmatophthalmus,* which were placed in the tribes *Tabanini* and *Dichelacerini* respectively. Kröber (1934) included *Lepiselaga* and *Selasoma* in the subfamily *Lepiselaginae,* but placed *Himantostylus* in the *Stenotabaninae* and relegated *Stigmatophthalmus* to the position of a subgenus of *Dicladocera* in the subfamily *Tabanini.* Fairchild (1942) placed *Lepiselaga* and *Selasoma* in *Tabaninae,* tribe *Lepiselagini.* Finally Mackerras (1955) included all the Neotropical *Tabaninae* with bare basicosta in one tribe, *Diachlorini.*

As presently known, *Selasoma, Stigmatophthalmus* and *Himantostylus* are monotypic, each containing but a single rather aberrant species, and will be discussed first.

Selasoma Macquart

1838, Dipt. Exot. 1(2): 187. Type *Tabanus tibialis* Fab.

Kröber (1934) included also *T. nigrocoeruleum* Rond. 1850 and *S. giganteum* Lutz 1913. The latter is a species of *Stibasoma,* as noted earlier (Fairchild 1961), while recent examination of the type of *nigrocoeruleum* in Naples shows it to be the same as *Dicladocera acheronitens* Kröb. 1931 (New synonymy). *S. tibiale* has a wide range in the Neotropics, being recorded from Oaxaca, Mexico to southern Brasil, but seems everywhere uncommon and local.

The position of *Selasoma,* similar in its coloration and incrassate tibiae to *Lepiselaga,* is dubious. It has generally been placed near *Lepiselaga* (Lutz 1913, Enderlein 1925, Kröber 1934) but there are fundamental points of difference. The basicosta bears a fair number of setae, the palpi are greatly inflated but not flattened, the frons is narrow with a rugose linear callus nearly filling it and without tubercle or ocelli at vertex, the labella are large and wholly membranous, the first antennal segment is not elongate, the second bears a dorsal tooth and the basal plate of third is wide and flattened. The eyes are unpatterned in life, dull greenish black, while those of *Lepiselaga* and *Himantostylus* are characteristically banded. According to Lutz (1913) the species is crepuscular and bites horses on the belly. Records from Panama confirm this.

Stigmatophthalmus Lutz

1913, Mem. Inst. Osw. Cruz, 5(2): 174, 184-185, Pl. 13, fig. 23. Type *Stigmatophthalmus altivagus* Lutz.

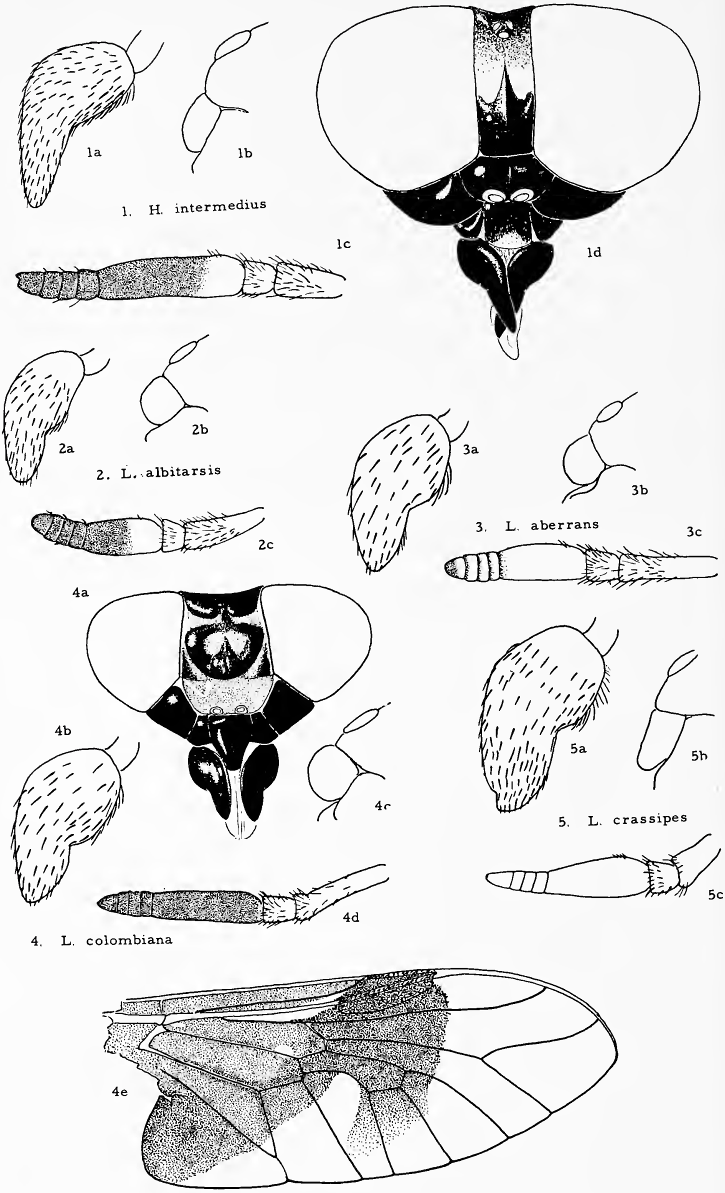
Stigmatophthalmus altivagus Lutz was placed by Lutz (1913) with *Selasoma* and *Lepiselaga,* by Enderlein (1925) near *Stibasoma,* and by Kröber as a subgenus of *Dicladocera.* It has, however, setose basicosta, large membranous labella, and no vestiges of ocelli. The wing pattern is somewhat like *Selasoma,* though more extensively black, and the fore tibiae slightly incrassate. Except for the wing color, there seem to be no characters that would exclude it from *Tabanus,* much less allow placement in the *Diachlorini.* It certainly does not seem in any way related to *Lepiselaga* or even *Selasoma.* Lutz figures the species as with green eyes with a single dark band. I have given a figure of head structures elsewhere (Fairchild 1961). Nothing is recorded of its habits, and it seems to have been taken only about Petropolis and in the mountains of Sta. Catarina in southern Brasil.

Himantostylus Lutz

Fig. 1

1913, Mem. Inst. Osw. Cruz, 5(2): 174, 183-184, Pl. 13, fig. 22. Type *H. intermedius.*

The genus and species were based on a single male from eastern Peru. Stone (1934) later described the female from Bolivia. A long series of females and a single male were secured in Darien, Panama, in 1963, and there are other specimens collected by Luis E. Peña at Quincemil, Dept. Cuzco, Peru, Oct. 1962 in the collection of Dr. L. L. Pechuman. Panama specimens are darker, having the cubital cell and anal area as dark as the basal cells, not paler as in the type and other Peruvian material.



1. H. intermedius

2. L. albitarsis

3. L. aberrans

4. L. colombiana

5. L. crassipes

FAIRCHILD — TABANIDAE

Himantostylus Lutz, as suggested by Stone (1934) and Barretto (1949), is very similar to *Lepiselaga* but differs structurally in having a strong tubercle at vertex with well marked vestiges of ocelli, a quite different frontal callus, and in lacking the narrowed discal cell. The labella are also without sclerotized strips, and the palpi less highly modified. The palpi of male *Himantostylus* are porrect, oval, inflated and shiny, those of *Lepiselaga* are decumbent and similar to the female, though more slender and less flattened.

Many of the peculiarities and similarities of *Lepiselaga* and *Himantostylus* may be due to what might be termed mimetic convergence. All the species bear a strong resemblance in size, coloration, and to some extent in actions, to stingless bees of the genus *Trigona*. This resemblance is strongest in *Himantostylus* and the subgenus *Conoposelaga*, less marked in *L. crassipes*. The latter at least is preyed upon by certain solitary wasps, as noted by Bates over a century ago (Bequaert 1926). *Himantostylus intermedius* is especially bee-like in its actions. In a jungle camp on the Rio Tacarcuna, Darien Province, Panama, I collected a good series of this species, and had an opportunity to observe its actions. The flies flew silently close to the ground, clustering on my canvas and rubber boots and seldom alighting above the ankles. They crawled busily over the boots in the manner of stingless bees investigating an attractive surface, but were unable to penetrate the thick material. When a hand was placed on the boots, they crawled over the fingers, but made no attempt to bite. *L. crassipes* also seems to prefer the lower part of the body, and also sometimes crawls about in a bee-like manner, but it bites viciously when a suitable site is found. Little is recorded as to the habits of the other species. Lutz (1913) notes that the original series of *L. aberrans* was taken at 3 p. m. and bit man and horses avidly. The original specimens of *L. albitarsis* were collected by D'Orbigny in 1827. His original journal is preserved in the

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EXPLANATION OF PLATE 15

Figures of heads, notopleural lobes and wing are to the same scale. The wing measures 5.3 mm. Figures of antennae and palpi are also to the same scale, but twice the magnification of heads.

Fig. 1 *Himantostylus intermedius* Lutz. a, palpus; b, dorsal view of notopleural lobe; c, antenna; d, head, frontal view. Panama. Fig. 2 *Lepiselaga (Conoposelaga) albitarsis* Macq. a, palpus; b, notopleural lobe; c, antenna. Argentina. Fig. 3 *Lepiselaga (Conoposelaga) aberrans* Lutz. a, palpus; b, notopleural lobe; c, antenna. Paratype. Fig. 4 *Lepiselaga (Conoposelaga) colombiana* n. sp. a, head; b, palpus; c, notopleural lobe; d, antenna; e, wing. Holotype. Fig. 5 *Lepiselaga (Lepiselaga) crassipes* Fab. a, palpus; b, notopleural lobe; c, antenna, Panama.

Museum d'Histoire Naturelle in Paris, and Dr. Tsacas kindly secured for me a photocopy of the parts dealing with Diptera. D'Orbigny records under number 9533-37, the number borne by the types, that the species lives on the banks of the Parana along its whole length, that its bites are very painful and that the local inhabitants, who already suffer much from the attacks of mosquitoes and a multitude of other insects, fear this species greatly, as it torments them cruelly and returns ceaselessly to the attack. These remarks indicate that *albitarsis* as well as *aberrans* have feeding habits similar to *crassipes,* but different from *Himantostylus.*

In summary, I believe that *Stigmatophthalmus* and *Selasoma* are both isolated and unrelated genera best placed in the tribe Tabanini. They may well be relatively old elements whose connections have disappeared. *Stigmatophthalmus altivagus* is a rather rare species, seemingly confined to the higher altitudes of the coast range of south eastern Brasil. *Selasoma* is widespread from Mexico to Brasil, but apparently local in occurrence. *Himantostylus* I believe belongs in the *Diachlorini,* but I think its resemblances to *Lepiselaga* are more likely due to mimetic convergence rather than close relationship in a phylogenetic sense. To me it appears closer to *Diachlorus* and *Stenotabanus* than to *Lepiselaga,* but it is in any event rather isolated.

I give below a key to the genera discussed here. All the species are black or largely so, with basally black wings, rather stout and chunky build, and tibiae more or less inflated.

KEY TO THE GENERA

1. Discal cell (1st M_2) of wings constricted, the vein forming its posterior margin strongly arched upward, the cell entirely infuscated. .... Lepiselaga 2.
   Discal cell normal, either wholly or partly hyaline, or with a hyaline spot. .... 3.
2. Frons about twice as high as wide, parallel sided, the vertex without bare area. Notopleural lobes not strongly protruding. Body when undenuded clothed with greenish irridescent scales. .... *(Lepiselaga)*
   Frons as wide or wider than high, widened below, the vertex protuberant and shiny. Notopleural lobes strongly inflated and protuberant. Body without greenish scales .... *(Conoposelaga)*
3. Basicosta bare. Small species less than 9 mm. long. Antennae slender, the basal plate of third segment subcylindrical, about twice length of style. Three distinct ocelli at vertex. Wing basally black or dusky to ends of basal cells, beyond this wing

glass clear with yellow veins and stigma. .... *Himantostylus*
Basicosta at least sparsely setose. Large species generally over 12 mm. Basal plate of antennae broad, or with a strong dorsal angle. No ocelli. Wing more extensively black, the discal cell at least half black. .... 4.

4\. All tibiae greatly inflated. Palpi greatly inflated and shiny. Subcallus, face and cheeks largely shiny. Basal black of wing extending to middle of discal cell, with a small clear spot in first and second basal cells near apex. Antennal plate broad and flattened, much longer than style, obtusely angulate above. .... *Selasoma*
Fore tibiae slightly inflated, others normal. Palpi slender, pollinose. Subcallus, face and cheeks brown pollinose. Basal black of wing extending beyond end of discal cell, the latter with a small transverse oval hyaline fenestra beyond middle. Antennal plate with a strong acute dorsal angle, almost a spine, the plate but slightly longer than style. .... *Stigmatophthalmus*.

Lepiselaga Macquart

1838, Dipt. Exot., 1(1): 153. Kröber, 1934, Rev. Ent. 4(2): 252. Fairchild 1942, Ann. Ent. Soc. Amer., 35(3): 290. Type *Tabanus lepidotus* Wied. (= *crassipes* Fab.)

Hadrus Perty, 1833, Del. Anim. Artic., Brasil, p. 183 (nec Dejean 1833 Coleoptera).

Lepidoselaga Osten Sacken, 1876, Mem. Boston Soc. Nat. Hist., 2: 435.

Conoposelaga Barretto, 1949, An. Fac. Med. Univ. S. Paulo, 24: 87-88. Type *Lepiselaga aberrans* Lutz.

The most recent definition of the genus is by Fairchild (1942). To this may be added the condition of the discal cell, which is narrowed in the middle by the strong anterior bending of vein M_3 where it forms the posterior border of the discal cell.

L. aberrans Lutz, (Fig. 3) for which Barretto erected the genus *Conoposelaga,* differs from *L. crassipes* (Fig. 5) most notably in the inflated notopleural lobes, inflated scutellum, broad frons with shiny vertex, and longer first antennal segment. These characters are to a considerable extent shared by *L. albitarsis* Macq. (Fig. 2) and the new species described below, so that there is justification for Barretto's action. I prefer, however, in view of the obviously close relationship of the four species, to retain *Conoposelaga* in a subgeneric sense.

Lepiselaga (Conoposelaga) colombiana n. sp.

Fig. 4

A small black species resembling *L. albitarsis* but with narrower frons, longer third antennal segment, and abdomen black tomentose dorsally.

Female. Length 6 mm., of wing 5.5 mm. Eyes short and sparsely pilose. Frons as figured, largely black and shiny, the pollinose areas dark brown. Subcallus yellow brown, wholly shiny and rather inflated. Frontoclypeus and genae wholly shiny black. Antennae and palpi as figured. Proboscis short, about equalling head height, the labella small and compact, at least partially sclerotized.

Mesonotum black, thinly dark pollinose with scattered brassy hairs, the notopleural lobes globose, shiny, sparsely dark haired. Scutellum black and shiny, somewhat inflated. Pleura and sternum dark brown pollinose, sparsely black-haired. All legs, except white tarsi, black and black-haired. All tibiae strongly incrassate. Halteres brown with brown knob. Wing as figured, the costal cell and basal cells dark yellowish brown, rest of pattern blackish.

Abdomen with first tergite velvety black with a small patch of yellow at extreme sides. Second tergite velvety black in middle third, lateral thirds shiny yellow. Third and fourth tergites largely velvety black, the lateral yellow decreasing posteriorly. Remaining tergites shiny black. The abdomen also bears scattered long yellow hairs, denser laterally and posteriorly. Beneath the abdomen is wholly shiny, yellow on first two or three segments, black on the remainder.

Holotype female, Barbascal, Intendencia de Meta, Colombia, 23 Sept. 1964, Vernon Lee coll. To be deposited in M.C.Z., Cambridge, Mass.

Paratype female, same data. The paratype is slightly smaller and with considerably less yellow on abdomen. The species can be separated from related species by the characters given in the key.

Key to species of Lepiselaga

1. Basal plate of third antennal segment longer than first two antennal segments. Black wing pattern with about 9 small round clear spots. Frons about twice as high as wide, with a small round basal callus. No bare area at vertex. Whole dorsum, including frons, with greenish metalic scales. .... *(Lepiselaga) crassipes* Fab.

   Basal plate shorter than first two antennal segments. Black wing pattern with no more than 3 round clear spots. Frons as wide as high or wider, the callus large and diffuse, the vertex extensively bare. Body without greenish scales. .... *(Conoposelaga)* 2.

2. Tergites 2 to 4 of abdomen orange yellow, with broad transverse orange pollinose bands. Dark wing pattern brownish, with a spur reaching hind margin in fourth posterior cell (3rd M). .... *aberrans* Lutz.

Abdomen at most yellowish horn colored at sides of anterior segments. Posterior spur of wing pattern fails to reach hind margin. .... 3.

3. Frons markedly wider than high, much wider below than at vertex. Third antennal segment basally yellow, the plate much less than twice length of style. Posterior spur of dark wing fascia narrow, ending abruptly. Only first tergite velvety black, the rest shiny. .... *albitarsis* Macq.

Frons about as high as wide, slightly widened below. Third antennal segment black, the plate twice length of style. Posterior spur of wing fascia broad, fading out in fourth posterior cell before wing margin. Tergites 1 to 4 extensively velvety black dorsally. .... *colombiana* n. sp.

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SELF-BURYING BEHAVIOR IN THE GENUS *SICARIUS* (ARANEAE, SICARIIDAE)[1]

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The family Sicariidae has only recently been recognized as a polyphyletic taxon. Although it is difficult to establish natural limits, Gertsch (1949) has more logically separated the group into the Scytodidae, Diguetidae, Plectreuridae, Loxoscelidae, and Sicariidae (s.s.), all of which had been subfamilies of the Sicariidae (Bonnet, 1945-1959). These five families are differentiated distinctly and naturally by their ethological characters. The sole reason for their being previously lumped is their common possession of simple genitalia. This character is automatically considered primitive and hence these spiders were "representative of the ancestral stock." Their genitalia may, indeed, be relatively unchanged from the primitive form but in many other characteristics these spiders are quite specialized and advanced and bear very little resemblance to the ancestral stock. One can readily talk of "primitive characters" but rarely of "primitive, living organisms."

Some of the highly specialized ethological characters of the families mentioned are:

Scytodidae: Prey captured by spitting gummy substance from chelicerae; egg cocoons carried; spiders sometimes live in web on stones and rocks or in houses (Dabelow, 1958).

Diguetidae: Tubular cocoon constructed from silk and detritus and suspended by web in vegetation over sheet web; layers of egg sacs in a cocoon which also acts as retreat for spider (Cazier & Mortenson, 1962).

Plectreuridae: Low lying mesh web, associated with tubular retreat under rock or debris, in which spider sometimes hangs up-side-down; eggs in loose cocoon (W. Eberhard, pers. comm.; Gertsch, 1958).

Loxoscelidae: Large, irregular sheet web (hackled band appearance); eggs in loose sac.

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[1] Research a by-product of National Institute of Health Grant No. AI-01944 to Dr. H. W. Levi.

Manuscript received by the editor October 15, 1965.

Sicariidae: No web, unique ethological specializations outlined below.

The family Sicariidae (s.s.) contains the single genus, *Sicarius*. The genus has a predominantly south temperate distribution with species also described from Peru, Chile, Argentina and Southern Africa, with single species found in eastern Brazil, the Galapagos Islands and Costa Rica. Merian (1913) states that this "distribution méridionale isolée est le résultat de la retraite de [ce genre], de la zone tropical vers le Sud." On biogeographic grounds Merian considers *Sicarius* part of an ancient fauna.

The simple genitalia in the Sicariidae place them in the ecribellate spider group known as the haplogynes. In regard to systematics, "spiders lacking distinctive genitalia, in particular the Haplogynae, tend to have been neglected rather than to have stimulated interest in extra-genital characters" (Cooke, 1965). These extra-genital characters must include aspects of the external morphology (as used in Cooke's study of *Dysdera*) as well as several non-morphological characters—e.g., ecological and ethological ones.

In order for a character to be taxonomically useful, whether morphological or not, it must be comparatively constant in the taxon being studied.

Sicarius exhibits three behavioral traits that are of potential systematic value:

1. *Stridulation* - When disturbed the spider will rub the femur of its pedipalp against ridges on the chelicerae, producing bee-like buzzing (Simon, 1893 of the South African species). Simon suggests that the buzzing frightens enemies.

2. *Cocoon Construction* - The structures built by an organism are the physical summation of certain behavioral patterns. In spiders these structures include webs and egg cocoons. As a hunting spider, *Sicarius* does not spin webs but constructs egg cocoons that are characteristically covered with an earthy coating. Simon (1899) utilized this ethological character in noting the difference in the cocoons of *Sicarius hahni* Karsch (S. W. Africa) and ? *S. peruensis* Keyserling (Peru).

3. *Self-burying* - This phenomenon, found in two species of South American *Sicarius*, is reported in this paper.

Two species of *Sicarius* collected by Dr. H. W. Levi in South America were used in this study. Because of an inadequate knowledge of the taxonomy of this genus I have designated by numbers the two distinct species discussed in this paper, and have so labelled the specimens and deposited them in the Museum of Comparative

Zoology. *Sicarius* sp. 1 was collected under a log in a pasture near Santiago del Estero, Argentina, on April 2, 1965. *Sicarius* sp. 2 was found under a rock at the base of a loma in the desert south of Lima, Peru on February 7, 1965.

Detailed observations and timings were made by analyzing, frame by frame, 16 mm. motion pictures (24fps) of the complete, self-burying activity. Several runs of each species were analyzed and twelve frames from one take of *Sicarius* sp. 1 are presented in Plates 1 and 2.

The basic pattern of behavior observed was similar in both cases though the species are distinct. This pattern is outlined in Table 1 and illustrated in Figures 1-12.

The first six steps (Table 1) are invariable, qualitatively, though time duration of each action and period between actions varies a great deal. In digging, the first two pairs of legs dig while the hind pairs stabilize the spider (Fig. 1). Positioning of legs (Step 6) varies from less than a second to four seconds.

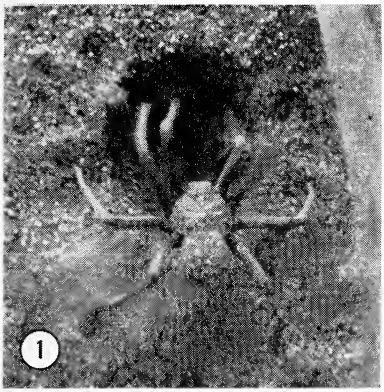
Step 7 consists of the first pair of legs alternately throwing sand over the body and exposed portions of the 4th legs (arrow in Fig. 6) from 6-15 times (approx. 4 times/second). Tufts of hairs on abdomen (arrow in Fig. 2) aid in holding the sand-covering in place. In *Sicarius* sp. 2 this action is split into two sections. First the throwing of sand, then a pause of about 30-120 seconds, then a continuation of

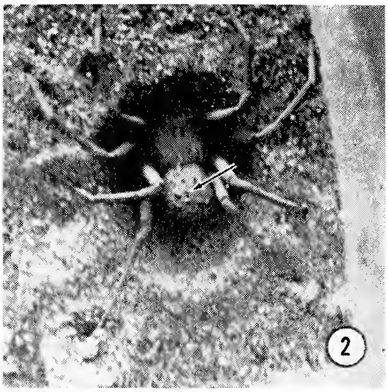
Table 1. Self-burying in *Sicarius* sp. 1 (duration in seconds, of each step within parentheses).

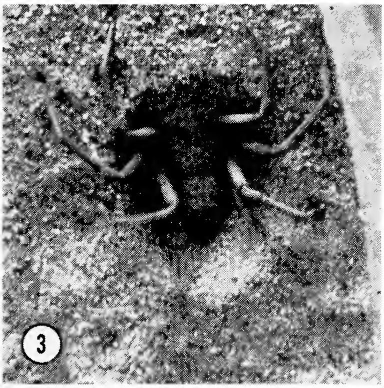
Step 1.	Digs hole (1.0)	Fig. 1
Step 2.	Jumps into hole (0.2)	Fig. 2
Step 3.	Adjusts abdomen (0.4)	
Step 4.	Adjusts 4th legs (0.6)	Fig. 3
Step 5.	Buries 4th legs partly (0.2)	Fig. 4
Step 6.	Positions legs (2.0)	Fig. 5
Step 7.	1st legs cover body and 4th legs with sand (1.8)	Fig. 6
Step 8.	Buries 1st legs partly (0.6)	Fig. 7
Step 9.	2nd left leg throws sand forward (0.3)	Fig. 8
Step 10.	Buries 2nd left leg (0.5)	
Step 11.	2nd right leg throws sand forward (0.2)	Fig. 9
Step 12.	Buries 2nd right leg (0.6)	Fig. 10
Step 13.	3rd left leg throws sand forward (0.2)	Fig. 11
Step 14.	Buries 3rd left leg (0.4)	
Step 15.	3rd right leg throws sand forward (0.2)	
Step 16.	Buries 3rd right leg (0.4)	Fig. 12

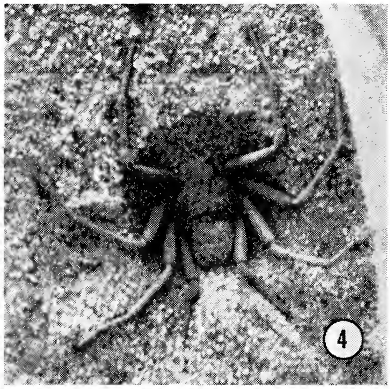
EXPLANATION OF PLATE 16

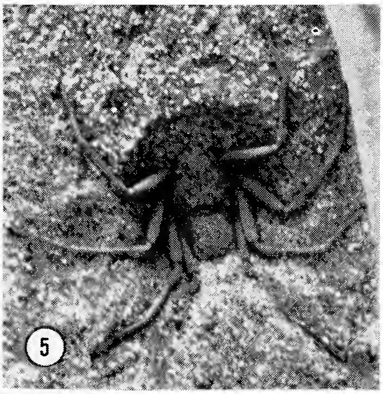
Figs. 1-6. Self-burying of *Sicarius* sp. 1, steps 1, 2, 4-7 (see Table 1 and text for details).

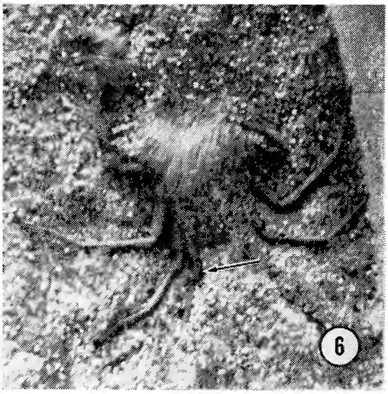




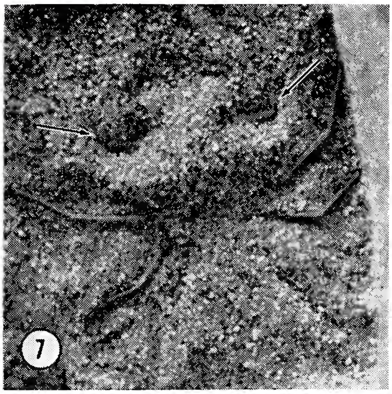








REISKIND — SICARIUS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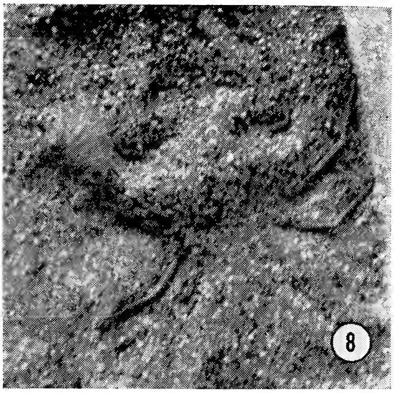
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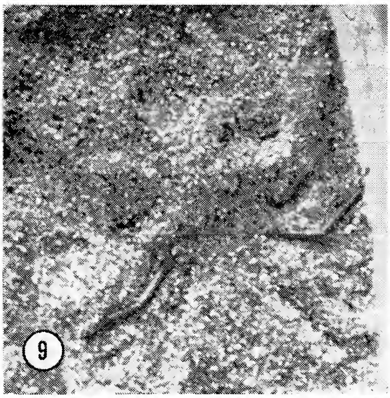
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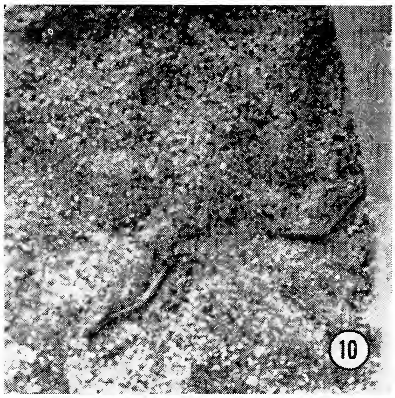
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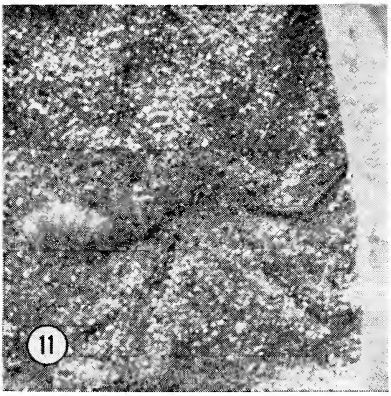
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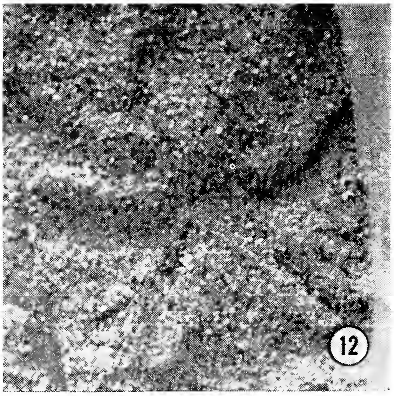
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Reiskind — Sicarius

Step 7 or beginning of Step 8. This same behavior is also observed in a more immature specimen of *Sicarius* sp. 2. In *Sicarius* sp. 1 there is usually no pause during Step 7 or between Steps 7 and 8.

The first legs are buried (Step 8), as are the second and third legs, by forward, downward, jerky movements. Often the legs are only partially buried, leaving the patella and part of the femur exposed (arrows in Fig. 7).

Step 9 begins with either the right or left second leg (usually the right). After throwing sand forward, covering the exposed part of the first leg of its side, each leg buries itself (Steps 9-12).

The third leg actions (Steps 13-16) resemble those of the second legs with either side beginning first. This usually completes the burying though there are often adjustments in the fourth legs, and sometimes fourth leg actions similar to the second and third legs.

The above description is of the complete, fixed behavior observed in both species of *Sicarius*. But often the burying stops prematurely, usually in response to some environmental difficulty — e.g., a cramped position or an unsatisfactorily dug hole. At other times cause of cessation before completion is unidentifiable.

To summarize, two species of *Sicarius* from South America show basically similar, fixed self-burying behavior with only one, distinct, qualitative difference (in Step 7). This fixed ethological character appears to be of potential systematic value.

The author wishes to thank Dr. H. W. Levi for suggesting this topic, collecting the organisms, and giving complete support in all phases of this work; Dr. W. K. Weyrauch for bringing this specific problem to notice: and both Drs. J. Abalos and P. Aquilar F. for invaluable aid in the field work.

EXPLANATION OF PLATE 17

Figs. 7-12. Self-burying of *Sicarius* sp. 1, steps 8, 9, 10-12, 16 (see Table 1 and text for details).

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A SECOND AFRICAN SPECIES OF THE DACETINE ANT GENUS *CODIOMYRMEX*[1]

By Robert W. Taylor
Biological Laboratories, Harvard University.

Codiomyrmex Wheeler, *sensu* Brown 1948, includes 4 previously described, worker-based species: *C. thaxteri* Wheeler, 1916 (Bull. Mus. Comp. Zool., 60 (8): 327, Port of Spain, Trinidad); *C. loveridgei* Brown, 1953 (Am. Midl. Nat., 50 (1): 21-23, Nyika Plateau, Nyasaland); *C. semicomptus* Brown, 1949 (Breviora, 108: 9-11, Shipton's Flat, Queensland, Australia); and *C. flagellatus* Taylor, 1962 (Breviora 152: 7-9, Clump Point, Queensland, Australia). Several others originally described in the genus have been placed elsewhere by Brown (1948).

Codiomyrmex tetragnathus new species

Holotype. A unique worker taken in a Berlese funnel by a native collector of the Museu do Dundo: ANGOLA: Dundo, Route Turismo (± 7° 02′ S., 20° 51′ E), Forêt-galerie, R. Luachimo, 28-III-1962 (ANG. 16888).

Type Deposition. Museu do Dundo, Lunda, Angola.

Description. The holotype has the following dimensions (for parameters of measurement and abbreviations see Brown, 1953): TL *c.* 2.4 mm; HL 0.62 mm; HW 0.49 mm; CI 79; Scape length (SL) 0.25 mm; ML 0.15 mm; MI 24; WL 0.60 mm.

Cephalic dorsum as shown in Figure 2; occipital lobes well developed; short intervening transverse occipital border moderately arched, narrowly carinate. Center of frons elevated, convex, its lateral parts and dorsa of occipital lobes flat to feebly concave, extreme edges forming a slightly raised flange, contours smoothly rounded throughout. Clypeal disc flat, anterior portion sloping fairly abruptly to the shallowly emarginate leading edge. Antennal scrobes strong, completely obscured in facial view, divided anteriorly by a narrow longitudinal ridge; ventral border cariniform, ending anteroventrally in a small tooth. Maximum ocular diameter 0.06 mm; antennae as usual for genus (Figure 1). Mandibles strongly convex; rising from clypeus. Masticatory border bearing two sets of teeth: an apical

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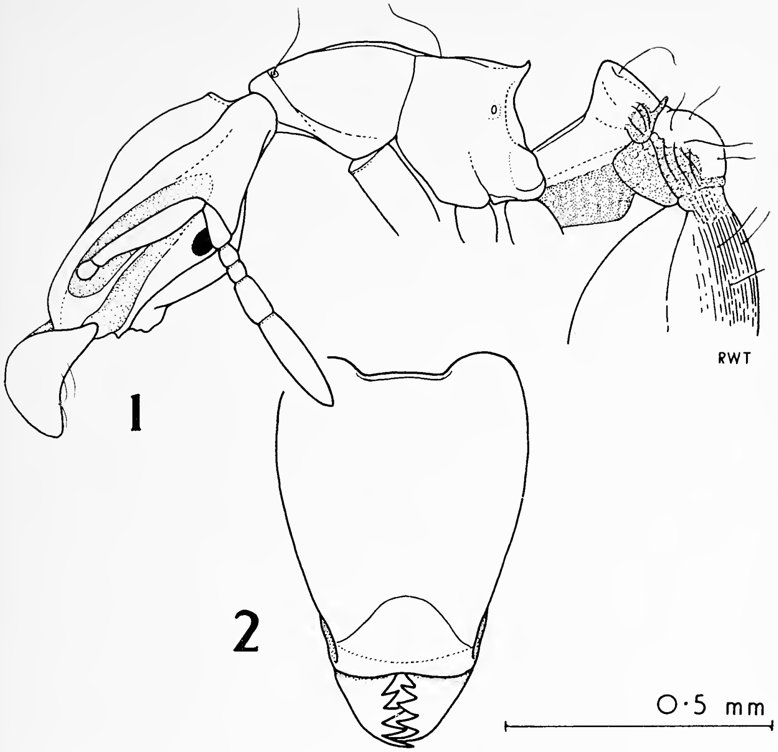
[1] Research supported U.S. National Science Foundation Grant No. GB 1634.
Manuscript received by the editor September 7, 1965

series of 3 subequal denticles about 0.01 mm high, and a main series of 5 strong, acute teeth of the type normally seen in *Codiomyrmex*. Of the latter, the 3rd is largest (*c.* 0.06 mm high), 2nd and 4th slightly smaller, 1st and 5th smallest (*c.* 0.05 and 0.04 mm high, respectively). Apices of large teeth, especially the 5th, inclined posteriorly. Denticles of apical series mounted on a process about 0.04 mm high and slightly wider at base, so that their apices are aligned with those of the major teeth. Basal lamella arising immediately behind posterior tooth, partly obscured by clypeus, apparently triangular. Labrum transverse, distal border strongly biconvex with a deep, acute median cleft.

Mesosomal profile as in Figure 1; dorsum transversely flat to feebly concave, lateral margins defined by a fine carina. Sides almost without sutures except the pro-mesonotal. Pronotum transversely marginate in front; 0.57 × as wide as head, 2.15 × as wide as propodeum. Humeral angles each with a low papilliform elevation. Promesonotal suture lacking on mesosomal dorsum, mesonotum and propodeum separated by a fine transverse carina. Propodeal declivity strongly concave; teeth only slightly divergent, their tips minutely hooked upwards; infradental lamellae weak; spiracles simple, unflanged. Petiolar profile as in Figure 1; peduncle with a pair of fine dorsolateral longitudinal carinae; node rising to a narrow transverse crest, its dorsum feebly convex in posterior view. Postpetiolar disc elliptical, almost twice as wide as long. First gastric segment 0.85 × as broad as long, 1.2 × as broad as deep; sides submarginate basally; basigastric costulae distinct, crowded, evenly developed, extending back to mid-length of segment. Usual complement of areolate spongiform material on petiole and postpetiole; posterodorsal bridges of both segments reduced to fine carina-like vestiges; anteroventral pad lacking on gaster.

Mandibles shining, with a few scattered punctures; scapes finely shagreened. Clypeus and anterior part of frons shining; remaining cephalic dorsum and antennal scrobes less lucid, with coarse granular shagreening. Mesosomal dorsum moderately shining, with effaced shagreening overlain by vestigial fine longitudinal costulae on promesonotum, several median costulae moderately distinct. Sides of mesosoma smooth to coarsely shagreened, generally shining, especially on pronotum and propodeum. Propodeal declivity strongly shining. Petiolar peduncle finely shagreened, node more coarsely so, its dorsum with 2 fine longitudinal costulae near midline. Postpetiole finely longitudinally costulate. First gastric tergum, behind basigastric costulae, with a finely etched reticulate microsculpture. Legs shagreened.



Figs. 1-2. *Codiomyrmex tetragnathus* n. sp.; holotype worker: Fig. 1. Head, mesosoma, petiole and postpetiole in lateral view. Fig. 2. Head in frontal view.

Mandibles each with several hairs ventrally; distal edge of labrum with a row of fine looped hairs, forming a thin tangle in its median cleft. Body hairs few, elongate, 0.1-0.24 mm long, arranged in erect bilateral pairs; completely lacking on head. Mesosoma, petiole and postpetiole with 2, 1, and 4 pairs respectively, distributed as in Figure 1. Petiolar and postpetiolar tergites also with a few fine reclinate lateral hairs which arch back over their posterolateral fungiform masses. First gastric tergite with three basilateral pairs, and 1 pair on dorsum near its posterior margin.

Pubescence reduced, dense on antennae, very scattered on frons, extremely scattered on first gastric tergite. Color very dark reddish-brown, mandibles, antennae, legs and tip of gaster more yellowish.

Remarks. C. tetragnathus is easily distinguished from most other members of its genus by many characters, including the head shape, the peculiar mandibular dentition referred to in the specific name, the structure of the propodeal teeth and infradental lamellae, the lack of an anteroventral gastric fungiform mass, the coloration and the extremely reduced pilosity. In the latter character this species belies its generic name even more than does *C. flagellatus*.

The only other known African species, *C. loveridgei,* is close to *tetragnathus*. It is smaller, with a straight transverse occipital border, a much more heavily sculptured head, and more dense pilosity. The three apical mandibular teeth are reduced in size and fused basally, much as in *tetragnathus,* and the anteroventral mass of spongiform material on the first gastric sternite is reduced to a diffuse vestige. It is difficult to decide whether the dental heterogeniety of these species is homologous with that seen in the related genus *Smithistruma,* or whether it represents a convergently developed specialization.

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FIVE NEW SPECIES OF THE GENUS *TMARUS* (ARANEAE, THOMISIDAE) FROM THE WEST INDIES

By Arthur M. Chickering
Museum of Comparative Zoology

The Genus *Tmarus* Simon, 1875, is widely distributed in Europe, Asia, Africa, Australia and in the Americas. This is especially true of South America. It appears to be abundant and highly diversified into species in the Neotropical region. At the present time thirty species are known from Panama alone. But, so far as I have been able to determine, the genus has not been reported from the West Indies until the present time. I was much interested, therefore, to find several species of this genus in my collections made during the last few years in Jamaica, Puerto Rico and Trinidad. These have now been carefully studied with the result that I am obliged to recognize five new species from these islands. Two of these species are known from both sexes; two are known only from males and the remaining one is known only from the female. These five species are described in the following pages of this brief paper and may be listed as follows: *Tmarus craneae* sp. nov.; *T. farri* sp. nov.; *T. insuetus* sp. nov.; *T. menotus* sp. nov.; *T. vertumnus* sp. nov. The types will be deposited in the Museum of Comparative Zoology at Harvard University.

Grant No. GB-1801 from the National Science Foundation made it possible for me to spend seven months making collections of spiders in the West Indies and Panama during the latter part of 1963 and the first five months of 1964. This grant is also making it possible for me to continue my studies at the Museum of Comparative Zoology for a considerable period. A Guggenheim Fellowship made it possible for me to collect in Jamaica, W. I. and in Panama in 1957 and 1958 and also to spend four months in the British Museum (Natural History). Dr. G. Owen Evans and Mr. D. J. Clark, Department of Zoology (Arachnida), British Museum (N. H.) have recently loaned me valuable specimens of the genus *Tmarus* to help me in my studies. As I have frequently stated in my published papers, I am deeply appreciative of the many privileges extended to me by the staff of the Museum of Comparative Zoology, Harvard University, over a period of many years. My studies could never have been carried on as they have been continued without this encouragement. Special acknowledgements should be extended to Dr. Ernst Mayr, Director;

Dr. P. J. Darlington, Jr., Alexander Agassiz Professor of Zoology; Dr. Herbert W. Levi, Associate Curator of Arachnology; and Miss Nelda Wright, Editor of Publications. These acknowledgements should now also be extended to Dr. Frank M. Carpenter, Alexander Agassiz Professor of Zoology and Editor of Psyche in which journal several of my published papers have appeared.

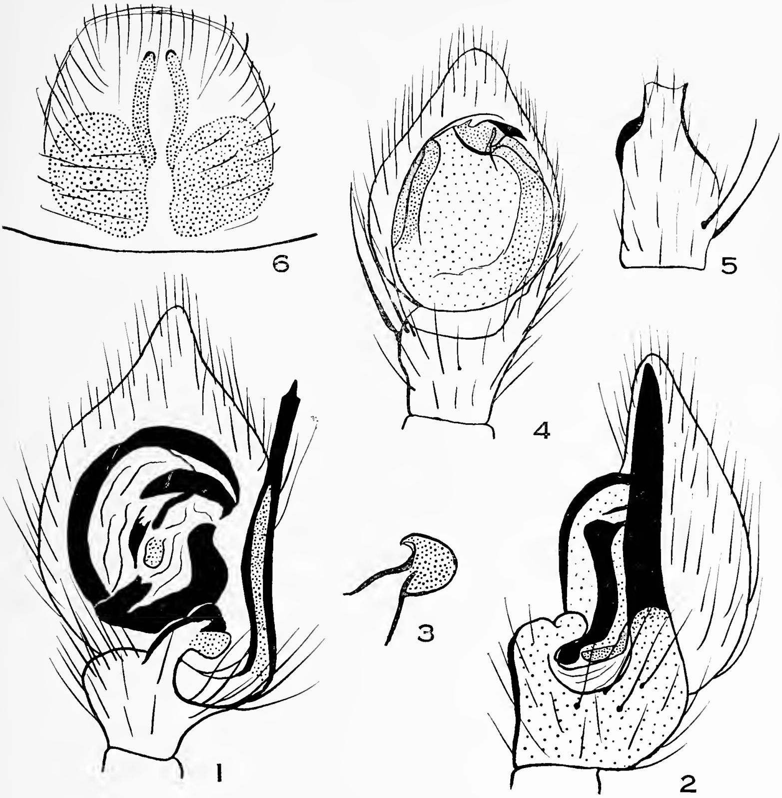
Genus *Tmarus* Simon, 1875

Tmarus craneae sp. nov.

Figures 1-3

This species is named after Miss Jocelyn Crane, Director, The William Beebe Tropical Research Station, Simla, Arima Valley, Trinidad, W. I.

Male holotype. Total length 4.19 mm, including quite porrect chelicerae and extended spinnerets. Carapace 1.52 mm long; 1.38 mm wide; about .53 mm tall, exclusive of the prominent lateral ocular tubercles; with the usual long, slender spines; surface between the spines smooth; with no median thoracic groove. Eyes: viewed from above, posterior row strongly recurved, anterior row moderately so; viewed from in front, anterior row straight, measured by centers. Central ocular quadrangle wider behind than in front in ratio of about 3 : 2; nearly as long as wide behind. Posterior row occupies nearly four fifths of width of carapace at that level. Ratio of eyes AME : ALE : PME : PLE = 5 : 10 : 6 : 10. AME separated from one another by slightly more than twice their diameter, from ALE by 2.6 times their diameter. PME separated from one another by nearly three times their diameter, from PLE by 4.6 times their diameter. Laterals separated from one another by 2.7 times their diameter. Clypeus porrect in the usual manner; apparently with the usual long, slender spines near ventral border (judged by scars); height, including membranous ventral border, equal to about seven times the diameter of AME. Chelicerae, maxillae, lip and sternum all apparently typical of the genus. Legs: 1 = 243 in order of length; first and second nearly twice as long as third and fourth; with many spines; tarsal claws as usual; trichobothria observed on tibiae, metatarsi and tarsi. Palp: patella short, unmodified; tibia with conspicuous apophyses and features of the tarsal bulb as shown in Figures 1-2. Abdomen: elongated and somewhat cylindrical; without special modifications; with numerous long, conspicuous, slender, dorsal spines. Color in alcohol: rather conspicuously colored; carapace yellowish with a narrow, red, ventral, marginal band; a dorsal, irregular, V-shaped



Figs. 1-6. External anatomy of *Tmarus*. Figs. 1-2, *T. craneae* sp. nov., left palpal tibia and tarsus; vertral and retrolateral views, respectively. Fig. 3, *T. craneae* sp. nov., another view of the ventral, tibial apopysis. Fig. 4, *T. farri* sp. nov., left palpal tibia and tarsus; ventral view. Fig. 5, *T. farri* sp. nov., left palpal tibia; retrolateral view. Fig. 6, *T. farri* sp. nov., epigynum from below.

red mark extends from PLE and down the posterior declivity for nearly half its decline; the clypeus bears a broad, somewhat U-shaped red figure; each chelicera bears a red spot on its front surface; other mouth parts generally yellowish; legs yellowish with many red dots and larger spots and stripes; first and second femora and, to a lesser extent, first and second patellae and tibiae, with many small, irregular, reddish spots on the prolateral surfaces; abdomen with a mixture of brown, white and red colors difficult to describe adequately; with a series of five irregular, white, transverse bars closely associated with narrow red bars; these separate the brown area into four more or less rectangular blocks; lateral areas yellowish white with darker, oblique bars; venter with a broad, very light brownish, median stripe flanked on each side by ventrolateral, yellowish white areas. This species seems to be closely related to *T. aculeatus* Chickering and others in which the male palp has the conspicuously developed tibial apophyses.

Type locality. The holotype male is from Simla, Arima Valley, Trinidad, W. I., April 18, 1964. Three immature specimens from the same locality, April, 1964 probably belong to the same species. The female is unknown.

Tmarus farri sp. nov.

Figures 4-6

The species is named after Dr. T. H. Farr, Science Museum, Institute of Jamaica, Kingston, Jamaica, W. I.

Male holotype. Total length from tip of porrect chelicerae to posterior end of somewhat extended spinnerets 3.32 mm. Carapace 1.16 mm long; almost exactly as wide as long; about .48 mm tall; sharply constricted below posterior margin of ALE and then broadly and regularly rounded to posterior border; with several long, slender spines each arising from a small, chitinized tubercle; without a median thoracic groove or pit. Eyes: lateral ocular tubercles well developed; viewed from above, posterior row definitely recurved, anterior row gently so, exclusive of the very convex lenses; seen from in front, anterior row straight, measured by centers. Central ocular quadrangle wider behind than in front in ratio of about 13 : 8; wider behind than long in ratio of about 26 : 23. Posterior row occupies about 10/13 of width of carapace at that level. Ratio of eyes AME : ALE : PME : PLE = 3.5 : 8.5 : 5 : 7.5. AME separated from one another by about three times their diameter, from ALE by a little more than 3.7 times their diameter. PME separated from one another by 3.2 times their diameter, from PLE by 4.6 times their diameter. Laterals separated by slightly more than twice the diameter of PLE. Clypeus quite porrect; apparently with seven spines in an upturned row but the lateral spines are small; height equal to slightly more than seven times the diameter of AME. Chelicerae, maxillae, and lip all typical of males of the genus. Sternum broadly scutiform; slightly convex; longer than wide in ratio of about 10 : 9; with many fine, procurved bristles; posterior end bluntly terminated opposite bases of fourth coxae which are separated by about their width. Legs: 123 =

4 in order of length; first and second more than twice as long as third and fourth; numerous trichobothria observed on tibiae, metatarsi and tarsi. Palp: reminiscent of the palp of *T. ineptus* O. P.-Cambridge and *T. intentus* O. P.-Cambridge as these species are now understood; essential features shown in Figures 4-6. Abdomen: with many spines; about one third from base there is a pair of small, low, dorsal tubercles each topped by a slender, stiff, somewhat recurved spine; about two thirds from base there is a median, low tubercle corresponding to the pronounced posterodorsal tubercle of the female; shortly anterior to this reduced dorsal tubercle the abdomen is somewhat widened; otherwise apparently typical of males of the genus. Color in alcohol: carapace with dorsal area yellowish in general but with small, irregular, reddish brown spots and streaks extending from median margins of tubercles bearing PLE to top of posterior declivity; clypeus about the same; lateral sides a mottled, darker, reddish brown; central part of posterior declivity yellowish with a central darker spot. Chelicerae: front surface with yellowish margins, somewhat darker centrally. Sternum yellowish with small, irregular, darker spots. Maxillae and lip yellowish with variations. Legs: light brownish in general; with brownish, yellowish and reddish spots; first two pairs of femora conspicuously spotted with irregular brownish and whitish spots; first two pairs of metatarsi and tarsi somewhat reddish. Abdomen: dorsum yellowish white with many irregular, small darker spots; venter light brownish centrally, flanked by yellowish white areas.

Female paratype. Total length, including somewhat porrect chelicerae, 3.84 mm. Carapace 1.62 mm long; 1.56 mm wide; about .81 mm tall; with numerous spines each of which arises from a small, chitinized tubercle; with a series of grooves radiating over the lateral regions from the dorsolateral areas. Eyes: lateral ocular tubercles large; with a deep depression separating ALE from PLE; viewed from above, posterior row recurved, anterior row slightly so, exclusive of the very convex lenses of ALE; viewed from in front, anterior row slightly procurved, measured by centers. Central ocular quadrangle wider behind than in front in ratio of about 19 : 12; wider behind than long in ratio of 38 : 31. Posterior row occupies about 11/12 of width of carapace at that level. Ratio of eyes AME : ALE : PME : PLE = 4 : 10.5 : 7 : 9.5. AME separated from one another by nearly four times their diameter, from ALE by a slightly greater distance. PME separated from one another by slightly more than 3.5 times their diameter, from PLE by about 4.7 times their diameter.

Laterals separated by slightly more than twice the diameter of ALE. Clypeus quite porrect; with one erect spine beneath interval separating AME and two erect spines on each side near ventral border; height nearly equal to eight times the diameter of AME. Mouth parts essentially typical of females of the genus. Legs: 1243 in order of length; spines are numerous and, in general, typical of females of the genus; trichobothria essentially as in male, also observed on palpal tibiae. Abdomen: very spiny and irregular along dorsal region (probably associated with shrinkage following deposition of eggs) ; with a well developed posterodorsal tubercle projecting upward at an angle; somewhat the widest in front of base of posterodorsal tubercle. Epigynum: essential features shown in Figure 6; some variations noted among paratypes. Color in alcohol: essentially as decribed for male but all colors are more vivid than in that sex; first two pairs of tarsi and metatarsi not reddish as in male but irregularly yellowish brown.

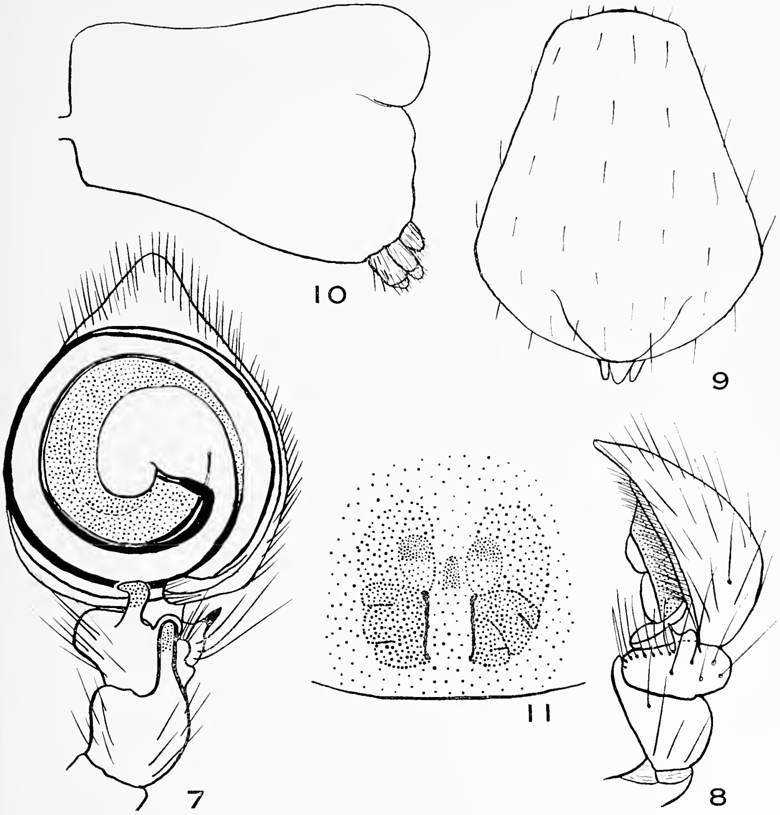
Type locality. Male holotype and female paratype taken on northeast slope of Long Mt., St. Andrew Parish, Jamaica, W. I., October 26th, 1957. Numerous paratypes of both sexes were taken with the holotype and also in St. Catherine Parish, Hanover Parish, and on other parts of St. Andrew Parish in 1954, 1957 and 1963.

Tmarus insuetus sp. nov.

Figures 7-8

The name of the species is a Latin adjective suggested by the unusual type of male palp.

Male holotype. Total length 4.03 mm. Carapace 1.5 mm long; 1.5 mm wide; .63 mm tall; surface very finely granulate; with numerous long, slender spines; posterior declivity gently arched, not steeply slanted. Eyes: ocular tubercles less prominent than usual in the genus but otherwise typical of the genus; viewed from above, posterior row rather strongly recurved, anterior row moderately so; viewed from in front, anterior row slightly recurved, measured by centers. Central ocular quadrangle wider behind than in front in ratio of 11 : 8; longer than wide behind in ratio of 13 : 11. Posterior row occupies about 6/7 of width of carapace at that level. Ratio of eyes AME : ALE : PME : PLE = 4 : 10 : 5 : 9. AME separated from one another by twice their diameter, from ALE by 2.75 times their diameter. PME separated from one another by 2.6 times their diameter, from PLE by nearly five times their diameter. Laterals separated from one another by about 2.2 times the diameter



Figs. 7-11. External Anatomy of *Tmarus*. Fig. 7, *T. insuetus* sp. nov., left palpal patella, tibia and tarsus; ventral view. Fig. 8, *T. insuetus* sp. nov., left palpal patella, tibia and tarsus; retrolateral view. Figs. 9-10, *T. menotus* sp. nov., female abdomen: dorsal and left lateral view; respectively. Fig. 11, *T. menotus* sp. nov., epigynum from below.

of ALE. Clypeus only moderately porrect; with a row of long, slender spines near ventral border; height, including membranous ventral border, nearly equal to six times the diameter of AME. Chelicerae, maxillae, lip and sternum all apparently typical of the genus. Legs: 1 = 234 in order of length; first two pairs very long and slender and with numerous, long, slender spines; third and fourth less than half as long as first and second and with less conspicuous spines; tarsal claws and trichobothria apparently typical of the genus. Palp: complicated; patella with unusual apophysis; tibia with a group of short apophyses; tarsus with embolus encircling the bulb more than three times (Figs. 7-8). Abdomen: cylindrical through anterior two thirds and then much narrowed to posterior end; only a slight indication of a median posterodorsal tubercle at about the beginning of the last quarter. Color in alcohol: less colorful, in general, than usual in the genus. Carapace: yellowish with a reddish streak around the medial borders of the lateral ocular tubercles. Mouth parts and sternum yellowish. Legs yellowish; lacking the conspicuous markings characteristic of many species in the genus. Abdomen: yellowish in general; dorsum with numerous white and reddish spots and transverse bands; venter with a broad, very light brown, central stripe flanked on each side by whitish areas.

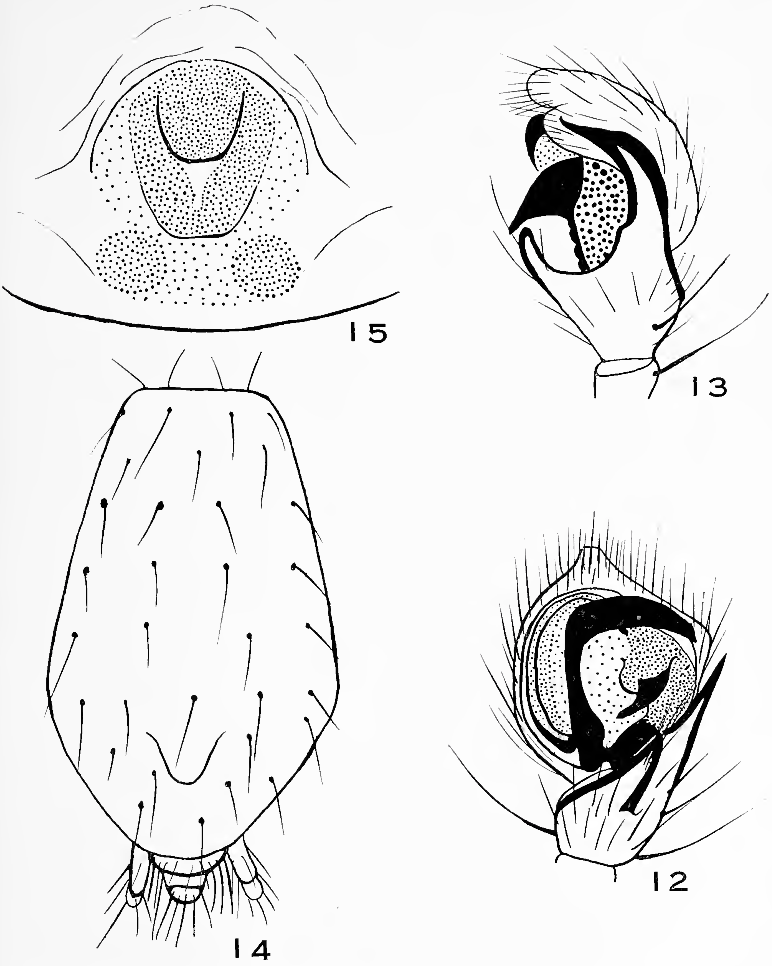
Type locality. The male holotype is from Simla, Arima Valley, Trinidad, W. I., April 23, 1964. One male paratype is in the collection from the same locality, April 17, 1964. The female is unknown.

Tmarus menotus sp. nov.

Figures 9-11

The name of the species is an arbitrary combination of letters.

Female holotype. Total length 5.2 mm, including somewhat porrect chelicerae (length increased somewhat by stretching in preservation). Carapace 1.65 mm long; 1.54 mm wide; about .7 mm tall; otherwise quite typical of females of the genus. Eyes: ocular tubercles as usual in females; viewed from above, posterior row moderately recurved, anterior row gently so, exclusive of the very convex lenses of ALE; viewed from in front, anterior row nearly straight, measured by centers. Central ocular quadrangle wider behind than in front in ratio of 19 : 12; wider behind than long in ratio of 19 : 15. Posterior row occupies a little more than 4/5 of width of carapace at that level. Ratio of eyes AME : ALE : PME : PLE = 5 : 12 : 7 : 10. AME separated from one another by about three times their diameter, from ALE by a slightly greater distance. PME separated from one another by slightly more than 3.5 times their diameter, from PLE by nearly 4.25 times their diameter. Laterals separated by a little more than twice the diameter of PLE. Clypeus quite porrect; with a row of seven slender spines; height nearly equal to seven times the diameter of AME. Chelicerae, maxillae, lip and sternum all apparently typical of females of the genus. Legs: 1 = 243 in order of length; with numerous spines; trichobothria observed on tibiae, metatarsi and tarsi; tarsal claws as usual. Abdomen: short, broad and tall (Figs. 9-10);



Figs. 12-15. External Anatomy of *Tmarus*. Figs. 12-13, *T. vertumus* sp. nov., left palpal tibia and tarsus; ventral and retrolateral views, respectively. Fig. 14, *T. vertumus* sp. nov., female abdomen; dorsal view. Fig. 15, *T. vertumus* sp. nov., epigynum from below.

with a short, obtuse, posterodorsal tubercle; spines short, inconspicuous; other features essentially typical of females of the genus. Epigynum: essential features shown in Figure 11; obscurely distinctive; unlike any other seen during my study of the genus in Panama and the

West Indies. Color in alcohol: carapace yellowish in general, with a mottled appearance; with many fine, brownish dots; bases of largest spines usually brownish; posterior declivity a medium brown. Legs and mouth parts yellowish in general; prolateral surfaces of first two pairs of femora, patellae and tibiae very light yellowish with darker spots. Abdomen: dorsum light yellowish in general but with many fine, dark dots; posterolateral surfaces a medium brown; venter with a narrow, median, light brown stripe flanked on each side by a very light yellowish area.

Type locality. The female holotype is from St. Catherine Parish, six miles east of May Pen, Jamaica, W. I., November 22, 1957. There are no paratypes and the male is unknown.

Tmarus vertumus sp. nov.
Figures 12-15

The name of the species is an arbitrary combination of letters.

Male holotype. Total length, including somewhat porrect chelicerae and extended spinnerets, 4.1 mm. Carapace 1.43 mm long; 1.41 mm wide; about .65 mm tall; ventral margin regularly rounded from opposite interval between ALE and PLE to posterior border; otherwise quite typical of males of the genus in the neotropical region. Eyes: lateral ocular tubercles well developed; those bearing AME and PME moderately so; viewed from above, posterior row rather strongly recurved, anterior row gently so, exclusive of the strongly convex lenses of ALE; viewed from in front, anterior row slightly procurved, measured by centers. Central ocular quadrangle wider behind than in front in ratio of about 3 : 2; wider behind than long in ratio of about 6 : 5. Posterior row occupies nearly .8 of width of carapace at that level. Ratio of eyes AME : ALE : PME : PLE = 4 : 9.5 : 6 : 9. AME separated from one another by about three times their diameter, from ALE by 3.5 times their diameter. PME separated from one another by slightly more than three times their diameter, from PLE by 4.3 times their diameter. Laterals separated by slightly more than twice the diameter of ALE. Clypeus: quite porrect; with the usual row of seven spines near ventral border; height equal to seven times the diameter of AME. Chelicerae, maxillae, lip and sternum all apparently typical of the genus. Legs: 123 = 4 in order of length; spines about as usual; tarsal claws typical; trichobothria observed on tibiae, metatarsi and tarsi. Palp: essential features shown in Figures 12-13; femur of moderate length; patella short, unmodified; tibia with two conspicuous apophyses; tarsus with a hook near center of bulb. Abdomen: first three fifths somewhat cylindrical in form; not flattened; widened a little about 2/3 from base; a short distance posterior to widened region there is a small, median, dorsal tubercle corresponding to the more conspicuous tubercle in the female; other features essentially typical of the genus. Color in alcohol: carapace yellowish in general; with many minute reddish dots and brownish spots and streaks impossible to describe in detail. Legs: yellowish with many small, reddish spots and streaks; first two pairs of femora with the characteristic mottled prolateral and retrolateral surfaces; third and fourth legs with more reddish spots than other legs. Sternum yellowish with small, pinkish dots irregularly distributed near margin. Abdomen: dorsum pinkish in general; a very narrow, reddish band extends across the widened region; irregular, reddish streaks occur in the posterior third of the dorsum and an irregular, narrow, reddish band separated in the middle occurs about half way between the base and the widened region; lateral sides yellowish with reddish dots and streaks; venter very light brown through the center flanked by whitish areas.

Female paratype. Total length, including porrect chelicerae and somewhat extended spinnerets, 5.91 mm; total length from anterior border of clypeus to posterior end of anal tubercle 5.4 mm. Carapace 1.8 mm long; 1.65 mm wide; about .7 mm tall; with about twelve long, slender spines around border of posterior declivity. Eyes: curvature of rows essentially as in male. Central ocular quadrangle wider behind than in front in ratio of about 3 : 2; wider behind than long in ratio of nearly 4 : 3. Ratio of eyes AME : ALE : PME : PLE = 5 : 12 : 7 : 10. AME separated from one another by a little more than three times their diameter; from ALE by slightly more than 3.5 times their diameter. PME separated from one another by about 3.5 times their diameter, from PLE by a little more than 4.6 times their diameter. Laterals separated by 2.3 times the diameter of PLE. Height of clypeus nearly equal to eight times the diameter of AME. Chelicerae, maxillae, lip and sternum all typical of females of the genus. Legs: 123 = 4 in order of length; spines, tarsal claws, palpal claws and trichobothria all typical of females of the genus studied by the author. Abdomen: considerably more robust than in male; much widened two thirds from base and then sharply narrowed to posterior end; posterodorsal tubercle somewhat more prominent than in male (Fig. 14). Epigynum: obscurely distinctive; unlike any other seen in the genus from the Neotropical region; essential features shown in Figure 15; some variations noted among paratypes. Color in alcohol: essentially like that of male.

Type locality. Male holotype from university farm east of campus, Mayaguez, Puerto Rico, W. I., January 15, 1964; female paratype from university farm north of campus, Mayaguez, January 17, 1964. Several paratypes of both sexes were taken with the described male and female types, at other localities in the same general region and on Route 106, 5 km. east of Mayaguez during January and February, 1964.

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A KEY TO NORTH AMERICAN *STATIRA* (COLEOPTERA: LAGRIIDAE)

By Carl T. Parsons
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From time to time during the past several years I have studied the Lagriidae with C. W. Leng's excellent collection as a basis. To this collection has been added valuable series especially from the southwest and Mexico generously presented by Dr. Floyd Werner. As indicated in the table of abbreviations below, various public and private collections have been examined. I am deeply indebted to the respective curators and individuals for extending this privilege.*

In the course of this study a few additions to our fauna turned up and a few changes seem advisable. Much more material is needed to clear up still pending problems. An account of *Arthromacra* will follow.

Key to North American *Statira*

1. At least middle and hind tibiae distinctly sulcate along nearly entire outer edge; disc of pronotum scabrous or rugulose 2
   Tibiae on outer edge rounded or flat (rarely feebly sulcate distally) as in *defecta,* disc of pronotum variably punctate, intervals between punctures usually alutaceous, rarely smooth 5
2. Setigerous punctures on first elytral interval not more than 6, on 3rd not more than 8, on 5th not more than 5, on 7th not more than 2, on 9th not more than 5 3
   Setigerous punctures on first elytral interval not less than 10, on 3rd not less than 13, on 5th not less than 12, on 7th not less than 10, on 9th not less than 11 4
3. Lateral margin of prothorax obliterated anteriorly, becoming distinct posteriorly; pronotum finely scabrous, rich dark

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*Specimens studied are referred to by abbreviations as follows: (A.M.N.H.), American Museum of Natural History; (A.N.S.P.), Academy of Natural Sciences Philadelphia; (C.A.F.), C. A. Frost collection in M.C.Z.; (C.T.P.), C. T. Parsons collection, Manchester Depot, Vermont; (C.U.), Cornell University; (F.P.B.), Florida Plant Board, Gainesville; (H.C.F.), H. C. Fall collection in M.C.Z.; (H.F.H.), Henry F. Howden collection; (Ill. N. H. S.), Illinois Natural History Survey; (M.C.Z.), Museum of Comparative Zoology; (U.S.N.M.), United States National Museum.

Manuscript received by the editor March 16, 1965.

brown; labrum, base of antennae, and legs paler; subopaque; in both sexes apical antennal segment equal to next 2½ segments .... *subnitida*

Lateral margin of prothorax evanescent anteriorly but just discernible; pronotum densely, minutely, punctulate, rugulose, and opaque; piceous, except prothorax, scutellum, legs, and basal two antennal segments rufo-testaceous; male apical antennal segment equal to next 3½ segments .... *colorata*

4\. Lateral margin of prothorax almost always obliterated anteriorly but starting at the middle becoming distinct posteriorly, rarely the margin continuing obsoletely to the anterior edge; margins of sulcus on fore and middle tibiae similar; pronotum finely rugulose and scabrous, much finer than eye facets; 1st elytral interval with 11-16 setigerous punctures, 3rd with 14-21, 5th with 12-20, 7th with 10-17 and 9th with 12-20 setigerous punctures .... *pluripunctata*

Lateral margin of prothorax entire and distinct; either anterior or posterior margin of sulcus on fore and mid tibiae raised to form a blackish carina; pronotum moderately coarsely scabrous, about as course as eye facets; 1st elytral interval with 20-28, 3rd with 21-26, 5th with 22-26, 7th with 22-28, and 9th with 22-35 setigerous punctures .... *hirsuta*

5\. Elytra testaceous to rufous with brown to black markings; no setigerous punctures on 5th elytral interval (except rarely 1 at apex) 6

Elytra unicolorous, usually dark (testaceous in teneral examples); several setigerous punctures on 5th elytral interval 7

6\. Male apical antennal segment equal to next 5 segments, in female equal to next 3½-4 segments; testaceous to rufous, elytra slightly paler, with large scutellar spot and transverse fascia, slightly behind middle and wider at sides than at middle, brown or black; 0-1 setigerous puncture at base of 1st elytral interval, 3rd elytral interval with 4-6 from base to apex, 7th with 2 at base, 9th with 4 along apical fourth .... *pulchella*

Male apical antennal segment equal to next 4-4 1/5 segments, in female equal to next 3 segments; rufo-testaceous, median black spot on each elytron not reaching the suture; 3rd elytral interval with 5-9 setigerous punctures, 7th with 2 at base, 9th with 3-4 along apical fourth .... *nigromaculata*

7\. Setigerous punctures on 1st elytral interval 19-26, on 3rd interval 18-33, on 5th interval 17-23, on 7th interval 8-13, on 9th interval 8-24 8

Setigerous punctures on 1st elytral interval 2-5, on 3rd interval 4-15, on 5th interval 4-11, on 7th interval 2-8, on 9th interval 4-11 9

8. Setigerous punctures on 1st elytral interval about 25, on 3rd interval 26-33, on 5th interval 17-23, on 7th interval 8-13, on 9th interval 8-17; setigerous punctures about as large as strial punctures, pronotum opaque, male apical antennal segment equal to next 4¼ segments, in female equal to next 3-3¼; length 9-11 mm. .... *opacicollis*

Setigerous punctures on first elytral interval 19-25, on 3rd interval 18-21, on 5th interval about 18, on 7th interval about 8, on 9th interval about 24; setigerous punctures at least twice as large as strial punctures; pronotum sub-opaque; male apical antennal segment equal to next 3¾-4, in female equal to next 3; length 12.5-14 mm. .... *huachucae*

9. Fore and middle tibiae rounded on outer edge; male apical antennal segment equal to next 3¾-7 segments, in female equal to next 2½-4 segments 10

Fore and middle tibiae flat on outer edge (rarely feebly sulcate distally); male apical antennal segment equal to next 2½-2¾ segments, in female equal to next 2-2¼ segments; disc of pronotum very densely and finely punctate, the punctures less than their diameters apart, the surface finely alutaceous; setigerous punctures on 1st elytral interval 4-5, on 3rd interval 3-6, on 5th interval 3-5, on 7th interval 1-3, on 9th interval 5-6 .... *defecta*

10. Disc of pronotum with punctures on the average at least 3 times their diameter apart; elytra brown to black (except bluish in *croceicollis* 11

Disc of pronotum with punctures separated by about their diameter; rufous, legs testaceous, abdomen piceous, elytra black with metallic bluish-green lustre; setigerous punctures on 3rd elytral interval 5-7, on 5th interval 4-5, on 7th interval 2 at base, on 9th interval about 6; male apical antennal segment equal to next 5½-5¾ segments, in the female equal to next 3¼ segments; length 9-10 mm. .... *liebecki*

11. Setigerous punctures on 3rd elytral interval 7-15 12

Setigerous punctures on 3rd elytral interval 3-5 13

12. Length 10.5-12.5 mm.; male apical antennal segment equal to next 3¾-4 1/3 segments, in female equal to next 2½-3 segments; brown to piceous black, head darker; setigerous punctures on 3rd elytral interval 10-15, on 5th interval about 11,

on 7th interval 5 on basal three-fifths, on 9th interval 8-11 .... *robusta*

Length 7-9.5 mm.; male apical antennal segment equal to next 4¾-5 segments, in female equal to next 3-3½ segments; prothorax and legs testaceous or rufous, head piceous, elytra piceous or black, the elytra with a distinct bluish lustre; setigerous punctures on 3rd elytral interval 7-14, on 5th interval 7-12, on 7th interval either 2 at base or 6-8 all along, on 9th interval 5-13 .... *croceicollis*

13. Setigerous punctures of elytra about the same size as the strial punctures; larger, 8-11.5 mm. 14

Setigerous punctures of elytra about twice as large as the strial punctures; smaller, 6.5-8.8 mm. 15

14. Posterior margin of fifth ventral segment produced around a distinct fovea; male apical antennal segment equal to next 4 2/3-5 segments, in the female equal to next 3 2/3-3 3/4 segments; color paler, tending to brown rather than piceous, elytra tending to brown especially along sutural margins .... *dolera* n. sp.

Posterior margin of fifth ventral segment simple, without fovea; male apical antennal segment equal to next 6½-7 segments, in the female equal to the next 4 segments or slightly less; color darker, tending to piceous black, elytra sometimes slightly more pale and with very narrow brown sutural margins .... *basalis*

15. Pronotum brownish piceous to piceous black usually concolorous with elytra; male apical antennal segment equal to next 5½ segments, in the female equal to next 3 1/3 segments, range Vermont to Wisconsin south to North Carolina and Tennessee .... *gagatina gagatina*

Pronotum testaceous to brownish rufous, head and elytra brownish piceous to piceous black; male apical antennal segment equal to next 5½-6½ segments, in the female equal to next 3 1/3 segments; range more southern, New York City to Alabama, also Michigan .... *gagatina resplendens*

Statira subnitida Leconte

Statira subnitida Lec., 1866, Smithsonian Misc. Coll., Wash., 167: 141-142.

Types: lectotype ♂ (not ♀ as Horn stated) no. 4749 and 1♀ cotype collected by John Xantus at Cape San Lucas, Baja California, in M.C.Z.

Range: Known only from Baja Califronia, Mexico, from the two types and female from Santa Rosa (H.C.F. in M.C.Z.). In the Horn collection (A.N.S.P.) are three specimens identified as *subnitida* in Horn's handwriting. The first from San Jose del Cabo is *colorata* and the other two are *defecta* from "Ariz".

Statira colorata Fall

Statira colorata Fall, 1909, Canadian Entomologist, 41: 165-166.

Types: holotype ♂ no. 24613 collected by Charles Fuchs at San José del Cabo, Baja California, Mexico (H.C.F.) With identical data are two males in the Casey collection (U.S.N.M.) and one male in the Horn collection (A.N.S.P.)

Statira pluripunctata Horn

Statira pluripunctata Horn, 1888, Trans. Amer. Ent. Soc. 15: 29.
Statira sulcicrus Champion, 1889, Biol. Centr.-Amer. Coleop. 4(2): 51-52. NEW SYNONYMY.

Types: of *pluripunctata* lectotype ♀ no. 8018 from Arizona (A.N.S.P.) and 1 ♀ evidently a cotype in the Leconte coll. (M.C.Z.) Of *sulcicrus* 2 ♂♂ and 2 ♀♀ cotypes collected by Hoge at Chilpancingo, Guerro, Mexico in the British Museum.

In the United States this common species is most nearly allied to *hirsuta.* But in must be nearer *pueblensis* Champion (not seen), which is said to be more stout, antennae less slender, hairs on femora longer, and pronotum densely, finely, and irregularly punctate and wrinkled, with prothorax more distinctly margined. Champion's *sulcicrus* is made a synonym from description only.

G. H. Nelson has collected in Arizona two examples which do not key out. A male taken on *Ephedra trifurca,* Aug. 28, 1954, at Portal has setigenous punctures on base only of first elytral interval and half the normal number of punctures on the other intervals. The other specimen, collected at light in Sabino Canyon, Santa Catalin Mts. Aug. 25, 1959, has typical male terminalia but only 4 setigerous punctures on first, 10 punctures on third, and 7 punctures on fifth elytral interval.

Range: This species occurs from June 20 to Sept. 20, chiefly late July to early August in southern Utah: state label (C.T.P.), St. George (C.U., A.M.N.H.), South Creek, Beaver Co. (C.U.) Texas: Alpine (C.U., H.C.F.), 2 and 15 miles west of Fort Davis (H.F.H.) New Mexico: La Cueva, Organ Mts. (H.C.F.); Arizona: Cochise Co., Santa Cruz Co., Pima Co., Pinal Co., Gila Co., Maricopa Co., Yavapai Co.; Mexico: Sonora (A.M.N.H.), Chihuahua (A.M.N.H., C.T.P.) Durango (A.M.N.H., C.T.P.), Guerrero (B.M.)

Habitat: It has been collected on cotton, *Datura meteloides,* and from leaf axils of *Yucca* with dead flowers in them. Werner and Nutting have taken it at light in the following plant associations in Arizona (C.T.P.): *Larrea,* mesquite-cholla, chaparral, sycamore-oak-ash, and mesquite-desert grassland.

Statira hirsuta Champion

Statira hirsuta Champion, 1889, Biol. Centr.-Amer. Coleop. 4(2): 50-51.

Statira simulans Schaeffer, 1905, Journ. New York Ent. Soc. 13: 180. NEW SYNONYMY.

Types: of *hirsuta* cotypes from "Mexico (coll. F. Bates), Jalapa, Iguala in Guerrero, Tapachula in Chiapas (Hoge); Nicaragua, Chontales (Belt) all in the British Museum. Jalapa is here designated the type locality since a series, of which two are in the A.M.N.H., was collected there. Of *simulans* from Brownsville, Texas (U.S.N.M.).

Range: In the United States *hirsuta* occurs from June 7 to August 8 in southeastern Texas at Brownsville, usually at the Esperanza Ranch. Also in the authors's collection is a specimen taken by Henry Wenzel in Dimmit Co., 250 miles northwest of Brownsville. The species extends through Mexico: (May 24 to August 22) Nuevo Leon, Tamaulipas, Vera Cruz, Mexico City, Guerrero, Chiapas to Nicaragua.

Habitat: F. Werner and W. Nutting collected *hirsuta* at light in desert shrub in Nuevo Leon and at light in mesophytic forest in Tamaulipas.

Statira pulchella Mäklin

Statira pulchella Mäklin, 1863, Act. Soc. Sci. Fenn. 7: 589. Reprinted April 13, 1863, pp. 101-2. Figured by Champion, 1889, Biol. Centr.-Amer. pl. 2, fig. 8.

Type: from Mexico presumably in the Zool. Mus. in Helsinki.

Range: This species occurs in the United States in extreme southeastern Texas at Brownsville where J. N. Knull collected a series on June 1-8, 1934 (H.C.F.) In Mexico it has been taken on the Atlantic slope in Vera Cruz: Jalapa (B.M., A.M.N.H.), Cordova (B.M.), Atoyac (B.M.) and in eastern San Luis Potosi: Tamasunchale (C.T.P.)

Habitat: F. Werner and W. Nutting took the Tamasunchale specimen at light in open river bottom on May 30.

Statira nigromaculata Champion

Statira nigromaculata Champion, 1889, Biol. Centr.-Amer. Coleop. 4(2): 33-34, pl. 2, fig. 9.

Types: from Mexico: Jalapa in Vera Cruz and Yolos in Oxaca; Guatemala: San Geronimo in the British Museum.
Range: This rare species occurs in southeastern Arizona: Aug. 6, 1948, Geronimo, Graham Co. (C.T.P.); July 1-15, 1923, Baboquivari Mts. (H.C.F.); July 18, 1948, Sonoita River, Patagonia, Santa Cruz Co. (A.M.N.H.); at light July 7, 1957 and at light July 26, 1948, Sabino Canyon, Santa Catalina Mts. (C.T.P., C.A.F.); Texas: July 20, 1956, 2 miles west of Ft. Davis (H.F.H., G.N., C.T.P.); July 26, 1956, Limpia Canyon near Ft. Davis (C.U.); Mexico: July 14 and 15, 1947, Camargo and 15 miles east of Parrah in Chihuahua (A.M.N.H.); also the above type localities.
Habitat: H. & A. Howden took a series at Ft. Davis on willow. Werner and Nutting took a series at light in the sycamore-oak-mesquite association in Sabino Canyon and the Geronaimo, Arizona specimen in willow-mesquite-cottonwood association.

Statira opacicollis Horn

Statira opacicollis Horn, 1888, Trans. Amer. Ent. Soc. 15: 30.

Types: lectotype ♂ no. 8017 collected by Morrison in Arizona (A.N.S.P.). Two evident cotypes are in the Leconte coll. (M.C.Z.)
Range: This rare species is known definitely from southeastern Arizona in Gila Co.: Sierra Ancha Mts. (C.U.) and Cochise Co.: Chiricahua Mts. A series of 67 specimens were taken by M. Statham May 3-19, 1956 at 5400 ft. five miles west of Portal, Cochise Co., Arizona (A.M.N.H., C.T.P., C.A.F.)

Statira huachucae Schaeffer

Statira huachucae Schaeffer, 1905, Science Bull. of the Museum of the Brooklyn Inst. of Arts and Sciences 1(7): 176.

Types: cotype ♂ and cotype ♀ both no. 42558 (U.S.N.M.), both labelled "type" in Schaeffer's writing. They were collected by Charles Schaeffer June 13, 14 in the Huachuca Mts. Arizona.
Range: This rare species is known from southeastern Arizona: July 14, 1952, Madera Canyon, Santa Rita Mts. in Pima Co., George Bradt (A.M.N.H.); July, Palmerlee, Cochise Co. (C.T.P.); and the following records from the Huachuca Mts.: July 1905 (C.T.P.); July 14, 1928, 6000 ft., A. A. Nichol (C.U.); July 14, 1928, 6000 ft., A. A. Nichol (C.U.); June 24 and July 13 (C.U.).

Champion (1889, p. 30) described *Statira alternans* based on a unique male from Tepansacualco, Mexico. It is possible that *huachucae* and *alternans* are identical. A specimen that is questionably *alternans* was taken June 4, 1948 at 8000 ft. at Gaborachic, Chihuahua, Mexico by George Bradt (A.M.N.H.).

Statira defecta Schaeffer

Statira defecta Schaeffer, 1905, Science Bull., Mus. Brooklyn Inst. of Arts and Sciences. 1(7): 175.

Type: Holotype no. 42557 Palmerlee, Cochise Co., Arizona (U.S.N.M.)

Range: This common species occurs in southeastern Arizona and adjoining New Mexico from July 5 to September 3, preponderantly during the latter half of July. In Arizona it extends from extreme southern Navajo Co., Gila Co., Pima Co., Santa Cruz Co., to Cochise Co., and across into Hidalgo Co., New Mexico.

Habitat: Werner and Nutting have taken it at light in the following plant associations in Arizona (C.T.P.): cholla-mesquite, chaparrel, oak-hackberry, sycamore-oak-mesquite, and rich mesophytic valley in pine zone.

Statira liebecki Leng

Statira liebecki Leng, 1923, Journ. New York Ent. Soc. 31: 185-187.

Types: holotype ♂ from Enterprise, Florida and allotype ♀ collected by H. P. Loding May 15, 1919 at Spring Hill, Alabama, both in author's collection (ex coll. C. W. Leng).

Range: This very rare spring species is known from the following records in addition to the above mentioned types: two male paratypes no. 26543 from Enterprise, Florida (H.C.F. ex Liebeck coll.); one male collected by H. P. Loding at Orchard, Alabama (H.C.F.); one female paratype, April 24, Crescent City, Florida (A.M.N.H.) and one paratype collected by W. T. Davis, April 29 at South Bay, Lake Okeechobee, Florida in Staten Island Inst. of Arts and Sci.; one male collected and presented by H. V. Weems, Jr. at Highland Hammock State Park, Florida on March 20. (C.T.P.)

This species appears to be closely related to or possibly identical with var. a of *Statira mexicana* Champion which occurs on the eastern slope of Mexico.

Statira robusta Schaeffer

Statira robusta Schaeffer, 1905, Journ. New York Ent. Soc. 13: 180.

Type: holotype ♀ no. 42556 collected by Charles Palm at Globe, Arizona (U.S.N.M.)

Range: This species occurs May to August in Colorado: Colorado Springs (Ill. N. H. S.); Arizona: Yavapai Co.; Maricopa Co., Gila Co., Cochise Co.; New Mexico: San Miguel Co., Otero Co.; Texas: Brewster Co.

Habitat: Werner and Nutting collected *robusta* on July 9 at light in the pinon-juniper-oak association in the Chisos Mts. of Texas (C.T.P.).

Evidently *robusta* is closely related to or possibly identical with *tuberosa* which Champion described, p. 31, from one female from Jalapa, Mexico. So far no Mexican examples have been seen.

Statira croceicollis Mäklin

Statira croceicollis Mäklin, 1863, Act. Soc. Sci. Fenn. 7: 594. ReprintedApril 13, 1863, p. 106.

Type: collected by Motschulsky at Mobile, Alabama; presumably in the Zool. Mus. in Helsinki.

Range: This early spring species has been collected during March 9 to April 24 most often in peninsular Florida: Dunedin (H.C.F., C.U.), Enterprise (C.T.P., H.C.F.), Jupiter (M.C.Z., Ill. N.H.S.), Kissimmee (A.M.N.H.), Lake Worth (C.U.), Biscayne (A.N.S.P.), Miami (CT.P.), Paradise Key (H.C.F., C.A.F.), Key Largo (A.M.N.H.) There are two specimens from Georgia: St. Simons Island (C.T.P.), "Geo." (H.C.F.); two specimens from Mississippi: Ocean Springs (C.U.), Lucedale (C.U.); and a female collected by A. Nicolay on June 23, 1933 at Chesapeake Beach, Maryland (H.C.F.)

Statira dolera new species

fig. 1.

Having the appearance of a teneral *basalis* but a little larger and distinctly larger than *gagatina*. The color tends to be more pale than *basalis* with the sutural margins of the elytra more pale than the rest of the elytra; shining, piceous, with the head darker and the elytra usually more pale, legs testaceous to brown with a tendency for the apices of the femora to be darker. Antennae and anterior part of head rufous. Vertex narrower than in *gagatina,* densely rather coarsely punctate, much more coarsely punctate than pronotum but a little more finely punctate than elytral striae. Eleventh antennal segment as long as 10th, 9th, 8th, 7th, and ¾ of 6th to all of 6th segments combined in the male and as long as the 10th, 9th, 8th, and 2/3-3/4 of 7th segments combined in the female. Prothorax of holotype with width/length as 1/.90, in the allotype as 1/.93; anterior margin truncate or very feebly emarginate, sides more rounded than in *gagatina* or *basalis,* posterior margin truncate, lateral line distinct and entire, disc very finely and sparsely punctate, the punctures about 6× their diameters apart, the intervals very finely granular. In the allotype and some paratypes the punctures

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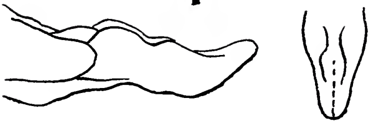

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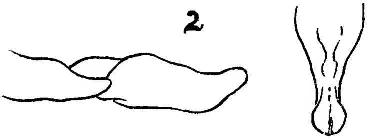

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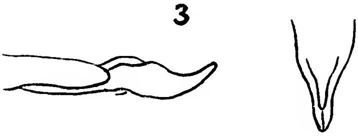

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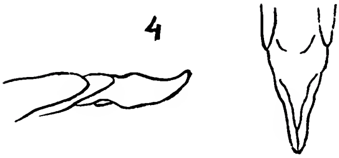

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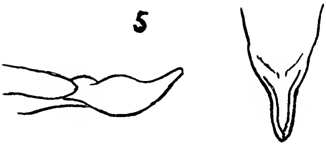

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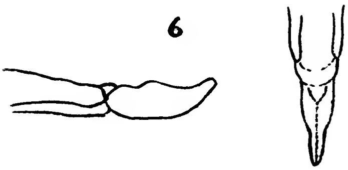

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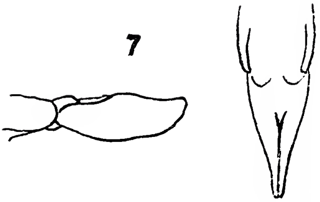

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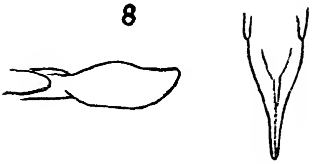

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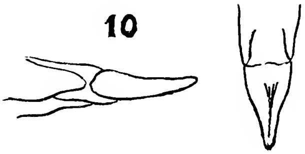

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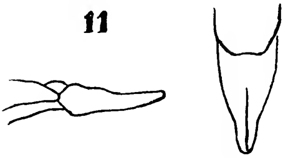

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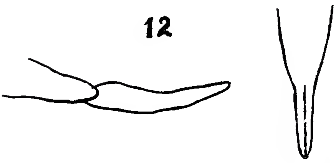

PARSONS — STATIRA

may be variably obsolete and the intervals almost smooth. Scutellum distinctly or obsoletely granular and distinctly or obsoletely very finely punctate.

Elytra striate with closely placed punctures along the striae, the intervals moderately convex and with the setigerous punctures the same size as the strial punctures. In presenting the numbers of setigerous punctures along the elytral intervals the first figure is of the holotype, the second where present of the allotype, and figures in parentheses represent variations in the paratypes. First elytral interval with 1 setigerous puncture at base and 2 (3) at apex, 3rd interval with 6, 5 (5-8) setigerous punctures placed all along, the 5th interval with 6, 4 (4-6), 7th interval with 2, 2 at base (there may also be 1 at apex), 9th interval with 6, 7 (5-11) along apical half. Femora glabrous, tibiae rounded on outer edge. In both sexes the posterior margin of the fifth ventral segment is produced around a distinct fovea, a character lacking in our other species. Male terminalia as figured. Holotype: length 10.7 mm., width of prothorax 1.95 mm., width of elytra at humeri 2.9 mm.; allotype: length 9.3 mm., width of prothorax 1.6 mm., width of elytra at humeri 2.5 mm. For this species the dimensions of the holotype are typical whereas dimensions of the allotype are minimum.

Range: All the specimens were taken from February 19 to May 1-12 in Florida as follows. Holotype ♂ Gainsville, H. L. Dozier (C.T.P. ex C. W. Leng); allotype ♀ April 1, 1947, Lake Placid, J. W. Green (C.T.P.). The following are designated paratypes. 1♀ April, Enterprise (C.T.P.); 1♀ Key West (C.T.P.); 2 ♀♀, 1 ♂ Florida (C.T.P., H.C.F.); 1♂ March 5, 1939, Edgewater, C. A. Frost (C.A.F.); 2♂♂ April 6, 1929 Dunedin, W. S. Blatchley (C.U., C.A.F.), ♀ washup Feb. 26, 1939 Coronado Beach, C. A. Frost (C.A.F.); 1♂ Feb. 19, Crescent City, Hubbard & Schwarz (U.S.N.M.); 1♂ Florida, Hubbard & Schwarz (U.S.N.M.); 1♂ March 1, Haulover, Hubbard & Schwarz (U.S.N.M.); 1♀ March 5, 1948, Gainsville, L. A. Hetrick (Florida Plant Board); Florida, A. T. Slosson (A.M.N.H.); 1♂ Lake Worth, A. T. Slosson (A.M.N.H.); 2 Ormond, A. T. Slosson (A.M.N.H.) (M.C.Z.); 1 ♂ Orange Grove, O. Seifert (C.T.P.); 1♀ March 20, 1955 and 3 ♂♂, 48 ♀♀ March 23-30, 1954, Oneco, Manatee Co. (C.U.,

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EXPLANATION OF PLATE 18

Figs. 1-12. Lateral and dorsal views of the terminalia of *Statira*. 1. *dolera* n. sp. 2. *basalis*. 3. *gagatina*. 4. *gagatina resplendens*. 5. species "S. Cal." 6. *liebecki*. 7. *huachucae*. 8. *robusta*. 9. *opacicollis*. 10. *pluripunctata*. 11. *colorata*. 12. *simulans*.

C.T.P.); 1 May 1-12, 1955, Welaka (C.U.); 2 Florida (Ill. N.H.S.); March 6, 1927, Micanopy (C.U.); March 6, 1945, Lake Placid (C.U.); 4 at light March 11, 1956, Titusville (H.F.H.); 13 Georgetown, March, April (M.C.Z.); 1♀ Sebastian (M.C.Z.); 1♂ 1♀ Waccassa River, Gulf Hammock, Levy Co. March 20, 1954 (C.U.)

Relationships: This species is most nearly related to *basalis* (Fig. 2), but averages larger, paler, and has shorter apical antennal segments, and distinctive hypopygidium and male terminalia (Fig. 1). Also the pronotum is usually more finely and sparsely punctate and the elytral intervals usually more convex.

Statira basalis Horn

Statira basalis Horn, 1888, Trans. Amer. Ent. Soc. 15: 31-32.

Type: lectotype no. 8016 from Florida in Acad. Nat. Sci. Philadelphia.

Range: This species occurs from February 15 to June, chiefly during April from North Carolina: Lake Mattamuskeet, Wilmington; South Carolina: Camden, Sampit; Georgia: Atlanta, Clarke Co.; to northern Florida: St. Johns Co., Rock Bluff, Osceola Nat. Forest; west through Alabama: Washington Co., Hazen, Florala, Mobile; Mississippi: Lafayette Co., Oxford, Richton, Lucedale; Louisiana: Vowell's Mill; Missouri: Poplar Bluff; Arkansas: South West, Cove Lake near Paris, Mt. Magazine; to Texas: Dallas.

Habitat: At Hazen, Alabama L. B. Woodruff beat *basalis* from oak and *Crataegus* blossoms in April.

Statira gagatina gagatina Melsheimer

Fig. 3

Statyra gagatina Melsh., 1846, Proc. Acad. Nat. Sci. Philadelphia 2: 311.
Statyra resplendens var. *fusca* Melsh. *ibid.* NEW SYNONYMY.

Types: of *gagatina* lectotype from Pennsylvania in Melsheimer collection (M.C.Z.) The lower of two specimens on one pin is designated the lectotype. What Leconte chose as type and labelled "*S. gagatina* ! Mels." is *basalis* Horn. Of var. *fusca* holotype labelled "var. *fusca* Melsh." in Melsheimer's handwriting in the Melsheimer collection (M.C.Z.)

The variability of *gagatina* has led to confusion which cannot yet be cleared up. The color varies from pale brown to black, the paler specimens being teneral. As Leng points out (Journ. N.Y. Ent. Soc. 31: 186-7) *gagatina* means "like asphalt or jet". Melsheimer described *gagatina* as "black, tinged with bluish, glossy". But specimens in his collection are brown to piceous. My notes on the

lectotype read "dark brown". Melsheimer described *fusca* as "uniformly yellowish-brown". It is just like teneral northern examples of *gagatina.* There is an occasional tendency for the pronotum to be paler than the head and elytra as in *resplendens.* The more extreme variations are discussed under *resplendens* and "sp. near *gagatina*".
Range: This species occurs, March 29 to July 25 chiefly in May, from southern Vermont: Bennington Co.; Massachusetts: Woods Hole, Marion; to North Carolina: Bell Island; Tennessee: Bristol, Knoxville; Arkansas: "Ark." (Ill. N. H. S.) a doubtful dealer's label; Iowa and Wisconsin.
Habitat: Melsheimer collected *gagatina* in June on leaves of black oak and service berry. It has also been taken by beating apple, hickory, sweet gum, wild cherry, and *Pinus virginiana.*

Statira gagatina resplendens Melsheimer
Fig. 4

Statyra resplendens Melsh., 1846, Proc. Acad. Nat. Sci. Philadephia 2: 311.
Type: described from Pennsylvania. Leconte has stated that the unique types of Melsheimer are in his collection. Some of these were subsequently returned to the Melsheimer collection. In the Leconte coll. (M.C.Z.) is a specimen labelled "S. resplendens! Mels." which means Leconte considered it the type. Unfortunately the locality label is an orange disc which indicates "southern states".

This name is questionable. It stands for *gagatina* in the more southern part of its range with a more or less rufous pronotum and last antennal segment a little longer. The most distinctive specimen seen is a male, July 4, 1925, Oakland Co., Michigan in the G. H. Nelson collection. This specimen has the last antennal segment equal to the next 6½ segments. Its slightly different terminalia is figured. Only very few specimens, ranging from New York City to Alabama, have been seen.

Statira sp. near *gagatina*
Fig. 5

In the collection of the Illinois Natural History Survey (Andreas Bolter coll.) is a male labelled "S. Cal." It is evidently closely related to *gagatina* but has a shorter last antennal segment, fewer setigerous punctures, and slightly deeper terminalia. Also the pronotum is more sparsely and finely punctate than in *gagatina.* The locality label is suspiciously like that of an unreliable dealer's.

The color, probably teneral, is testaceous with head brown between the eyes. Last antennal segment as long as next 4½ segments. All tibiae rounded on outer edge; all femora glabrous. Pronotal margins distinct and entire. Last ventral segment simple. Disc of pronotum with five punctures averaging about 4× their diameters apart, surface finely granular. Setigerous elytral punctures about twice as large as strial punctures. Setigerous punctures as follows. Left elytron: 1st interval 1 at apex, 3rd interval 2 at apical fourth; 5th interval with 1 at base and 1 at apical fifth; 7th interval 2 at base; 9th interval 5 along apical fourth. Right elytron: 1st interval 1 at base, 3rd interval 1 at apical fifth, 5th interval 1 at basal fourth and 1 at apical fifth; 7th interval 2 at base, 9th interval 5 along apical fifth. Elytral punctures, striae, and convexity of intervals as in *gagatina.* Length 7.5 mm.

THE GENUS *NEOHERMES* (MEGALOPTERA: CORYDALIDAE)*

By Oliver S. Flint, Jr.
Smithsonian Institution, Washington, D. C.

Neohermes was erected in 1908 by Nathan Banks for several American species then placed in *Chauliodes*. The only comprehensive treatment of the genus is that of Weele (1910), who in his monographic revision of the Megaloptera synonymized all the names available for the North American members of the genus. Recently, I happened to compare the genitalia of eastern and western specimens of *Neohermes* and it was immediately obvious that they were different. After careful study of much more material I am able to recognize five species in the genus.

I wish to thank the following who generously loaned specimens and provided other valuable information: Mr. D. E. Kimmins, British Museum (Natural History), London, England; Dr. Ellis G. MacLeod, Harvard University, Cambridge, Massachusetts; Dr. J. G. Franclemont and Dr. L. L. Pechuman, Cornell University, Ithaca, New York; Dr. Lewis P. Kelsey, University of Delaware, Newark, Delaware; Dr. Paul H. Arnaud, Jr., California Academy of Sciences, San Francisco, California; and Dr. Jerry A. Powell. University of California, Berkeley, California.

Neohermes Banks

Banks, 1908, Proc. Ent. Soc. Wash. **10**: 29. Weele, 1909. Notes Leyden Mus. **30**: 258; 1910, Coll. Zool. Selys 5 (1): 52. Munroe, 1951, Canad. Ent. **83**: 33-35; 1953, Canad. Ent. **85**: 190-192. Kimmins, 1954, Bull. Brit. Mus., Ent. **3**: 418-419. Chandler, 1956, Aquatic Ins. Calif. : 232.

Male with moniliform antennae, about three-fourths as long as fore wings, each segment bearing a whorl of bristly setae; antennae of female subserrate, about one-half as long as forewings. Forewing with R_3 and R_4 fused for nearly half of their length, and generally with a crossvein beyond their separation; anterior branch of 2A united with 1A for a short distance. Hindwing with first branch of M forked apically. Wing membrane slightly grayish; forewing and costal margin and apex of hindwing densely marked with black spots set at right angles to the veins; forewing with a large black mark at the level of m-cu. Male genitalia with anal plate cylindrical, apex

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*Manuscript received by the editor June 23, 1965

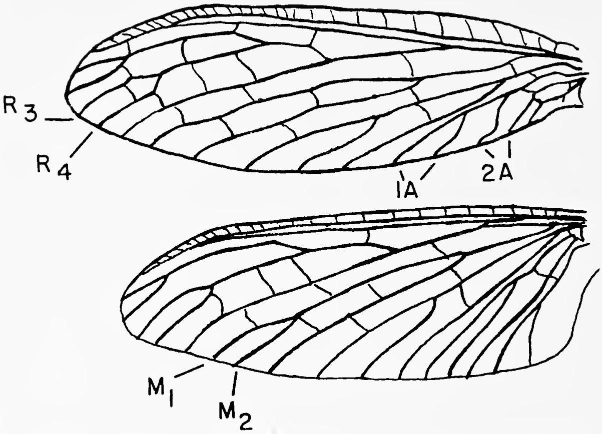


Fig. 1. Wings of *Neohermes* (after Chandler 1956).

often decurved, with an apicomesal patch of short, black setae; ninth sternum forming a broad scoop; aedeagus flat, tip bilobed, with a central ridge. Female genitalia with anal plate triangular, gonapophysis lateralis may bear an apical papilla.

Type-species: *Chauliodes filicornis* Banks (original designation).

The genus *Neohermes*, known only from North America, is closely related to *Protochauliodes* Weele which is known from Western North America, Chile, and Australia. The males of *Neohermes* are easily recognized by their long hairy antennae (similar to a bottle-brush). The females of the two genera sometimes are very difficult to separate; the presence of a crossvein in cell R_3 of the forewing is generally reliable, but it is sometimes lacking in *Neohermes* or present in *Protochauliodes;* the gonapophyses laterales in the western species of *Neohermes* lack an apical papilla (present in the eastern ones) which is present in the *Protochauliodes* species in the same region.

There is some variation in the shapes of the anal plates and aedeagi in all species. The three eastern species recognized probably do not have significantly differently shaped anal plates but do seem to have quite different aedeagi. It is possible that additional material from more localities in the southeastern United States will show intergradation in the shape of the aedeagus.

Neohermes filicornis (Banks)

Figures 2-4, 9

Chauliodes filicornis Banks, 1903, Proc. Ent. Soc. Wash. 5: 238.

Neohermes filicornis (Banks): Banks, 1908, Proc. Ent. Soc. Wash. 10: 29. Weele 1910, Coll. Zool. Selys 5(1): 52-54. Van Dyke, 1944, Pan-Pacific Ent. 20: 110.

The male type of the species is present at the Museum of Comparative Zoology at Harvard University. In addition to the type many more specimens of the species from New Mexico, Arizona, and California have been studied. Although this species and *californicus* are both found in California, they occupy different ranges within the state.

The male is easily separated from the closely related *N. californicus* by the shape of the anal plate which is not bifurcated but produced apicoventrally. The females of the two species are difficult to separate although the anal plate is usually not produced into a point in *filicornis*.

Male genitalia. — Ninth tergum large, sternum scoop-like. Anal plate with apicoventral angle produced, bearing mesally many short black setae in this region; apicodorsal angle rarely slightly produced. Aedeagus scoop-shaped, apex produced into a pair of submesal lobes, from which run rather straight ridges to the base; lateral margin evenly convex.

Female genitalia. — Anal plate triangular, with apical point barely developed. Gonapophysis lateralis without papilla.

Length of forewing. — male (70 examples) 29 to 50 mm., ave. 39.0; female (25 examples) 37 to 54 mm., ave. 45.8.

Holotype, male — Arizona, Jerome, June 24, 1902, Oslar. Museum of Comparative Zoology.

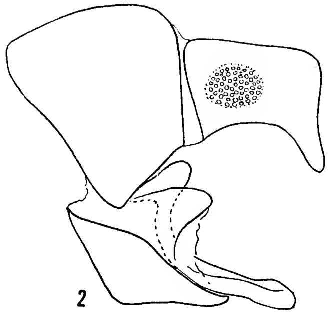
Distribution. — NEW MEXICO: Silver City (July). ARIZONA: Chiricahua Mts. (June, July, May); Huachuacha Mts. (June); Santa Rita Mts. (June); Baboquivari Mts.; Sta. Catalina Mts. (June); Coconino Co. (July); Garcia; Palmerlee (July, Aug., Oct.). CALIFORNIA: San Diego Co. (May, June); Orange Co. (July); Riverside Co. (July); Los Angeles Co. (June, July, Aug.); Ventura Co. (Aug.); San Luis Obispo (July, Aug.); Santa Clara Co. (June); Alameda Co. (June); Contra Costa Co. (Sept.); Marin Co. (July); Sonoma Co. (Feb., July); Mendocino Co. (Aug.); Lake Co. (Aug.).

Neohermes californicus (Walker)

Figures 5-8

Chauliodes californicus Walker, 1853, Neur. Brit. Mus. **2**: 199. Hagen, 1861, Syn. Neur. N. Amer. : 190. MacLachlan, 1867, Jour. Linn. Soc. Zool., **9**: 259; 1869, Ann. & Mag. Nat. Hist. **4**(**4**): 40. Banks, 1892, Trans. Amer. Ent. Soc. **19**: 357; 1907, Trans. Amer. Ent. Soc. **33**: 21. Davis, 1903, Bull. N. Y. State Mus. **68**: 463.

Neohermes californicus (Walker): Banks, 1908, Proc. Ent. Soc. Wash. **10**: 29. Weele, 1910, Coll. Zool. Selys **5**(**1**): 53. Caudell, 1933, Pan-Pac. Ent. **9**: 125. Van Dyke, 1944, Pan-Pac. Ent. **20**: 110. Munroe, 1951, Canad. Ent. **83**: 33. Chandler, 1956, Aquat. Ins. Cal. : 232.



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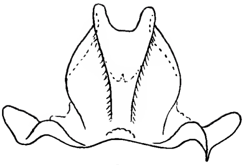

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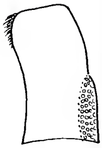

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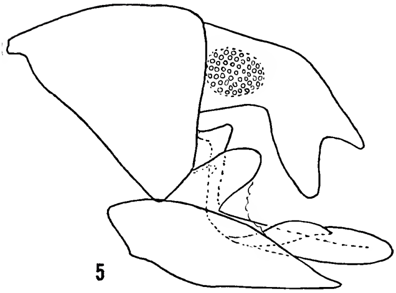

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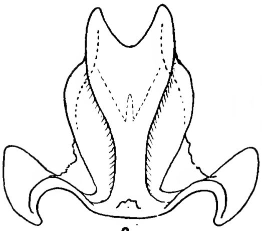

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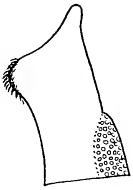

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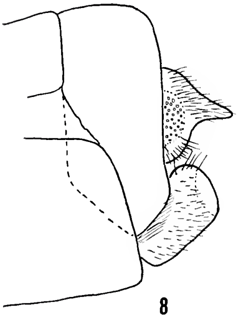

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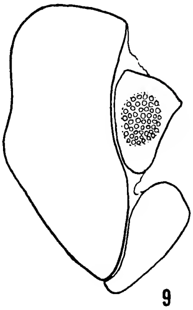

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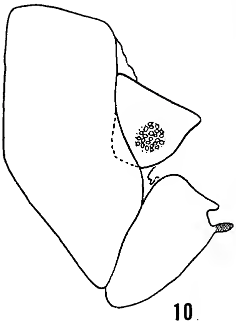

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FLINT — NEOHERMES

Examples of this species from California and Nevada have been studied. D. E. Kimmins kindly prepared the accompanying figure of the female genitalia from the holotype located in the British Museum. He further states that there is a second specimen (male) which was apparently the one used by Weele for his figure of the genitalia, but that it is not a type candidate.

The species is closest to *N. filicornis* from which it is easily separated in the male sex by the forked anal plate, and in the female by the more pointed anal plate.

Male genitalia — Anal plate decurved for apical half, with tip bifid; mesal surface of ventral lobe with short, black setae. Aedeagus scoop-like, apex produced into a pair of submesal lobes, which are developed into slightly sinuous ridges running to the base; lateral margin convex.

Female genitalia — Anal plate triangular, apex produced into a distinct point. Gonapophysis lateralis without papilla.

Length of forewing. — male (20 examples) 34 to 47 mm., ave. 39.9 mm.; female (21 examples) 36 to 48 mm., ave. 42.9 mm.

Distribution. — CALIFORNIA: Modoc Co. (July); Lassen Co.; Siskiyou Co. (June); Shasta Co. (July); Tehama Co. (April, May); Plumas Co.; Sierra Co.; (Aug.); Mendocino Co. (June); El Dorado Co. (July); Sacramento Co. (June), Tuolumne Co. (June, July, Aug.); Mariposa Co. (June); Fresno Co. (June); Tulare Co. (June, July). NEVADA: Reno.

Neohermes angusticollis (Hagen)

Figures 10-13

Chauliodes angusticollis Hagen, 1861, Syn. Heur. N. Amer. : 191. MacLachlan, 1869, Ann. & Mag. Nat. Hist. 4 (4) : 40. Banks, 1892, Trans. Amer. Ent. Soc. **19**: 357; 1907, Trans. Amer. Ent. Soc. **33**: 20. Davis, 1903, Bull. N. Y. State Mus. **68**: 462.

Neohermes angusticollis (Hagen): Banks, 1908, Proc. Ent. Soc. Wash. **10**: 29. Weele, 1910, Coll. Zool. Selys **5** (1): 52.

This species, as defined herein, is known only from Georgia. There are no types of this species in the Hagen collection at the Museum of Comparative Zoology, nor are any known to me elsewhere. Therefore I am taking the following action which preserves all names. The

---

EXPLANATION OF PLATE 19

Neohermes filicornis (Bks.). Fig. 2, ♂ genitalia, lateral. Figs. 3 and 4, aedeagus and anal plate, dorsal. *N. californicus* (Walk.). Fig. 5, ♂ genitalia, lateral. Figs. 6 and 7, aedeagus and anal plate, dorsal. Fig. 8, ♀ genitalia, lateral. *N. filicornis* (Bks.). Fig. 9, ♀ genitalia, lateral. *N. angusticollis* (Hag.). Fig. 10, ♀ genitalia, lateral.

type locality is restricted to the first mentioned state, Georgia, and a neotype is designated below.

The three eastern species are closely related; indeed I am unable to find any differences between the females. The aedeagus of *angusticollis* differs from that of the other species in its deeply and narrowly divided tip and the shallow basolateral excisions.

Male genitalia — Anal plate tubular, slightly constricted at midlength; mesal surface of tip with short black setae. Aedeagus scoop-like, tip divided by a deep, narrow, mesal slit; basolateral excision shallow, extending only about a fourth of the length of aedeagus.

Female genitalia. — Anal plate with apex produced into a short point. Apex of gonapophysis lateralis with a short, dark appendage, above which is a semicircular excision and a short protuberence.

Length of forewing. — Male (2 examples) 28 mm.; female (2 examples) 33 and 35 mm.

Neotype, male. — Atlanta, Georgia, 6-11-39, P. W. Fattig. USNM type No. 68040.

Distribution — GEORGIA: Atlanta, 19 June 1946, P. W. Fattig, 1♂ 1♀; Emerson, 14 June 1940, P. W. Fattig, 1♀.

Neohermes matheri Flint, new species

Figures 17-19

The species is only known from a male and 2 females, all from Mississippi.

The aedeagus of *matheri* is considerably thicker than that of the other species, the posterior margin is strongly upturned with the tip bifid and the halves divergent, and there is a strong lateral process.

Male genitalia. — Anal plate, elongate, tubular, slightly constricted at midlength; mesal face with short, black setae. Aedeagus not turned up basally, central ridge high; tip slightly divided, halves divergent; basolateral excision about a third the length of aedeagus, with lateral point strong and upturned.

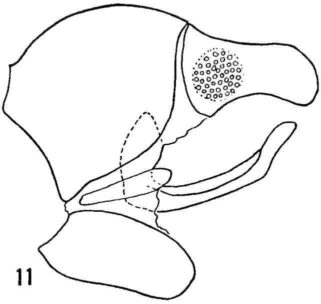
Female genitalia. — Inseparable from that of *N. angusticollis.*

Length of forewing. — Male and female, each 29 mm.

Holotype, male. — Clinton, Hinds Co., Mississippi, 12 June, 1960, collection of Bryant Mather, USNM type No. 68041.

EXPLANATION OF PLATE 20

Neohermes angusticollis (Hag.). Fig. 11, ♂ genitalia, lateral. Figs. 12 and 13, aedeagus and anal plate, dorsal. *N. concolor* (Dav.). Fig. 14, ♂ genitalia, lateral. Figs. 15 and 16, aedeagus and anal plate, dorsal. *N. matheri* Flint. Fig. 17, ♂ genitalia, lateral. Fig. 18 and 19, aedeagus and anal plate, dorsal.



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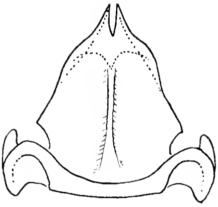

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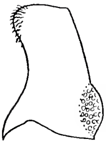

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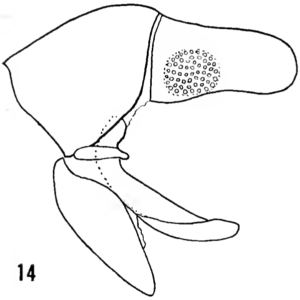

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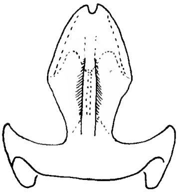

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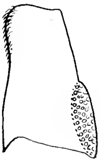

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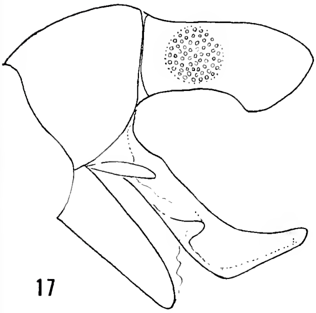

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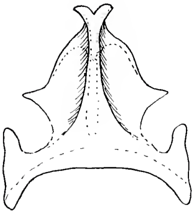

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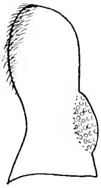

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FLINT — NEOHERMES

Paratypes, female. — Hattiesburg, Forrest Co., Mississippi, 31 May 1964. R. & B. Taylor, 2♀.

Neohermes concolor (Davis)
Figures 14-16

Chauliodes concolor Davis, 1903, Bull. N. Y. State Mus. **68**: 462. Banks, 1907. Trans. Amer. Ent. Soc. **38**: 21.

Neohermes concolor (Davis): Weele, 1910, Coll. Zool. Selys 5 (1): 53.

There are six syntypes of this species at Cornell University and one at the Museum of Comparative Zoology. All, however, are females, of which one in the Cornell Collection is designated lectotype. In addition to these examples, I have studied specimens from New York, Massachusetts, Delaware, New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, North Carolina, Kentucky, Missouri, and Arkansas.

The aedeagus of this species is rounded apically with a shallow, mesal excision, and the basolateral excisions are rather deep and wide.

Male genitalia. — Anal plate tubular, scarcely constricted, but some variation in contours among examples; mesal face with short, black setae. Aedeagus scoop-like, slightly turned up basally; tip with a slight mesal excision, basolateral excision deep and about one-third length of aedeagus; central ridge well developed.

Female genitalia. — Inseparable from that of *N. angusticollis*.

Length of forewing. — Male (13 examples) 26 to 32 mm., ave. 28.2 mm.; female (18 examples) 30 to 39 mm., ave. 35.4 mm.

Lectotype, female (here designated). — "Cornell U. No. 815 sub." "Lectotype Cornell U. No. 4269" "Chauliodes concolor type" "Lectotype Chauliodes concolor Davis By Flint 1965".

Distribution. — MASSACHUSETTS: Southbridge (July). NEW YORK: Wayne Co. (July); Ithaca (July, Aug.); Binghamton (July). DELAWARE: Porters; Newark (July). NEW JERSEY: Middlesex Co. (July). PENNSYLVANIA: State College (July). MARYLAND: Dorchester Co. (July); Montgomery Co. (July); Laurel (June). DISTRICT OF COLUMBIA: Washington (June). VIRGINIA: Falls Church (May, June, July); Blacksburg (June). NORTH CAROLINA: Durham (June). KENTUCKY: Mammoth Cave Nat. Pk. (June). MISSOURI: Willard (June). ARKANSAS: Imboden; Hot Springs Nat. Pk. (June).

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PSYCHE

A JOURNAL OF ENTOMOLOGY

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The September, 1965 Psyche (Vol. 72, no. 3) was mailed January 18, 1965.

The Lexington Press. Inc., Lexington, Massachusetts

PSYCHE

Vol. 72 December, 1965 No. 4

FURTHER STUDIES ON NEOTROPICAL EPYRINI (HYMENOPTERA, BETHYLIDAE)[1]

By Howard E. Evans
Museum of Comparative Zoology

This paper is a supplement to two recent papers published in the Bulletin of the Museum of Comparative Zoology.[2] Although these papers were several years in the making, as so often happens they had scarcely appeared when a considerable amount of new material came into my hands. The present paper is concerned with range extensions, notes on variation, and new species in the genera *Rhabdepyris, Bakeriella, Calyozina,* and *Epyris.* The abbreviations employed are the same as those used in my two previous papers, but for the sake of ready reference the abbreviations are listed again at the conclusion of this paper.

Rhabdepyris (Rhabdepyris) muesebecki Evans, 1965

This species was recorded from the United States only from two specimens intercepted at quarantine in Texas. However, it is apparently established in Texas, as I took a male while sweeping herbaceous vegetation at the north edge of the city of Brownsville on June 29, 1965. I also have a female before me from Mera, Ecuador, collected January 26, 1923, by F. X. Williams [coll. Bishop Mus., Honolulu]. This is within the known geographic range of this species, but the specimen is of interest because of its large size (LFW 2.1 mm). It keys out well in my revision if one makes allowance for greater variation in size than previously indicated.

---

[1] Research and publication supported by a grant from the National Science Foundation, No. GB-1544. *Manuscript received by the editor December 7, 1965.*

[2] 1964. A synopsis of the American Bethylidae (Hymenoptera, Aculeata). Bull. Mus. Comp. Zool., 132: 1-222.

1965. A revision of the genus *Rhabdepyris* in the Americas (Hymenoptera, Bethylidae). Bull. Mus. Comp. Zool., 133:67-151.

SMITHSONIAN INSTITUTION MAY 3 1

Rhabdepyris (Rhabdepyris) nigriscapus Evans, 1965

This species was described from a single female from the province of Jujuy, Argentina, unfortunately indicated as a "♂" in the original description, although stated to be a female two lines later. Mr. Fritz Plaumann has recently sent me a second female, this one from Nova Teutonia, Santa Catarina, Brazil, collected in March, 1965. This specimen agrees closely with the type in color and most structural characters, but it is considerably larger (LFW 2.1 mm) and the front femora measure only 2.65 × as long as their maximum width. The head is also slightly wider (WH 1.02 × LH) and the front narrower (WF 1.02 × HE); the ocellar triangle is broad, OOL only .77 × WOT. Thus this specimen bridges some of the gaps supposed to separate *nigriscapus* and *minutulus*. The latter species may still be separable on the basis of its extremely small size, more compact antennae, pale scape, and somewhat more robust front femora; but only the accumulation of much more material of this complex will permit final clarification of specific characters.

Rhabdepyris (Rhabdepyris) multilineatus n. sp.

This species is of unusual interest because the pronotum lacks a foveolate groove paralleling its posterior margin; actually such a groove is partially developed in one of the two available males, but absent in the other male and in all six females. I used the presence of such a groove as a subgeneric character in my 1965 revision, but evidently it will not hold. Otherwise *multilineatus* is a reasonably typical member of this subgenus, being related to those species in which the front angle of the ocellar triangle of the female is less than a right angle. In the male the ocellar triangle is somewhat broader, so that the males will run to *gracilis* in my key (as they also will with respect to head shape). Actually the males are readily separable from those of both *gracilis* and *muesebecki* on the basis of the pale and much more compact antennae.

This species is also of special interest since the type series has associated with it the first host data for any member of this genus. Pinned with the type series is an adult and a larva of the dermestid *Cryptorhopalum septemsignatum* Sharp [det. J. M. Kingsolver]; the word "notes" is written on the label in the handwriting of the collector, F. X. Williams. Dr. Williams writes that he can no longer find these notes, but he remembers collecting some empty cocoons under loose bark along the edge of a forest; he believes that the *Rhabdepyris* adults were reared from larvae which were feeding on dermestid larvae breeding in the refuse in the cocoons. Perhaps this should be considered a doubtful host record, since the notes are not extant. However, it seems a very logical association, since dermestids are the hosts of several species of *Laelius*. As I pointed out in 1965, the morphological gap between *Laelius* and *Rhabdepyris sensu stricto* is a very small one.

Holotype. — ♀, ECUADOR: Milagro, December 1922 (F. X. Williams) [Bishop Mus., Honolulu].

Description of female type. — Length 3.1 mm; LFW 2.4 mm. Black; mandibles and antennae rufo-testaceous except flagellum weakly infuscated on upper surface; coxae and femora dark brown, legs otherwise bright rufo-testaceous; wings hyaline, veins and stigma amber. Clypeus sharply, obtusely angulate; third antennal segment about as long as thick. Head slightly higher than wide, WH .97 × LH; vertex produced above eye tops by a distance equal to about half the eye height; front of moderate breadth, WF .59 × WH, 1.17 × HE; front angle of ocellar triangle very slightly less than a right angle, OOL 1.25 × WOT. Front wholly alutaceous, with shallow, widely spaced punctures. Pronotum alutaceous but somewhat shining, strongly punctate, its posterior margin depressed but not paralleled by a groove. Scutellar groove a slightly arcuate band of nearly equal width throughout. Propodeal disc 1.2 × as wide as long, with five strong discal carinae plus strong lateral and sublateral carinae, all nine carinae reaching the posterior margin or nearly so. Front femora 2.5 × as long as their maximum width.

Allotype. — ♂, ECUADOR: same data as type [Bishop Mus., Honolulu].

Description of male allotype. — Length 2.8 mm; LFW 1.9 mm. Coloration as described for female. First four antennal segments in a ratio of about 17:7:7:8, segments three and eleven each about 1.2 × as long as thick. WH/LH = 1.0; WF .63 × WH, 1.36 × HE; ocellar triangle rather broad, front angle about a right angle; OOL 1.16 × WOT. Front alutaceous, somewhat shining, punctures inconspicuous. Pronotum and scutellar groove as described for female; propodeal disc 1.2 × as wide as long, carinate much as in the female; side-pieces of propodeum strongly beaded.

Paratypes. — 5 ♀♀, 1 ♂, ECUADOR: same data as type except 4 ♀♀ dated December 4, 1922 [Bishop Mus., Honolulu; MCZ].

Variation. — The females show only slight variation in size (LFW 2.2-2.4 mm) and only minor variation in color and sculpture; WH varies from .96 to 1.0 × LH, WF from 1.15 to 1.20 × HE, OOL from 1.2 to 1.3 × WOT. The male paratype is slightly smaller than the allotype (LFW 1.8 mm) and is very similar except that the posterior margin of the pronotum is preceded by a row of shallow foveae.

Rhabdepyris (Rhabdepyris) gracilis Evans, 1965

I described this species from a female from Sacramento, California, and a male from near Durango, Mexico, remarking that the association seemed probable in spite of the distance between these two localities. I have since seen a male from Danville, Contra Costa Co., California (F. X. Williams, Aug. 8, 1948) [CAS] agreeing so closely with the allotype from Durango that I feel confident that my association of the sexes was correct. This specimen is identical to the allotype in size, color, and most standard measurements, but OOL is only 1.15 × WOT. A female collected by F. X. Williams at Danville on May 29, 1952 [CAS] probably also belongs here, but the groove paralleling the posterior margin of the pronotum is virtually absent and OOL is only 1.10 × WOT; in size, color, and other standard measurements it is similar to the Sacramento type.

Rhabdepyris (Rhabdepyris) nigripilosus (Ashmead), new combination

Mesitius nigripilosus Ashmead, 1895, Proc. Calif. Acad. Sci., (2) 5: 539. [Type: ♀, MEXICO: NAYARIT: Tepic (CAS)].

Epyris nigripilosus Kieffer, 1914, Das Tierreich, 41: 345. — Evans, 1964, Bull. Mus. Comp. Zool. Harvard, 132: 108.

Rhabdepyris (Rhabdepyris) huachucae Evans, 1965, Bull. Mus. Comp. Zool. Harvard, 133: 73. [Type: ♀, ARIZONA: Ramsey Canyon, Huachuca Mts., March 22, 1956 (Werner & Butler) (MCZ)]. New synonymy

Through the courtesy of Mr. Hugh B. Leech, I have recently had an opportunity to study the type of Ashmead's *nigripilosus*, and I find that Kieffer and I were incorrect in assuming it to be an *Epyris*. Beyond much question it is a second specimen of the species I described from southeastern Arizona as *huachucae*. The type of *nigripilosus* differs from that of *huachucae* in the following particulars: slightly larger (LFW 2.6 mm); front femora with only a small brownish blotch toward base, otherwise testaceous, middle femora wholly testaceous; head more nearly circular, WH .98 × LH; front very narrow, WF and HE subequal, the punctures very slightly stronger and more closely spaced; OOL 1.35 × WOT; propodeal disc somewhat broader, measuring 1.35 × as wide as its median length. This is a relatively large and distinctive species of the subgenus.

Rhabdepyris (Trichotepyris) hirticulus new name

Rhabdepyris (Trichotepyris) nigropilosus Evans, 1965, Bull. Mus. Comp. Zool. Harvard, 133: 84. Preoccupied by Ashmead, 1895.

Although Ashmead called his species *nigripilosus* (see preceding species), according to the International Code of Zoological Nomenclature, article 58, compound words differing by only a connecting vowel are to be considered homonyms. A new name is therefore proposed for this species, which is known from several females from Panama and Brazil.

Rhabdepyris (Trichotepyris) apache Evans, 1965

I described this large and striking species from three females from Arizona and a male from Sonora, Mexico. It now appears that it is widely distributed and locally not uncommon in western Mexico. I collected 11 ♀♀ and 1 ♂ from the tops of young *Ambrosia* plants, apparently containing honeydew, on the outskirts of Guadalajara, Jalisco, Mexico, July 17-28, 1965. I have also seen 1 ♂ from 8 miles SE of Elota, Sinaloa, Mexico, collected May 19, 1962, by L. A. Stange [UCD] and 1 ♂ from Maria Madre Isl., Tres Marias, Nayarit, Mexico, collected May 22, 1925 (H. H. Keifer) [CAS]. In the original description I noted that the pronotal disc of the male is sharply declivous anteriorly and laterally. In all three of the males listed above, the disc is actually subcarinate anteriorly and along the anterior half of the lateral margins. Also, in some of the females from Guadalajara, one can detect a faint, irregular carina along the anterior margin of the pronotal disc. I have already suggested that *Anisepyris* and *Trichotepyris* are closely related by way of the *megacephalus* species group of the latter subgenus. It would appear that *apache* provides an almost perfect intermediate between these two taxa. For the present I shall, however, leave it in *Rhabdepyris (Trichotepyris)*, since on the whole it seems to fit best in the *megacephalus* group of that subgenus.

Rhabdepyris (Trichotepyris) fortunatus Evans, 1965

This species was based on a single female from Costa Rica. I have before me two females which resemble the type very closely, one from Bucay, Ecuador, Oct. 4, 1922, and one from Blairmont, British Guiana, Oct. 1923 (both collected by F. X. Williams) [Bishop Mus., Honolulu]. Both are slightly larger than the type (LFW 2.6-2.9 mm) and have the ocellar triangle slightly more remote from the eye margins (OOL 1.3-1.4 × WOT). The very short third antennal segment is characteristic of this species.

Rhabdepyris (Chlorepyris) virescens Evans, 1965

This large, well characterized species was known to range throughout tropical South America and into Panama. Apparently it also ranges throughout the remainder of tropical Central America and Mexico, for I took a very typical female of this species while sweeping vegetation just behind the beach at Playa Matanchen, near San Blas, Nayarit, Mexico, on August 7, 1965. As might be expected, this specimen is more similar to material from Panama than to the type (from southern Brazil); the apical third of the abdomen is rufous, the femora are wholly rufous, and the front is relatively narrow (WF 1.10 × HE). LFW measures 4.0 mm; WH/LH = 1.05; the front femora measure 2.05 × as long as wide.

Bakeriella inconspicua Evans, 1964

On July 6, 1965, I collected two males of this species on banana leaves at Tamazunchale, San Luis Potosi, Mexico, thus extending the known range of the species several hundred miles northwestward. These males are small (LFW 2.1-2.3 mm) and agree with males from Tabasco in having the scape slightly infuscated and the front and thoracic dorsum rather strongly shining. The female of this species is still unknown.

Bakeriella brasiliana Evans, 1964

This species was described from a single female from Minas Gerais, Brazil. I have seen one additional female from a place far distant from the type locality but so similar to the type that its conspecificity can scarcely be questioned. This specimen was taken on July 14, 1918, at the Limon Plantation, Chagres R., Panama (sweeping around cornfield, H. Dietz & J. Zetck) [USNM]. This specimen is of the same size as the type and of similar coloration except that the apex of the abdomen is dark brown rather than ferruginous; standard measurements are very much like those of the type except that OOL is 1.7 × WOT, the propodeal disc 1.1 × as wide as long. It is conceivable that *brasiliana* represents the otherwise unknown female sex of *depressa* Kieffer or *flavicornis* Kieffer, though by analogy with *olmeca* Evans and with *subcarinata* n. sp. I would expect the females of *depressa* and *flavicornis* to have five-toothed mandibles and at least some evidence of a median carina on the pronotum.

Bakeriella subcarinata n. sp.

This is the fourth known species in which the male possesses a vertical carina on the temples and a median carina on the pronotum; it is the second of these four species in which the female is known (or at least tentatively associated with the male). In this case the female lacks a carina on the temples (as in *olmeca* Evans) but possesses a weak median carina on the pronotum (in contrast to *olmeca*). The female will run to *inca* Evans in my 1964 key, but it differs in several respects, most conspicuously in having 5-toothed mandibles and in having the median pronotal carina very weak and not set in a depression. The male runs to *olmeca* in my key, but differs in having well formed lateral ridges on the pronotum and in having the third antennal segment only 1.3 × as long as thick.

Allotype. — ♀, PERU: Quincemil, Dept. Cuzco, 750 meters, Nov. 5-16, 1962 (L. Peña) [MCZ].

Description of female allotype. — Length 5.0 mm; LFW 4.3 mm. Black; mandibles testaceous except black at base, the teeth rufous; antenna pale ferruginous, scape and outer flagellar segments strongly infuscated on upper surface; legs black except tibiae and tarsi dull ferruginous; wings lightly tinged with yellowish brown. Mandibles with a broad, oblique apical margin which bears five teeth, the basal three teeth very much smaller than the two large apical teeth. Clypeus very short, broadly subangulate. Eyes weakly hairy; antennal scrobes not margined; third antennal segment about 1.5 × as long as thick. WH .95 × LH; eyes converging below, WF 1.20 × HE; OOL 1.5 × WOT. Vertex broadly rounded off a considerable distance above eye tops; temples fairly broad but ecarinate. Front shining, weakly alutaceous, with strong punctures which are separated by 1-3 × their own diameters. Pronotal disc somewhat more strongly alutaceous, also with strong punctures; anterior, transverse carina straight; median carina weak, alutaceous, not set in a depression; posterior margin with a polished ridge; sides of disc subcarinate in front; side-pieces rugose, especially below. Mesoscutum polished anteriorly, posterior half alutaceous, punctate, slightly depressed; scutellar pits large, transverse, separated by a thin septum. Propodeal disc 1.15 × as wide as long, transversely striate between the three discal carinae, otherwise with only weak sculpturing. Front femora measuring 2.4 × as long as wide.

Holotype. — ♂, PERU: Tingo Maria, Dept. Huanuco, 620 meters, Oct. 5-12, 1964 (C. C. Porter) [MCZ].

Description of male type. — Length 4.0 mm; LFW 2.6 mm. Black; mandibles testaceous, except basal third black, teeth rufous; scape black except apical fourth, as well as all of following three segments, testaceous, remainder of antennae mostly fuscous; legs black except tarsi straw-colored, tibiae only partially infuscated; wings lightly tinged with yellowish brown. Mandibles with five sharp teeth; clypeus obtusely angulate; scrobes carinate; eyes weakly hairy. First four antennal segments in a ratio of about 20:8:9:10, segment three about 1.3 × as long as thick, segment eleven 1.6 × as long as thick. WH 1.08 × LH; eyes converging strongly below, WF 1.15 × HE; OOL 1.4 × WOT. Temples with a carina which starts at the vertex but extends only to about the middle of the eyes. Front alutaceous, moderately shining, obscurely punctate. Pronotal disc alutaceous, even over the crest of the median carina, which is stronger than in the female; anterior, transverse carina angled backward only very weakly at the midline; sides of disc subcarinate anteriorly, posterior margin with a polished elevation preceded by a row of small foveae. Mesoscutum strongly alutaceous and slightly depressed on the posterior half; scutellar pits large, separated by a thin septum medially. Propodeal disc 1.1 × as wide as long, disc transversely striate between the three discal carinae; posterior angles dentate in front of the strongly developed foveae.

Paratypes. — 3 ♂♂, PERU: Monson Valley, Tingo Maria, Oct. 10, Nov. 29, 1954 (E. I. Schlinger and E. S. Ross) [CAS].

Variation. — The three male paratypes vary slightly in size (LFW 2.4-2.8 mm) but resemble the type very closely in color and standard measurements. In all three specimens the carina on the temples terminates near the middle of the eyes; in all three the median carina of the pronotum is slightly weaker than in the type, although more distinct than in the female allotype.

Bakeriella inca Evans, 1964

This species was described from a single female from Puerto Bermudez, Rio Pichis, Peru. I have recently studied 1 ♀ and 2 ♂♂ of this species collected by E. I. Schlinger and E. S. Ross in the Monson Valley, Tingo Maria, Peru, Sept.-Dec. 1954 [CAS]. The female is slightly larger than the type (LFW 3.3 mm) and the head is as wide as high, but there are no other differences worthy of note. The males lack a carina on the temples, have a strong median carina on the pronotum which is set in a depression, and have hairy eyes; thus they key out readily in my key. In these males LFW is 2.1-2.6 mm; WH is 1.02-1.05 × LH, 1.25-1.30 × HE, OOL about 1.5 × WOT. There are no important differences in color or sculpturing as compared to the female except that the front is only obscurely punctate and the antennal scrobes are carinate (as is usual in males of this genus).

Bakeriella rossi Evans, 1964

The collecting of Schlinger and Ross in the Monson Valley, Tingo Maria, Peru, in September and October 1954 also turned up 1 ♀ and 3 ♂♂ of this species, previously known from 3 ♂♂ from Colombia. The female will run to couplet 8 of my key; the 5-toothed mandibles at once separate it from *brasiliana,* the very weakly arched, non-angulate transverse pronotal carina from *olmeca,* the fuscous coxae and femora and much larger size from *floridana.* The female is 5.5 mm long, LFW 3.9 mm; the body is black except that the apical fourth of the abdomen is suffused with dull ferruginous. The clypeus is sharply, obtusely angular; the eyes are hairy; the vertex is broadly rounded off far above the eye tops, WH being only .9 × LH; WF is 1.22 × HE, OOL 1.8 × WOT, the propodeal disc 1.2 × as wide as long and bearing the usual three carinae.

Bakeriella depressa Kieffer

Since treating this species in 1964, I have seen one additional male, from Tena, Ecuador, collected February 28, 1923, by F. X. Williams [Bishop Mus., Honolulu]. It is the largest specimen I have seen (LFW 3.0 mm) but presents no unusual structural features. The antennae of this species are consistently more elongate than in *flavicornis* Kieffer, segments three and eleven being 1.35-1.5 × as long as thick as compared to 1.1-1.3 × as long as thick in *flavicornis.* Also, the antennae of most specimens are decidedly dusky apically, while in *flavicornis* they are wholly light yellowish brown. In addition to the type of the latter species I have seen four topotypic paratypes in the collection of Cornell University.

Calyozina mexicana n. sp.

This remarkable species seems to be closer to the type species, *ramicornis* Enderlein, from Formosa, than to the two neotropical species I assigned here in 1964. In particular, there are ten long branches on the antennae as opposed to only seven or eight short branches in *neotropica* and *amazonica.* This species also differs from the latter two species in having 5-toothed mandibles, dentate claws, a groove connecting the two scutellar pits, and some unusual sculpturing on the sides of the thorax and propodeum. It is possible that *mexicana* should not be regarded as congeneric with *neotropica* and *amazonica,* but considering the fact that all three species are known from only one specimen (in each case a male), as well as the many problems of generic classification in this section of the Epyrini, it seems best to be conservative.

Holotype. — ♂, MEXICO: 23 mi. S Matias Romero, Oaxaca, Aug. 14, 1963 (F. D. Parker & L. A. Stange) [MCZ].

Description of male type. — Length 6.2 mm; LFW 3.8 mm. Black, head and thoracic dorsum with a faint bluish cast, last two abdominal segments rufous; mandibles rufo-testaceous; scape black, flagellum dull ferruginous, the branches dusky; coxae black, legs otherwise wholly bright rufo-testaceous; wings lightly tinged with brown. Mandibles with a large apical tooth and four small teeth in a slightly oblique series; clypeus broadly angulate, its median carina nearly straight in profile. Antennae strongly pectinate; segment three considerably shorter than two, much wider than long, bearing a rather short process; segments 4-12 each bearing a slender process slightly longer than the segment proper (segments 4 and 12) up to about 3 × as long as the segment proper (segments 7-10); segment 13 elongate, clavate; segments 2-5 each bearing long, erect setae, following segments with shorter setae but with long setae on the processes, these setae much longer than the width of the processes. Head unusually broad, WH 1.25 × LH; front broad, WF .70 × WH, 1.50 × HE; vertex broadly rounded off a short distance above eye tops; ocelli in a broad triangle, WOT slightly exceeding OOL. Front polished, non-alutaceous, with small, widely spaced punctures. Thoracic dorsum slightly alutaceous, duller than front; pronotal disc sloping gradually toward the front and its sides approaching to a rounded anterior margin, the disc not at all prominent antero-laterally; scutellar pits large, subcircular, separated by slightly less than their own diameters, connected by a very slender but fairly deep groove. Propodeal disc 1.15 × as wide as its median length, with three strong discal carinae between which it is transversely ridged; laterad of the discal carinae the surface is smoother, but there is a low longitudinal ridge between the lateral discal and strong sublateral carinae; propodeal side-pieces polished, with several prominent longitudinal ridges which are continuous with similar ridges on the mesopleura and which form (more especially on the mesopleura) two concentric ellipses. Middle and hind tibiae somewhat spinose; claws with a short, erect tooth. Thoracic venter rather flat, the middle and hind coxae rather widely separated on the venter.

Epyris cubanus n. sp.

This is the first *Epyris* known from Cuba, and only the third species reported from the West Indies. It is one of few species of *Epyris* of metallic coloration.

Holotype. — ♀, CUBA: Rio Cauto, Oriente Prov., April 1928 (C. F. Stahl) [USNM].

Description of female type. — Length 3.0 mm; LFW 2.0 mm. Head and thorax dark olive-green, shining; pronotal collar ferruginous; propodeum black; abdomen dark reddish brown, fading to light brown laterally and apically; mandibles testaceous, black at extreme base; antennae testaceous except most of scape and upper side of flagellum dark brown; coxae fuscous, front and hind femora dark brown, legs otherwise testaceous; wings hyaline. Mandibles bidentate; clypeus obtusely angulate, rounded at the midline, elevated medially but without a distinct carina. Antennal segment three wider than long, segment eleven 1.4 × as long as wide. Head elongate, WH .89 × LH; WF .62 × WH, 1.20 × HE; vertex passing straight across a considerable distance above eye tops, the ocelli in a broad triangle far above eye tops; OOL 1.33 × WOT. Front polished, very weakly alutaceous, with small, widely spaced punctures. Thoracic dorsum also weakly alutaceous, obscurely punctate; pronotal disc nearly twice as long as mesoscutum, with smooth contours; notauli linear, except very slightly widened near the posterior margin; scutellar pits small, oblique, longer than wide, the two pits separated by about 3 × their own greatest diameter. Propodeal disc 1.2 × as wide as its median length, with a complete median carina plus several short carinae in the basal triangle, but otherwise with only weak surface sculpturing; posterior angles subfoveolate; side-pieces shining, somewhat alutaceous. Mesopleura weakly alutaceous. Mesopleura weakly alutaceous, with a small, deep pit above and a longitudinal ridge below. Front femora strongly incrassate, measuring only 1.8 × as long as wide; middle tibiae very weakly spinose; claws dentate. Abdomen robust, subfusiform, not at all depressed apically.

Epyris depressigaster n. sp.

This species is of interest not only because of its brilliant coloration, but also because the apical portion of the abdomen is strongly depressed, suggesting some of the apterous Pristocerini. The head is less elongate and flattened than is usual in this genus.

Holotype. — ♀, BRAZIL: Nova Teutonia, Santa Catarina, July 17, 1937 (F. Plaumann) [BMNH].

Description of female type. — Length 6.0 mm; LFW 3.5 mm. Head and thorax dark blue-green; propodeum black; abdomen shining black except apical third bright ferruginous; mandibles and antennae wholly rufo-testaceous; legs testaceous except all coxae fuscous, hind femora medium brown; wings subhyaline. Mandibles bidentate, the outer tooth sharp, the inner tooth broad and blunt. Clypeus broadly angulate, the median carina nearly straight in profile. Antennae compact, segments three and eleven each slightly longer than wide. Head only slightly higher than wide, WH .97 × LH; eyes large, prominent, protruding; front convex, with a linear impression on the lower fourth. WF subequal to HE; ocelli in about a right triangle, OOL 1.1 × WOT; bottom of anterior ocelli on a line with the eye tops, the vertex broadly rounded off a distance above the eye tops equal to only about one third × HE. Front strongly alutaceous below, the punctures separated by little more than their own diameters; at the level of the ocelli the front is less strongly alutaceous and the punctures more widely spaced. Thoracic dorsum weakly alutaceous, wholly covered with small punctures except the scutellar disc impunctate; pronotal disc about 1.6 × as long as mesoscutum; scutellar pits oblique, elongate, separated by 1.3 × their own length. Propodeal disc about as long as wide, with three strong, complete discal carinae plus lateral carinae, between these five carinae with weak, irregular transverse striae; posterior angles weakly foveolate. Mesopleura pleura shining, with small punctures; upper fovea small but well defined, lower fovea large, broadly open above. Front femora slender, 2.3 × as long as wide; middle tibiae with dense, short spines above; claws with a strong, erect tooth, the outer ray curved so as to be nearly parallel to the tooth. Abdomen depressed throughout, but more especially so on the apical half, the last segment very thin in lateral view.

Epyris crassipes n. sp.

This distinctive species appears to be one of the commoner elements in the *Epyris* fauna of southeastern Brazil. It is a glossy, black species having unusually robust femora in both sexes and having the propodeal sculpturing largely restricted to a basal triangle.

Allotype. — ♀, BRAZIL: Nova Teutonia, Santa Catarina, Feb. 1, 1963 (F. Plaumann) [MCZ].

Description of female allotype. — Length 4.2 mm; LFW 3.0 mm. Black, shining, the extreme tip of the abdomen suffused with brown; mandibles ferruginous, black at extreme base; scape dark brown above, paler beneath, flagellum testaceous, weakly suffused with brown on upper surface; legs fuscous except front and middle tibiae and all tarsi testaceous; wings subhyaline. Mandibles slender, with a strong apical tooth, basad of this with a truncate cutting edge. Clypeus with a protuberant, narrowly rounded median lobe. Third antennal segment about as long as wide, segment eleven 1.5 × as long as wide. WH .90 × LH; eyes convergent below, WF 1.08 × HE; vertex passing straight across far above eye tops (except slightly gibbous just behind the ocellar triangle); ocelli in a broad triangle, OOL 1.4 × WOT; anterior ocellus far above eye tops. Front strongly shining, obscurely alutaceous, with small, widely spaced punctures. Thoracic dorsum more evidently alutaceous than head; pronotal disc 1.7 × as long as mesoscutum, with distinct, somewhat irregularly spaced punctures; mesoscutum with a few weak punctures; scutellar pits oblique, about twice as long as wide, separated by twice their own length. Propodeal disc 1.3 × as wide as long, with complete median and lateral carinae, otherwise shining and with weak sculpturing except in a large, median, basal triangle, where there are several irregular longitudinal carinae and transverse ridges. Mesopleura shining, foveae not defined, but with a ridge which passes above the pit and then arches downward to form what would usually be the lower margin of the lower fovea. Front femora very broad, measuring twice as long as their greatest width, the middle femora even more robust, 1.7 × as long as wide; middle tibiae with long spines above and below; claws weakly dentate. Abdomen robust, not depressed.

Holotype. — ♂, BRAZIL: same data as allotype except collected in June, 1952 [MCZ].

Description of male type. — Length 4.0 mm; LFW 3.1 mm. Black, shining; mandibles testaceous except black at base, rufous at apex; antennae wholly rufo-testaceous, the flagellum a bit dusky, especially apically; coxae and femora dark brown, legs otherwise light brown; wings subhyaline. Mandibles very slender, the apex acute, simple. Clypeus with a protuberant, subangulate median lobe. First four antennal segments in a ratio of about 22:10:11:16, segment three 1.3 × as long as thick, segment eleven 2.1 × as long as thick. WH .98 × LH; eyes convergent below, WF 1.1 × HE; ocelli in a compact triangle well above eye tops, OOL 1.4 × WOT. Vertex passing straight across a distance above eye tops equal to about .6 × HE. Front strongly polished, with small punctures which are separated by several times their own diameters at the level of the ocelli, but much more closely spaced below. Thoracic dorsum also strongly polished, the mesoscutum, however, weakly alutaceous; pronotal disc more than twice as long as mesoscutum. Scutellar pits and features of propodeum and mesopleura as described for female; propodeal disc measuring 1.4 × as wide as long, its posterior angles foveolate. Legs robust, front femora measuring only 2.2 × as long as their greatest width; claws weakly dentate.

Paratypes. — 1 ♀, 4 ♂♂, BRAZIL: same data as type and allotype except various dates (July 1937, May 1938, June 1962, Nov. 1963) [MCZ, BMNH].

Variation. — The female paratype is of the same size as the allotype and shows no important differences in color, sculpture, or standard measurements. The four male paratypes vary in length from 3.2 to 4.5 mm, LFW 2.7-3.1 mm; WF varies from 1.00-1.15 × HE. One of these specimens has an unusually broad ocellar triangle, and in this specimen OOL is only 1.22 × WOT; in this specimen the propodeal disc is also shorter than usual, measuring 1.6 × as wide as its median length.

ALPHABETICAL LIST OF ABBREVIATIONS USED IN TEXT

Structures

HE: height of eye (maximum, lateral view)
LFW: length of fore wing
LH: length of head (apical margin of clypeus to median vertex crest)
OOL: ocello-ocular line (minimum distance from eye to lateral ocellus)
WF: width of front (measured at its minimum point)
WH: width of head (maximum, including eyes)
WOT: width of ocellar triangle (including lateral ocelli)

Institutions

BMNH: British Museum (Natural History), London
CAS: California Academy of Sciences, San Francisco
CU: Cornell University, Ithaca, N.Y.
MCZ: Museum of Comparative Zoology, Cambridge, Mass.
UCD: University of California, Davis
USNM: United States National Museum, Washington

THE TAXONOMIC PROBLEM OF SEXUAL DIMORPHISM IN SPIDERS AND A SYNONYMY IN *MYRMECOTYPUS* (ARANEAE, CLUBIONIDAE)[1]

By Jonathan Reiskind
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With the major exception of many of the vertebrate groups, some mollusks, and butterflies, much of the current evolutionary work in zoology requires, concurrently, research at the "alpha" level of taxonomy in which species are characterized and named (Mayr, Linsley and Usinger, 1953). While this appears to be just a continuation of the work of Linnaeus, Clerck, and others it is by no means an old-fashioned, unchanging endeavor. With the advent of Darwin's theory and, later, the new systematics of the 20th century alpha taxonomy has continued to incorporate the most recent advances in evolutionary biology. Behavioral, ecological, distributional, physiological and biochemical characteristics must be utilized in this "lowest level" of taxonomy in addition to the traditional morphology. In this way the typological and morphological result of overlooking two sibling species or splitting a single species into two species can be avoided. An error of the latter type is often a result of sexual dimorphism.

In non-hermaphroditic, sexually reproducing organisms there usually exists some sort of morphological sexual dimorphism. Sometimes this is limited to the sexual structures themselves, but more often it is extended to secondary sexual characters. In spiders there are three types of secondary characters. Type one is intimately involved in the physical act of copulation and is represented by the pedipalps of males which are modified into organs for the transference of seminal fluid to the female during mating. Type two is associated with the courtship before mating which includes the bizarre and colorful structures that are observed in the Salticidae (especially the males) as well as the size differences in certain argiopoid groups. All structures resulting from sexual selection or reproductive requirements fall into this second type. Type three is unrelated to the procreative process and includes size, color and shape differences whose origins are either due to non-sexual selection or possible pleiotropic effects.

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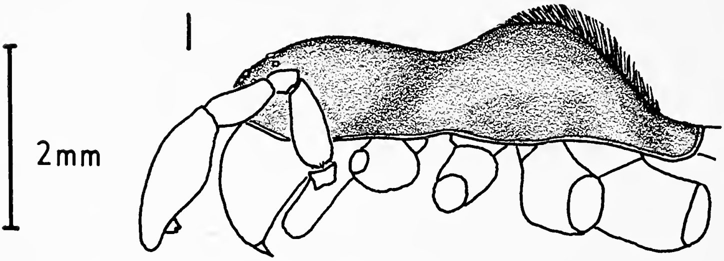
[1] Research a by-product of National Institutes of Health Grant No. AI-01944 to Dr. H. W. Levi, and of an NSF Graduate Fellowship.

Manuscript received by the editor January 28, 1966.

The problem that results from this dimorphism is that of properly pairing the male and female of the same species. With the rare exception of finding two spiders *in copula* or, in some Araneidae for example, finding the apical tip of the embolus broken off inside the seminal receptacle of the female, this problem must be solved indirectly. This is the point at which a taxonomist's intuition or reason is required. In addition to the comparison of the two adult sexes the use of the immature forms may now come in use. Many araneologists consider pre-adult forms (i.e. those lacking male palpi or epigyna) to be taxonomically useless. But the external morphology of the immatures will be less affected by the strong sexual dimorphism found in many adults and therefore exhibit the more stable characters in the species.

In a recent article (Unzicker, 1965) two new species of Myrmecotypus were described. Each one was described from a single specimen: *M. rettenmeyeri* Unzicker from a male, and *M. discreta*



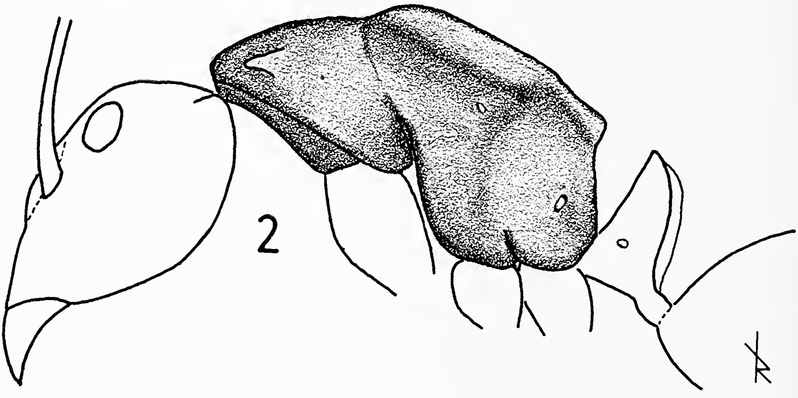


Fig. 1. Lateral view of *Myrmecotypus rettenmeyeri* Unzicker.
Fig. 2. Lateral view of *Camponotus sericeiventris* (Guérin).

Unzicker from a female. Both species were collected at the same locality, in the same way, within three days of one another. The two spiders are almost identical with the obvious exception of sexual structures. Hence it is strongly suggested that *M. discreta* is the synonym of *M. rettenmeyeri.* In addition, examination of an immature specimen of this species reveals a basic external morphology and color pattern that is in common with both adults. This species does not exhibit as much sexual dimorphism as in many other members of the Micariinae where the immature forms are even more useful.

Often a species can be properly delimited only after some contact with the living form in its natural habitat. Both *M. rettenmeyeri* and *M. discreta* have a strange "longitudinal band of black hairs extending along midline of cephalothorax from dorsal depression to base of constriction at posterior end" (Unzicker, 1965) (see Fig. 1). From observations and collections made by Dr. A. M. Chickering at the type locality in Panama it appears that in both sexes the band of hair enhances the resemblance to the ant *Camponotus sericeiventris* (Guérin) with which they share the same habitat. The crests of black hairs correspond to the solid longitudinal keel-like dorsal extensions of the posterior sections of the thorax of *C. sericeiventris* (Fig. 2). The chances that two spiders in the same genus imitate the same ant at the same place and time are ecologically improbable. This is strong additional evidence supporting the synonymy of two species.

To summarize, "alpha taxonomy" is presently a dynamic science incorporating many new techniques. Sexual dimorphism presents the problem of inadvertant splitting of species which can often be avoided by the use of careful comparisons as well as immature stages and field observations. Using these methods *Myrmecotypus discreta* is found to be the female form of *M. rettenmeyeri.* As first reviser I select *M. rettenmeyeri* as the valid name.

I wish to thank Dr. Carl Rettenmeyer for the loan of the types of the spiders cited above.

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THE HABITS AND DISTRIBUTION OF *MACROMISCHA SUBDITIVA* WHEELER (HYMENOPTERA: FORMICIDAE)

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Before discussing *Macromischa subditiva* I wish to review some older observations on the habits of this beautiful genus. The nests of Macromischa are seldom easy to find. The one exception to this rule appears to be *M. sallei* Guérin, whose abundant and conspicuous carton nests, built around the twigs of bushes, are certain to attract attention. It thus happens that *M. sallei* is the only species in the genus for which adequate field data exist. In 1913 W. M. Mann studied hundreds of nests of *sallei* in Haiti (1). The uniformity of these nests was remarkable; they were invariably constructed of carton and invariably suspended from the branches of bushes or small trees. While Sallé's San Domingan nests had come from bushes growing on marshy plains (2) the Haitian nests occurred on rocky, well-drained ridges, hence there was no reason to suppose that the latter nests had been placed in bushes to avoid water-soaked soil. In short, the nesting habits of *M. sallei* appeared to be not only arboreal but also those of a non-adaptable arboreal.

This circumstance strongly influenced W. M. Wheeler in the nidification list which he published in his 1931 study of Macromischa (3). At that time Wheeler had nesting data for 28 species of Macromischa and he knew that there is a wide range of nesting response within the genus. His list carries eight nesting categories and, while some of these are rather similar, the range extends from strictly arboreal to strictly terrestrial species. This list is invaluable to anyone who is studying Macromischa in the field and, since Wheeler was trying to show no more than the variable nesting habits of different species of Macromischa, he amply accomplished his purpose. The objectionable feature of the nidification list is its failure to give the number of nests on which the inclusions are made. To secure this information it is necessary to consult the authorities whose names are carried after the names of the species whose nests they observed. When this is done it is clear that 17 of the 28 species listed were known from a single nest and hence could appear

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Manuscript received by the editor October 3, 1965

in only one nesting category. Nor was the situation much better with most of the 11 other species. Seven of these were known from two colonies each and two from three colonies each. Thus there were only three species (*flavitarsis* 5 colonies; *wheeleri* 8 colonies, *squamifera* 15 colonies) which might be said to furnish more than a suggestion of nest preferences. What Wheeler did with these last two species is astonishing. He knew that both *wheeleri* and *squamata* have flexible nesting habits. In 1920 W. M. Mann published observations that leave no doubt on this score and I had later amplified Mann's data in a personal communication to Dr. Wheeler (4). Yet both *wheeleri* and *squamata* each appeared in a single category in the nidification list. Thus, although Wheeler saw clearly that nesting responses vary widely within the genus Macromischa, he failed to appreciate that the nesting response of the individual species may also be variable. On the basis of present data it is impossible to say what percentage of species in the genus possess flexible nesting habits but, if further progress is to be made with the habits of Macromischa, it is imperative to recognize that some of the species, among them *subditiva,* behave in this fashion.

Remarkably few records of any kind have been published for *M. subditiva* since Wheeler described this species in 1903 (5). In 1912 Mitchell and Pierce provided a two-line habit note on specimens taken in Victoria County, Texas which repeated the observations carried in Wheeler's original description (6). When M. R. Smith monographed our species in 1939 he gave no new data on habits and added only one new locality record (7). Apparently there are no other published records for *subditiva,* although M. R. Smith stated in a paper published in 1947, that the species occurs in Louisiana (8). This reference is enigmatic, since no locality was cited and since repeated surveys in the area between Austin and the Louisiana border have failed to turn up *subtiva* in eastern Texas. The record is not included in the list presented in this paper.

From what has already been said it should be obvious that it is important to distinguish between records based on strays and records where the nest was found. I have, therefore, divided the records into two groups, the first based on strays (Table I), the second on nests taken (Table II).

In six of the above colonies a single female was present. It is impossible to say whether this was true of the seventh nest (Wimberley colony) for part of this colony was scattered when the crevice in which it was living was forced open. In addition to the female

Table I

Records for *M. subditiva* based upon strays

Station	*Collector*	*Where taken*
TEXAS:		
Austin (Travis Co.)	W. M. Wheeler	On leaves of bushes
New Braunsfels (Comal Co.)	W. M. Wheeler	Dead limbs on ground
Harlingen (Cameron Co.)	R. A. Vickery	Not stated
10 miles west of Boca Chica (Cameron Co.)	W. S. Creighton	Cavities in dead mesquite limb
Fowlerton (La Salle Co.)	W. S. Creighton	Cavities in dead mesquite limb
Delta Lake (Hidalgo Co.)	W. S. Creighton	On willow bark

Table II

Records for *M. subditiva* based upon nests

Station	*Collector*	*Nest site*
TEXAS:		
Austin (Travis Co.)	W. M. Wheeler	In willow bark (*Salix* sp.)
Victoria (Victoria Co.)	J. D. Mitchell	Under willow bark (*Salix* sp.)
30 miles NE of Raymondsville (Kenedy Co.)	W. S. Creighton	Burrows in live-oak limb (*Q. virginiana*)
2 miles west of Wimberley (Hays Co.)	W. S. Creighton	Crevice in limestone ledge.
Bentsen State Park (Hidalgo Co.)	W. S. Creighton	Under hackberry bark (*Celtis laevissima*)
La Feria (Cameron Co.)	W. S. Creighton	Abandoned termite burrows in partly buried plank
NUEVO LEON:		
Chipinque Mesa (Monterrey)	W. S. Creighton	Burrows in live-oak limb (*Q. fusiformis*)

the largest colony contained 145 workers, the smallest one only twelve workers. It appears, therefore, that the colonies of *subditiva* are always small and seldom, if ever, pleometrotic.

Two captive colonies were established in February 1965 and it was soon apparent that *subditiva* is a very easy ant to maintain in artificial nests. It appears to be omnivorous, since the captive colonies rarely refused anything edible, but it has a strong preference for insect food. The captive colonies ate termites, fruit flies, house flies, crane flies, mosquitos, dermestid beetles, crickets, caterpillars and various moths and butterflies. With the exception of adult sawflies and stoneflies, which they plainly disliked, although they ate them, they accepted this varied insect diet without hesitation. They are one of the few ants which the writer has studied that would eat cut-worms. Their favorite food appeared to be the larvae of buprestid bettles. The ant larvae were mostly fed by regurgitation but, on occasion, bits of insect tissue were placed in their jaws.

In the captive colonies the rate of egg-laying averaged out to slightly less than three eggs per day. The eggs hatched into larvae in about 30 days and these transformed into pupae in about 23 days. The pupal period was about 19 days. The pupae darken extensively after 14 days and at emergence are so deeply colored that there is no callow period in the strict sense of the term. These newly emerged adults can be told from their older nestmates but this is by no means easy for the color difference is slight and largely confined to the lower surface of the body. It is usually easier to tell a "callow" by its actions for, during the first two or three days after emergence they take little part in the nest activities. The pupal exuvium is pulled off in long strips by the workers. Two or three will often work together at stripping off the exuvium, which they apparently eat. During the stripping the emerging imago often assists the process by bending its body from side to side.

It appears that *subditiva* produces and matures brood throughout the year. The writer has taken nests of *subditiva* from the middle of October to the middle of March and these have invariably contained brood. With the exception of two male pupae this brood has been free of sexual forms, hence it seems likely that under ordinary conditions only worker brood is produced during the winter months. It may be added that *subditiva* has no trouble bringing brood through in artificial nests. During the time that the captive colonies were under observation the population of one of them more than tripled.

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NOTES ON THE INDO-AUSTRALIAN ANTS OF GENUS *SIMOPONE* FOREL (HYMENOPTERA-FORMICIDAE)[1]

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I recently discussed a Philippine specimen of *Simopone* which was tentatively identified as *S. bakeri* Menozzi (Taylor, 1965: 6). Subsequent examination of the *bakeri* holotype has shown the Philippine specimen to be representative of a new species, which is described below, along with diagnostic notes on the *bakeri* type. Three species of *Simopone* are now known from the Indo-Australian area. All are represented only by their worker holotypes. They are similar in habitus, and constitute a compact and undoubtedly closely related complex within this predominantly African cerapachyine genus. The generic diagnosis presented earlier (Taylor, *loc. cit.*) needs no modification at this point.

Simopone chapmani sp. n.

Type locality. PHILIPPINE ISLANDS: *Negros:* Horns of Negros, 3600 ft. The unique worker holotype was collected, presumably in rain forest, by the late Dr. James W. Chapman, for whom this species is named.

Type deposition. Museum of Comparative Zoology, Harvard University (Type No. 31199).

Description. Dimensions (in mm): aggregate total length (TL) *ca.* 5.0; head length at midline (HL) 0.91; maximum head width (HW) 0.68; cephalic index (HW × 100/HL) (CI) 75; maximum eye diameter 0.30; ocular index (eye diameter × 100/HW) (OI) 44; minimum interocular distance 0.34 (1.14 × eye diameter); PW 0.55; WL 1.2; petiolar node length at midline 0.68; maximum petiolar node width 0.56; postpetiolar length at midline 0.64; maximum postpetiolar width 0.61. Generally similar to the New Guinean *S. gressitti* Taylor, and agreeing with its original description (Taylor, 1965, Breviora 221: 3), except in the following characters:

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[1] Research supported by U. S. National Science Foundation Grant No. GB 1634.

The *Simopone bakeri* Menozzi holotype, discussed here, was generously loaned for study by Prof. Dr. Guido Grandi, Istituto di Entomologia. Universita degli studi, Bologna, Italy.

Manuscript received by the editor January 19, 1966.

1. Smaller size, with narrower head and proportionately large eyes, which are less widely separated relative to their maximum diameter; postpetiole slightly longer than broad in dorsal view (length 1.05 × width). (The relevant dimensions of *gressitti* are: TL *ca.* 6.4 mm; CI 81; OI 38; eyes separated by 1.53 × their maximum diameter; postpetiole length 0.70 mm, width 0.75 mm — length 0.93 × width.)

2. Transverse occipital carina lacking distinct ribs along its anterior edge.

3. Lateral suturation of mesosoma complete, but less distinct. Transverse ribbing vestigial on dorsal promesonotal suture and lacking on dorsal mesometanotal suture.

4. Transverse anterior petiolar carina without ribs.

5. Sides of postpetiole, in dorsal view, almost parallel, very feebly divergent posteriorly.

6. Body entirely smooth and shining, except for some vestigial fine longitudinal striae on frontal carinae, and scaly microsculpture on sides of pronotum and propodeum, and on metepisternal areas.

7. Post-cephalic ground pilosity more abundant. Very fine short reclinate to suberect hairs scattered on dorsum of mesosoma, most abundant on sides of propodeal dorsum. Similar pilosity moderately abundant on dorsa of petiole and postpetiole. Single, more erect, but barely longer hairs at midlength of each frontal carina and above each eye, but not elsewhere. No subpetiolar "brush" developed; only 2 hairs break the subpetiolar profile.

The mandibular dentition is worn but was probably originally like that of *bakeri,* as described by Menozzi. The legs are damaged; so details of the tibial and tarsal armament are not known.

Relationships. See below under *S. bakeri.*

Simopone bakeri Menozzi

Simopone bakeri Menozzi, 1926, Atti Soc. Nat. Mat. Modena, (6) 4: 92 (1925), worker. Type locality: Singapore.

The notes below are based on the unique holotype, which has the following dimensions (in mm, see preceding description for explanation of symbols): TL *ca.* 5.6; HL 1.00; HW 0.65; CI 65; maximum eye diameter 0.32; OI 49; minimum interocular distance 0.32 (equal to eye diameter); PW 0.58; WL 1.36; petiolar node length at midline 0.72; maximum petiolar node width 0.62; postpetiolar length at midline 0.73; maximum width of postpetiole 0.65. Close to *chapmani* and *gressitti,* and agreeing with the original description of the latter, except in the following characters:

1. Smaller size (about as in *chapmani*), with much narrower head and proportionately much larger eyes, which are less widely separated relative to their maximum diameter; postpetiole distinctly longer than broad in dorsal view (length 1.12 × width).

2. Anterior clypeal border strongly biconcave in frontal view, with a distinct median anterior tooth.

3. Transverse occipital and anterior petiolar carinae as in *chapmani.*

4. Lateral mesosomal suturation weaker, as in *chapmani.* Dorsal promesonotal suture distinctly transversely ribbed; mesometanotal suture lacking on mesosomal dorsum.

5. Sides of postpetiole as in *chapmani,* almost parallel in dorsal view.

6. Sculpturation generally as in *chapmani,* but scaly microsculpture lacking on sides of pronotum, which are smooth and shining.

7. Vestiture much more abundant than in either *gressitti* or *chapmani.* Moderately long reclinate to sub-erect hairs fairly abundant on head, those at center of frons shortest and least abundant, those along frontal carinae more erect, a single more elongate hair above each eye. Dorsa of mesosoma, petiole and postpetiole with similar, but somewhat longer pilosity, least abundant on disc of pronotum, best developed on propodeum and petiole. Single longer hairs on pronotal humeri, on petiole slightly behind its anterior corners, and dorso-laterally at about mid-length of postpetiole. Anterior gastric pilosity slightly less abundant and shorter than that of nodes, several more elongate hairs laterally, apex surrounded by long arched hairs. The subpetiolar process is partly obscured by glue; it appears that about 10-12 long hairs normally break its ventral profile; they do not form a regular brush-like series as in *gressitti.*

Relationships. S. bakeri is more similar, and probably more closely related to *chapmani* than to *gressitti.* It is easily distinguished from *chapmani* by the cephalic and ocular proportions, the structure of the anterior clypeal border, and the more abundant vestiture. These three species form an apparently morphoclinal sequence *(bakeri → chapmani→ gressitti)* in various characters, including decrease in relative size of the eyes (i.e. OI), and increase in relative head width (i.e. CI), in the spacing of the eyes relative to their maximum diameter, and in the width of the postpetiolar dorsum relative to its length. Reduction and specialization of the pilosity also follow this sequence. *S. bakeri* appears to have the most primitive habitus and probably most resembles the ancestral Indo-Australian stock, except perhaps for its possession of a median clypeal tooth, and the lack of a dorsal mesometanotal suture.

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A NEW SPECIES OF THE SPIDER GENUS *XYSTICUS* (ARANEAE: THOMISIDAE) FROM ARIZONA*

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The North American crab spiders are now comparatively well known taxonomically. This is particularly true of the species in the large genus *Xysticus*, which has been twice revised continentally by Gertsch (1939, 1953) and treated in more regional works by Buckle and Redner (1964), Schick (1965), and Turnbull, *et al.* (1965). It seems probable that any additional new forms that will be discovered will be from remote parts of the continent or in sibling relationship with known species. Several species have, however, been described only from one sex.

The purpose of this paper is to describe a distinctive new species of *Xysticus* from the mountainous parts of Arizona. Its structure clearly places it in the *locuples* group of the apophysate division of the genus, and its range suggests it to be an inland endemic of the southwestern United States.

Xysticus humilis sp. n.

(figs. 1-5)

Male: Total length 3.45 and 3.16 mm.; carapace 1.88 and 1.68 mm. long and 1.82 and 1.59 mm. wide; femur II 1.86 and 1.68 mm. long (measurements made, respectively, on the holotype and a paratype). Carapace low and smoothly rounded from side to side, being little higher at level of legs II than at level of posterior eye row; front nearly vertical; surface with thin coat of short, stiff, recumbent setae; eye area and front set with several spiniform setae; orange-yellow in color, with indistinct pale V in front of dorsal groove, which is uncolored, and with thin black line at side margins. Both rows of eyes recurved; ocular quadrangle wider than long, slightly wider behind than in front; laterals larger than medians; posterior medians only slightly closer to each other than to posterior laterals. Legs pale yellowish, I and II slightly darker than III and IV and with orange-brown tibiae; femur I with 3-4 weak prolateral spiniforms, 1-2 dorsals, 0 retrolaterals; tibia I with 0-3 weak dorsal spiniforms, 0 prolaterals, 4 pairs of ventrals, 0 retrolaterals; tarsal claws

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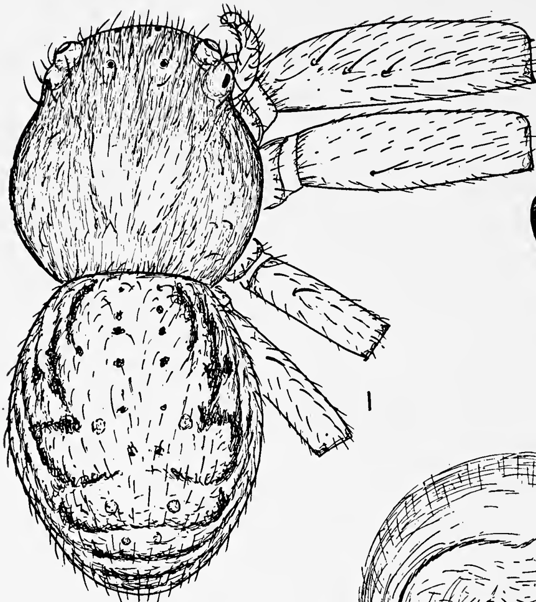
*Manuscript received by the editor January 3, 1966.



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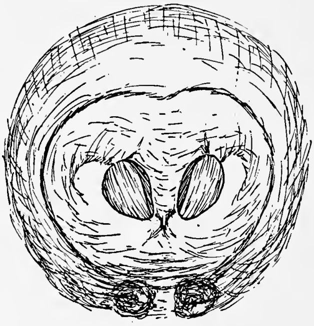

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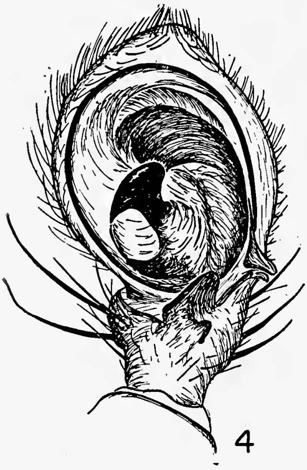

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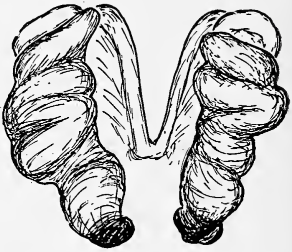

5

REDNER AND DONDALE — XYSTICUS

with 5 teeth. Abdominal dorsum pale yellowish to off-white, with pattern composed of thin lateral black lines on anterior half and 4-5 similar transverse lines posteriorly.

Tibia of palpus with ventral apophysis flattened and bladelike, and bearing small basal lobe; distal tegular apophysis flattened; embolus not thickened at tip (Figs. 2, 4).

Female: Total length (allotype) 5.21 mm.; carapace 2.61 mm. long and 2.46 mm. wide; femur II 2.32 mm. long. Structure and color essentially as in male, but femora I and II concolorous with other segments; abdominal pattern and carapace setation as in Figure 1. Epigynum with deep atrium and paired atrial sclerites as in Figure 3; spermathecae as in Figure 5, each copulatory tube arising posteriorly and forming convoluted mass dorsal to anterior end of spermatheca.

Range: Arizona.

Type Locality: Holotype male and one paratype male from Portal, Cochise County, Arizona, July 19, 1964, J. A. Woods and V. Roth collectors. Deposited in the American Museum of Natural History, New York.

Other Locality: Allotype female from 2 miles north of Rodeo, Arizona, June 12, 1957, Statham and Plimton collectors. Deposited in the American Museum of Natural History, New York.

Diagnosis: *X. humilis* most resembles *X. bradti* Gertsch, which is known only from males taken in the State of Chihuahua, and *X. texanus* Banks, a better-known species, from Nuevo Leon, Texas, Arizona, Colorado, and the southeastern United States. Both *X. bradti* and *X. texanus* are relatively small in size and weakly setaceous in carapace and legs. *X. humilis* is distinct from these and all other known species of *Xysticus* in its low, pale, smoothly-convex carapace, in its abdominal pattern of thin black lines, and in details of the external genitalia. The male palpus has a stout basal tegular apophysis with a small irregularity midway along its basal margin (Fig. 4), whereas in *bradti* and *texanus* this structure is slender and smoothly tapered. The distal tegular apophysis further differs from that of *texanus* in being flat and rounded in outline rather than slender and "heeled", while the epigynal atrium is nearly circular instead of broadened, and the atrial sclerites are approximately ovoid instead of elongate and slender.

EXPLANATION OF PLATE 21

Figs. 1-5. *Xysticus humilis* sp. n. 1. Dorsal view of female. 2, 4. Male palpi. 3, 5. Female epigynum and spermathecae.

ACKNOWLEDGMENTS

The specimens described in this paper were lent to us by Dr. W. J. Gertsch, American Museum of Natural History, New York, to whom we are sincerely thankful.

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THE TYPES OF PROCTOTRUPOIDEA (HYMENOPTERA) IN THE CHARLES T. BRUES COLLECTION AT THE MUSEUM OF COMPARATIVE ZOOLOGY

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During a two week visit to the Museum of Comparative Zoology in June, 1964, I examined the types of 60 species of Proctotrupoidea described by Charles T. Brues. These belonged to the following families: 21 Proctotrupidae, 7 Diapriidae, 13 Scelionidae, 15 Platygasteridae, and 4 Ceraphronidae. In the present report a number of lectotypes are selected, some new combinations are suggested, and an account of the state of preservation of all types listed is given. The names and synonymy used in this paper are those proposed by Masner and Muesebeck (Supplement 2, Hymenoptera of America north of Mexico. United States Department of Agriculture, in press). The taxonomic categories subfamily and tribe are not used in the present paper; the genera and species are arranged alphabetically throughout the families. Under each species are listed the various labels on the type specimen, from top to bottom, each "label" being separated by a semicolon. Specimens are glued to card points except when specifically mentioned as pinned (on minuten nadeln).

Family PROCTOTRUPIDAE

Codrus Panzer, 1801

Codrus angusticeps (Brues)

Proctotrypes angusticeps Brues, 1910. Wis. Nat. Hist. Soc. Bul. 7: 112. Mt. Constitution, Jul. 09, Wash.; Type; MCZ type label; *Exallonyx angusticeps* Brues

Holotype female No. 31002, well preserved. Unique.

Codrus ashmeadi (Brues)

Exallonyx ashmeadi Brues, 1919. N. Y. Ent. Soc. Jour. 27: 10, 13.

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Thanks are extended to the staff of the Museum of Comparative Zoology, particularly to Professor E. Mayr, Dr. H. E. Evans, and Professor P. J. Darlington, Jr. Thanks are also due to the National Research Council of Canada for support during completion of this paper.

Manuscript received by the editor January 16, 1966.

Machias, Me., VII-20-09, C. W.; MCZ type label; *Exallonyx ashmeadi* Brues

Holotype male No. 31006, well preserved. Three paratype males.

Codrus carinatus (Brues)

Exallonyx carinatus Brues, 1919. N. Y. Ent. Soc. Jour. 27: 11, 15.

Oroville, Wash., May 1, 1912; Type; MCZ type label; *Exallonyx carinatus* Brues

Holotype male No. 30993, well preserved. Unique.

Codrus fuscicornis (Brues)

Exallonyx fuscicornis Brues 1919. N. Y. Ent. Soc. Jour. 27: 10, 12.

Woods Hole, Mass.; Type; MCZ type label; *Exallonyx fuscicornis* Brues

Holotype male No. 31005, well preserved. Unique.

Codrus grandis (Brues)

Exallonyx grandis Brues, 1919. N. Y. Ent. Soc. Jour. 27: 11, 17.

Ramsey, N. J.; VIII-22-9; Type; MCZ type label; *Exallonyx grandis* Brues

Holotype female No. 31010, well preserved. Unique.

Codrus obscuripes (Brues)

Proctotrypes obscuripes Brues, 1910. Wis. Nat. Hist. Soc. Bul. 7: 112, 114.

Mt. Constitution, Jul. 09, Wash.; Type; MCZ type label; *Exallonyx obscuripes* Brues

Holotype male No. 31007, well preserved. One paratype male + documentary specimens.

Codrus pallidicornis (Brues)

Exallonyx pallidicornis Brues, 1919. N. Y. Ent. Soc. Jour. 27: 11, 14.

Putnam Ct., 12 July 1905, HL Viereck; Type; MCZ type label; *Exallonyx pallidicornis* Brues

Holotype male No. 30994, well preserved. Two paratype males.

Codrus parvulus (Brues)

Exallonyx parvulus Brues, 1919. N. Y. Ent. Soc. Jour. 27: 11, 16.

Oroville, Wash., I-IV, Melander; Type; MCZ type label; *Exallonyx parvulus* Brues

Holotype male No. 30992, left antenna after 9th segment off. Eleven paratype males.

Codrus placidus (Brues)

Proctotrypes placidus Brues, 1910. Wis. Nat. Hist. Soc. Bul. 7: 112, 113.

Mt. Constitution, Jul. 31-8, Wash.; Type; MCZ type label; *Exallonyx placidus* Brues

Holotype male No. 31004, well preserved. Unique.

Codrus pleuralis (Brues)

Exallonyx pleuralis Brues, 1919. N. Y. Ent. Soc. Jour. 27: 10, 14.

Type; MCZ type label; *Exallonyx pleuralis* Brues

Holotype male No. 30991, well preserved. Two paratype males.

Codrus serricornis (Brues)

Proctotrypes serricornis Brues, 1910. Wis. Nat. Hist. Soc. Bul. 7: 112, 115.

Puget Sound, Wash., Jul. 08; Type; MCZ type label; *Exallonyx serricornis* Brues

Holotype male No. 31009, right antenna after 6th segment and left antenna after 3rd segment missing. Two paratype males.

Codrus similis (Brues)

Exallonyx similis Brues, 1919. N. Y. Ent. Soc. Jour. 27: 10, 11.

Tacoma, Wash., 28-VIII-11; Type; MCZ type label; *Exallonyx similis* Brues

Holotype female No. 31003. Four paratype females.

Codrus simplicior (Brues)

Proctotrypes simplicior Brues, 1910. Wis. Nat. Hist. Soc. Bul. 7: 112, 116.

Puget Sound, Wash., Jul. 08; Type; MCZ type label; *Exallonyx simplicior* Brues

Holotype male No. 30990, right antenna after 7th segment missing, left antenna and wings missing, legs and gaster glued separately to card point. Unique (!).

Cryptoserphus Kieffer, 1907

Cryptoserphus melanderi Brues

Cryptoserphus melanderi Brues, 1919. N. Y. Ent. Soc. Jour. 27: 8.

Pullman, Wash., V-18-09; Type; MCZ type label; *Cryptoserphus melanderi* Brues

Holotype male No. 31000, well preserved. Two paratype males.

Cryptoserphus occidentalis Brues

Cryptoserphus occidentalis Brues, 1919. N. Y. Ent. Soc. Jour. 27: 7.

Chatcolet Lake, Idaho, VIII-1915, A. L. Melander; Type; MCZ type label; *Cryptoserphus occidentalis* Brues

Holotype female No. 30999, left antenna missing after 2nd segment. Four paratype females.

Nothoserphus Brues, 1940

Nothoserphus mirabilis Brues

Notroserphus mirabilis Brues, 1940. Amer. Acad. Arts Sci. Proc. 73: 263.

Taihorin, Formosa, H. Sauter, 1911; 7. VII; MCZ type label; *Nothoserphus mirabilis* Brues

Holotype male No. 29789, left antenna broken after 3rd segment, but remainder glued to mount; right antenna missing after 9th segment (pinned). One paratype male.

Phaenoserphus Kieffer, 1908

Phaenoserphus longipes Brues

Phaenoserphus longipes Brues, 1919. N. Y. Ent. Soc. Jour. 27: 9.

Almota, Wash., 24-VI, Melander; Type; MCZ type label; *Phaenoserphus longipes* Brues

Holotype male No. 31001, well preserved. Unique.

Proctotrupes Latreille, 1796

Proctotrupes cockerelli (Brues)

Serphus cockerelli Brues, 1919. N. Y. Ent. Soc. Jour. 27: 3, 4.

Eldora, Colo., Aug. 18 (Cockerell); Type; MCZ type label; *Serphus cockerelli* Brues

Holotype male No. 30997. well preserved (pinned). Unique.

Proctotrupes debilis (Brues)

Serphus debilis Brues, 1919. N. Y. Ent. Soc. Jour. **27**: 3, 5.

Wawai, Wash., 20-V-11; Type; MCZ type label; *Serphus debilis* Brues

Holotype male No. 30998, well preserved. Unique.

Proctotrupes sequoiarum (Brues)

Serphus sequoiarum Brues, 1919. N. Y. Ent. Soc. Jour. **27**: 3, 4.

Muir Woods, VIII-7-15, Cal., A. L. Melander; Type; MCZ type label; *Serphus sequoiarum* Brues

Holotype male No. 30996, left antenna after 8th segment off, left front leg after coxa missing. Unique.

Proctotrupes zabriskiei (Brues)

Serphus zabriskiei Brues, 1919. N. Y. Ent. Soc. Jour. **27**: 2, 3.

Rochester, N. Y., J. L. Zabriskie, 10. VI. 1905; Type; MCZ type label; *Serphus zabriskiei* Brues

Holotype female No. 30995, left antenna after 8th segment off. Unique.

Family DIAPRIIDAE

Auxopaedeutes Brues, 1903

Auxopaedeutes lyriformis Brues

Auxopaedeutes lyriformis Brues, 1910. Wis. Nat. Hist. Soc. Bul. **8**: 82.

Forest Hills, Mass., V-16-1910; MCZ type label; *Auxopaedeutes lyriformis* Brues Type

Holotype female No. 31027, well preserved. Unique.

Entomacis Foerster, 1856

Entomacis ambigua (Brues)

Hemilexodes ambigua Brues, 1903. Amer. Ent. Soc. Trans. **29**: 126.

Nest *Stenamma fulvum piceum*, Colebrook, 8.25.01; Type; MCZ type label; lectotype selected by L. Masner, 1964; *Hemilexodes ambigua* Brues

Lectotype female No. 31021, well preserved. Two additional females (paralectotypes).

Hoplopria Ashmead, 1893

Hoplopria grandis Brues

Hoplopria grandis Brues, 1915. Psyche **22**: 11.

Porto Velho, Rio Madeira, Brazil, Mann & Baker; Type; MCZ type label; *Hoplopria grandis* Brues ♀ type

Holotype female No. 31022, well preserved. Unique.

Psilus Panzer, 1801

Psilus debilis (Brues) comb. n.

Galesus debilis Brues, 1915. Psyche **22**: 12.

Independencia, Parahyba, Brazil, Mann & Heath; Type; MCZ type label; *Galesus debilis* Brues ♀ type

Holotype female No. 31025, well preserved. Unique.

Trichopria Ashmead, 1893

Trichopria acutiventris (Brues)

Phaenopria acutiventris Brues, 1902. Amer. Nat. **36**: 372.

Austin, Tex., 3.01; Type; MCZ type label; in nest *Eciton caecum; Phaenopria acutiventris* Brues

Holotype female No. 31026, well preserved. Unique.

Xanthopria Brues, 1915

Xanthopria nitida Brues

Xanthopria nitida Brues, 1915. Psyche 22: 11.

Independencia, Parahyba, Brazil, Mann & Heath; Type; MCZ type label; *Xanthopria nitida* Brues ♀ type

Holotype female No. 31024, well preserved. Two paratype females (!).

Xanthopria opaca Brues

Xanthopria opaca Brues, 1915. Psyche 22: 10.

Independencia, Parahyba, Brazil, Mann & Heath; Type; MCZ type label; *Xanthopria opaca* Brues ♀ type

Holotype female No. 31023, well preserved. Two paratype females.

Family SCELIONIDAE

Calotelea Westwood, 1837

Calotelea parvipennis Melander et Brues

Caloteleia (!) *parvipennis* Melander et Brues, 1903. Biol. Bul. 5: 22.

Woods Hole, Mass.; *Halictus*; Type; MCZ type label; *Caloteleia parvipennis* Melander et Brues type

Holotype female No. 31014, right antenna after 7th segment and left antenna after 6th segment off. Unique (!).

Gryon Haliday, 1833

Gryon robustus (Brues)

Hadronotus robustus Brues, 1907. Wis. Nat. Hist. Soc. Bul. 5: 156.

Austin, Tex.; Type; MCZ type label; *Hadronotus robustus* Brues

Holotype female No. 31017, well preserved. Unique.

Lepidoscelio Kieffer, 1905

Lepidoscelio viatrix Brues

Lepidoscelio viatrix Brues, 1917. Nat. Acad. Sci. Proc. 3: 139.

MCZ type label; *Lepidoscelio viatrix* Brues, type

Holotype female No. 31018. Two paratype females ("On an *Orthacris* sp. det Uvarov").

Macroteleia Westwood, 1835

Macroteleia caerulea (Brues) comb. n.

Cacellus caeruleus Brues, 1918. Mus. Comp. Zool. Harv. Bul. 62: 122.

Graciosa Bay, Santa Cruz Is., W. M. Mann '16; MCZ type label; *Cacellus caeruleus* Brues

Holotype female No. 9070, well preserved. Unique.

Classified in *Macroteleia* with some doubts.

Macroteleia herbigrada Brues

Macroteleia herbigrada Brues, 1915. Psyche 22: 7.

Independencia, Parahyba, Brazil, Mann and Heath; Type; MCZ type label; *Macroteleia herbigrada* Brues, type ♂

Holotype male No. 31016, right antenna after 6th segment off. Unique.

Macroteleia pallipes (Brues) comb. n.

Hoploteleia pallipes Brues, 1915. Psyche 22: 8.

Para, Brazil, W. M. Mann; Type; MCZ type label; *Hoploteleia pallipes* Brues, type ♂

Holotype male No. 31013, well preserved. Unique.

Classified in *Macroteleia* Westwood with some doubts.

Paridris Kieffer, 1908

Paridris nigricornis (Brues)

Idris nigricornis Brues, 1903. Amer. Ent. Soc. Trans. 29: 125.

Mixed nest Myr. Lep., Colebrook, 9-10-01; MCZ type label; lectotype selected by L. Masner, 1964; *Idris nigricornis* Brues, types (!).

Lectotype male No. 31016, left antenna after 8th segment off. Two paralectotype males.

Scelio Latreille, 1805

Scelio nitens Brues

Scelio nitens Brues, 1906. Wis. Nat. Hist. Soc. Bul. 4: 110.

Type; Algoa Bay, Capland, 29.11.96, Dr. H. Brauns; MCZ type label; lectotype selected by L. Masner, 1964; *Scelio nitens* Brues

Lectotype female No. 31019, well preserved. Two paralectotype females (!) (? conspecific with lectotype).

Scelio pulchripennis Brues

Scelio pulchripennis Brues, 1906. Wis. Nat. Hist. Soc. Bul. 4: 109.

Type: Algoa Bay, Capland, 22.1.96, Dr. Brauns; MCZ type label; *Scelio pulchripennis* Brues

Holotype female No. 31020, well preserved. Unique (!).

Scelio setiger Brues

Scelio setiger Brues, 1918. Mus. Comp. Zool. Harv. Bul. 62: 121.

Ugi, British Solomon Is., W. M. Mann; MCZ type label; *Scelio setiger* Brues

Holotype female No. 9069, well preserved.

Telenomus Haliday, 1833

Telenomus fiskei Brues

Telenomus fiskei Brues, 1910. Psyche 17: 106.

Machias, Me., Aug. 20, 1909; Type; MCZ type label; *Telenomus fiskei* Brues

Holotype female No. 31011, right antenna missing. Unique (!).

Telenomus heracleicola Brues

Telenomus heracleicola Brues, 1906. Wis. Nat. Hist. Soc. Bul. 45: 143, 146.

Wash. Exp. Sta. No. 026; Type; MCZ type label; lectotype selected by L. Masner, 1964; *Telenomus heracleicola* Brues

Lectotype female No. 31012, well preserved (pinned). One paralectotype female (!).

Trimorus Foerster, 1856

Trimorus fortis (Brues) comb. n.

Hoplogryon fortis Brues, 1915. Psyche 22: 6.

Independencia, Parahyba, Brazil, Mann & Heath; Type; MCZ type label; *Hoplogryon fortis* Brues ♂ type

Holotype male No. 30987, well preserved. Unique.

Family PLATYGASTERIDAE

Fidiobia Ashmead, 1895

Fidiobia tritici (Brues)

Rosneta tritici Brues, 1908 Wis. Nat. Hist. Soc. Bul. 6: 157.

Middleport, N Y., 1908; Type; MCZ type label; *Rosneta tritici* Brues

Holotype female No. 300, missing from the card point (fore wing only left). Unique.

Gastrotrypes Brues, 1922

Gastrotrypes caudatus Brues

Gastrotrypes caudatus Brues, 1922. Amer. Acad. Arts Sci. Proc. 57: 272.

Forest Hills, Mass., 5,1916; MCZ type label; lectotype selected by L. Masner, 1964; *Gastrotrypes caudatus* Brues,' types (!)

Lectotype female No. 31041, well preserved. 16 paralectotype females.

Gastrotrypes spatulatus Brues

Gastrotrypes spatulatus Brues, 1922. Amer. Acad. Arts Sci. Proc. 57: 271.

Kartabo, B. G., Jul. Aug. 1920, W. M. Wheeler; MCZ type label; lectotype selected by L. Masner, 1964; *Gastrotrypes spatulatus* Brues

Lectotype female No. 31040, well preserved. Two paralectotype females.

Isostasius Foerster, 1856

Isostasius crassus Brues

Isostasius crassus Brues, 1922. Amer. Acad. Arts Sci. Proc. 57: 277.

Kartabo. B. G., Jul. Aug. 1920, W. M. Wheeler; MCZ type label; *Isostasius crassus* Brues, type

Holotype female No. 31030, well preserved. Two paratype females.

Platygaster Latreille, 1809

Platygaster anormis (Brues)

Aneuron anormis Brues, 1910. Wis. Nat. Hist. Soc. Bul. 8: 49.

Albany, N. Y., IV-18, 1908; MCZ type label; lectotype selected by L. Masner, 1964; *Aneuron anormis* Brues

Lectotype male No. 31039, left antenna after 4th segment missing. Four paralectotype males and one paralectotype female.

Platygaster carinifrons (Brues) comb. n.

Polygnotus carinifrons Brues, 1910. Broteria 9: 155.

MCZ type label; lectotype selected by L. Masner, 1964; *Polygnotus carinifrons* Brues

Lectotype male (!) No. 31034, well preserved. Three paralectotype males but no female.

Platygaster coronatus (Brues) comb. n.

Polygnotus coronatus Brues, 1910. Broteria 9: 154.

MCZ type label; lectotype selected by L. Masner, 1964; *Polygnotus coronatus* Brues

Lectotype female No. 31035, well preserved. Three paralectotype males.

Platygaster latescens (Brues) comb. n.

Polygnotus latescens Brues, 1910. Broteria 9: 156.

MCZ type label; lectotype selected by L. Masner, 1964; *Polygnotus latescens* Brues

Lectotype female No. 31036, well preserved. Three paralectotype females.

Platygaster mediocris (Brues) comb. n.

Polygnotus mediocris Brues, 1910. Broteria 9: 157.

MCZ type label; lectotype selected by L. Masner, 1964; *Polygnotus mediocris* Brues

Lectotype female No. 31037, well preserved. Three paralectotype males.

Platygaster noveboracensis (Brues)

Eritrissomerus noveboracensis Brues, 1910. Wis. Nat. Hist. Soc. Bul. 8: 48.

Albany, N. Y., IV. 5, 1907; Type; MCZ type label; lectotype selected by L. Masner, 1964; *Eritrissomerus noveboracensis* Brues, types (!)

Lectotype male No. 31038, well preserved. Two paralectotype males.

Platygaster simplex (Brues) comb. n.

Polygnotus simplex Brues, 1922. Amer. Acad. Arts Sci. Proc. 57: 257.

#b; MCZ type label; lectotype selected by L. Masner, 1964; *Polygnotus simplex* Brues

Lectotype female No. 31032, well preserved. Two paralectotype females (!).

Platygaster tubulosa Brues

Platygaster tubulosa Brues, 1922. Amer. Acad. Arts Sci. Proc. 57: 276.

MCZ type label; *Platygaster tubulosa* Brues, type

Holotype female No. 31033, well preserved. Two paratype females.

Sceliotrachelus Brues, 1908

Sceliotrachelus braunsi Brues

Sceliotrachelus braunsi Brues, 1908. Genera Insectorum, fasc. 80: 13.

Algoa Bay, Capland, Dr. Brauns; MCZ type label; *Sceliotrachelus braunsi* Brues, type

Holotype male (!) No. 30989, right antenna after 7th segment off (pinned). One paratype male.

Synopeas Foerster, 1856

Synopeas minor (Brues)

Polymecus (Dolichotrypes) minor Brues, 1922. Amer. Acad. Arts Sci. Proc. 57: 268.

Kartabo, B. G., Jul. Aug. 1920, W. M. Wheeler; MCZ type label; lectotype selected by L. Masner, 1964; *Polymecus (Dolichotrypes) minor* Brues ♀ ♀

Lectotype female No. 31028, well preserved. Two paralectotype females (!).

Trichacis Foerster, 1856

Trichacis meridionalis (Brues) comb. n.

Xestonotus meridionalis Brues, 1910. Broteria 9: 150.

MCZ type label; lectotype selected by L. Masner, 1964; *Xestonotus meridionalis* Brues; *Trichacis* (Fouts)

Lectotype female No. 31031, well preserved. One paralectotype female (!).

Family CERAPHRONIDAE

Ceraphron Jurine, 1807

Ceraphron croceipes Brues

Ceraphron croceipes Brues, 1902. Amer. Nat. 36: 369.

Type; in nest *E. coecum;* MCZ type label; *Ceraphron croceipes* Brues

Holotype female No. 30984, well preserved. Unique.

Conostigmus Dahlbom, 1858

Conostigmus orcasensis (Brues)

Megaspilus orcasensis Brues, 1910. Wis. Nat. Hist. Soc. Bul. 7: 118

Puget Sound, Wash., Jul. 08; MCZ type label; *Megaspilus orcasensis* Brues, ♂ type

Holotype male No. 30985, well preserved. Unique.

Ecitonetes Brues, 1902

Ecitonetes subapterus Brues

Ecitonetes subapterus Brues, 1902. Amer. Nat. 36: 370.

Type; Austin, Tex.; MCZ type label; *Ecitonetes subapterus* Brues

Holotype female No. 30983, thorax slightly cracked. Unique.

Lygocerus Foerster, 1856

Lygocerus constrictus Brues

Lygocerus constrictus Brues, 1910. Wis. Nat. Hist. Soc. Bul. 7: 119.

Mt. Constitution, Jul. 09, Wash.; MCZ type label; *Lygocerus constrictus* Brues, type

Holotype male No. 30986, well preserved. Two paratype males.

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THE HABITAT OF *PLATYPATROBUS* DARLINGTON (COLEOPTERA: CARABIDAE)

By Henri Goulet
College Bourget, Rigaud, Québec, Canada.

Since its description in 1938, *Platypatrobus lacustris* Darlington has remained a great mystery. Despite intensive searches both in Canada and the United States, only six examples had been found. But in 1965 the mystery seemingly was solved, for 51 specimens were captured by the author and his companions during three visits to Meach Lake, Qué., in Gatineau Park, near Ottawa.

Platypatrobus lacustris was described as a new genus and a new species from a single female taken by Hubbard and Schwarz at Batchawana Bay, Ontario (north of Sault Sainte Marie) on August 15, probably in 1876 or 1877. The species was known only from the type until Dr. C. H. Lindroth and Dr. P. J. Darlington discovered in the C. H. Frost collection a male taken at light by Dr. A. E. Brower at Sinclair, in northernmost Maine, on July 30, probably in the 1950's. Br. A. Robert found another male at light in Mont Tremblant Park, Qué., on July 1961. On July 28, 1963, two specimens were captured at light by Mr. and Mrs. R. T. Bell at Stowe, in northern Vermont. Finally Mr. J. Larson found one example on Simpson Island, in Great Slave Lake, N.W.T., Canada, on July 18, 1964; and found another example at light on July 28 at Lethbridge, Alberta, in 1965.

The rarity of *Platypatrobus* indicates a special habitat. Dr. Darlington noted that, unlike species of allied genera, specimens of *Platypatrobus* frequently bore mites and he suspected that these might offer a clue to the habitat of the beetle. Dr. E. Lindquist indentified the single mite carried by Mr. Larson's specimen as *Protodinychus sp.* and pointed out that *Protodinychus* occurred commonly in beaver houses in Algonquin Provincial Park, Ontario (collector: Dr. M. Wood).

At Meach Lake, Qué., about 15 miles northwest of Ottawa, Ontario, the author discovered an abandoned beaver pond. The water level was very low and the beaver house was largely surrounded by very wet soil. On June 26, collecting very close to this house produced one teneral specimen of *Platypatrobus;* 40 specimens, including several that were teneral, were found on July 6, and 10 more on July 10. None were found on August 6, when the soil was less wet;

and none were found on any date around a nearby beaver house in a drier situation. The beetles occurred beneath embedded logs and under loose bark of old stumps, sometimes several inches beneath the surface of the extremely wet soil which was exposed to the sun and which contained much organic matter and debris. Numerous scarce or local Carabidae that occur in the same general habitat are *Elaphrus olivaceus* LeConte, *Bembidion versutum* LeConte, and Agonum cincticolle (Say). We noted other beetles there that bore the mite *Protodinychus: Leptinellus validus* (Horn), *Agonum melanarium* (Dejean), and *Quedius sp.* (those specimens were found around the beaver house only).

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THE GENUS *ZONOSEMATA*, WITH NOTES ON THE CYTOLOGY OF TWO SPECIES (DIPTERA — TEPHRITIDAE)[1]

By Guy L. Bush
Department of Biology, Harvard University

The genus *Zonosemata* (Trypetinae, Trypetini) was established by Benjamin (1934) to include the type, *Trypeta electa* Say, and *Zonosema vittigera* Coquillett. The latter species he considered as possibly only a western race of *electa*. Both are recognized as distinct in this revision and two new species from Mexico and one from Jamaica are described.

Zonosemata is closely related to the Holarctic and Neotropical *Rhagoletis* Loew (including *Zonosema* Loew), the monotypic Nearctic *Rhagoletoides* Foote, the Neotropical *Rhagoletotrypeta* Aczél, and the Palearctic and Indian *Carpomyia* Rondani[2]. It shows particularly close affinities in habitus to certain Mexican and Neotropical *Rhagoletis*, such as *R. striatella, R. ferrugineus, R. lycopersella, R. ochraspis,* and others, some of which infest solanaceous fruits as do at least two species of *Zonosemata.* Cytologically the chromosomes of *Zonosemata* also bear some resemblance to those of *R. striatella.* Furthermore, unlike other *Rhagoletis* species, the egg of *striatella* is stalked and somewhat like those of *Z. electa* (Fig. 26) and *Z. vittigera.* These similarities, coupled with the fact that four of the five species are from Mexico and Jamaica, suggest that *Zonosemata* probably originated in Central or possibly South America from some common ancestor with *Rhagoletis.* Further field work in these regions may therefore eventually clarify the relationships between these two genera.

BIOLOGY

The biology of *Z. vittigera* and *Z. electa* has been discussed in some detail by several authors (Peterson 1923, Benjamin 1934, Burdette 1935, Cazier 1962, and Foott 1963). Both species normally infest certain native species of horsenettle (*Solanum* spp., *Solanaceae*).

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[1] Published with the aid of a grant from the Committee on Evolutionary Biology, Department of Biology, Harvard University. *Manuscript received by the editor, August 30, 1965.*

[2] The presence of minute ocellar bristles in *Carpomyia* is the only character that effectively separates this genus from *Rhagoletis.* This character is of doubtful importance and *Rhagoletis* may eventually fall into synonymy with *Carpomyia* (for detailed discussion see Bush 1966).

Since 1921, however, *electa* has become a serious pest of peppers and eggplants in the eastern United States. Recently it was found attacking these plants as far north as southwestern Ontario (Foott 1963). The hosts of the three new species are not known, but they may also be expected to infest the fruits of solanaceous plants.

There is evidence that the pepper and horsenettle populations, at least in Ontario, have become somewhat ecologically isolated from each other. Foott (1963) noted that larvae from horsenettle emerge later and are considerably smaller than those emerging from peppers. He offered three possible explanations for this observation: microclimatic conditions were different for the two hosts; nutritive qualities of the fruits varied; earlier availability of pepper fruits allowed expansion of the early emerging fly population. As pointed out by Bush (1966), the third possibility would establish allochronically isolated populations on different hosts and permit divergence to progress rapidly in the absence of gene flow from the parent population. This could result in the formation of two distinct host races. A careful study of these populations would be extremely interesting as little is known about the formation of host races and species in phytophagous insects.

CYTOLOGY

Mitotic configurations in the larval brain and adult testes were examined in *Z. electa* and *Z. vittigera.* Tissue was pretreated in a saturated aqueous solution of coumarin for 5 - 8 minutes, fixed and stained in proprionic orcein for 5 minutes, and squashed in a drop of stain following the method of Bush (1962). Pretreatment of the tissue with coumarin was necessary to produce well flattened metaphase plates and to locate the kinetichores.

The karyotypes of both species are indistinguishable. In the male there are five pairs of very small metakinetic autosomes and a heteromorphic pair of extremely long acrokinetic and heterochromatic sex chromosomes (Fig. 1). Following coumarin pretreatment the chromatids of the X chromosome at metaphase are usually joined only at their extreme ends forming an oblong ring (Fig. 1, X). The chromatids of the shorter Y chromosome are usually closely approximated over much of their length and form a figure

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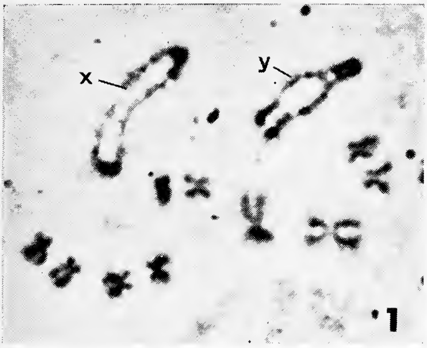
Explanation of Plate 22

Figs. 1-3. Mitosis in neuroblast cells of *Zonosemata electa:* (1) metaphase; (2) prophase; (3) anaphase.

Figs. 4-8. Right wings of *Zonosemata* spp.: (4) *electa,* N. J., U. S. A.; (5) *vittigera,* Texas, U. S. A.; (6) *cocoyoc,* paratype, Morelos, Mex.; (7) *minuta,* type, Jamaica, W. I.; (8) *vidrapennis,* paratype, Mexico, Mex.



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BUSH — ZONOSEMATA

eight (Fig. 1, Y). At prophase (Fig. 2) the X chromosomes are greatly elongated and are associated with a nucleolar organizer. At late anaphase (Fig. 3) the chromatids of the sex chromosomes are still in contact on the metaphase plate while the fully disjoined autosomes have reached the poles. In both sexes a large heterochromatic irregular-shaped body is always visible in the nucleus during interphase. However, it is not clear whether this represents only one or both sex chromosomes. Both the autosomes and the sex chromosomes have a fuzzy appearance during all stages of division, suggesting that some genetic activity may be in progress even during cell division. The polytene chromosomes of the salivary gland, gut, and Malpighian tubules were checked and found unsuitable for detailed analysis.

Zonosemata Benjamin

Spilographa Loew (in part), 1873, Smith. Misc. Coll. 256: 244, 336.

Zonosema Coquillett, 1899, Jour. N.Y. Ent. Soc. 7: 261.

Phorellia Hendel (in part), 1914, Abh. u. Ber. Zool. Mus. Dresden (1912) 14: 28.

Zonosemata Benjamin, 1934, U.S. Dept. Agri. Tech. Bull. 401: 17-18. [Type of genus, *Trypeta electa* Say, location unknown, apparently lost[3]; type locality: Indiana]. — Aczél, 1951, Acta zool. Lilloana 9: 214. — Aczél, 1954, Dusenia 5: 152-153.

Further details on the nomenclatorial history of this genus may be found in Benjamin (1934) and Stone (1951).

GENERIC DIAGNOSIS. *Zonosemata* may be distinguished from other members of the tribe Trypetini by the following combination of characters:

1. Predominantly yellow with black maculations, a cream colored notopleural stripe and brown crossbands on the wing.
2. Dorsocentrals located closer to a line drawn between postalars than to anterior supraalars.
3. One pair of well developed outer scapular bristles, inner pair absent or if present (rarely) then minute.
4. Sex chromosomes diffuse, much elongated, heterochromatic and heteropycnotic; autosomes very small and diffuse.
5. Surstyli blunt, short and broad; not greatly elongated beyond prensisetae.
6. *Usually* four pairs of lower fronto-orbital bristles.
7. Dorsum lacking pollinose microtrichia.
8. Larvae with minute poorly sclerotized stomal guard hooks.

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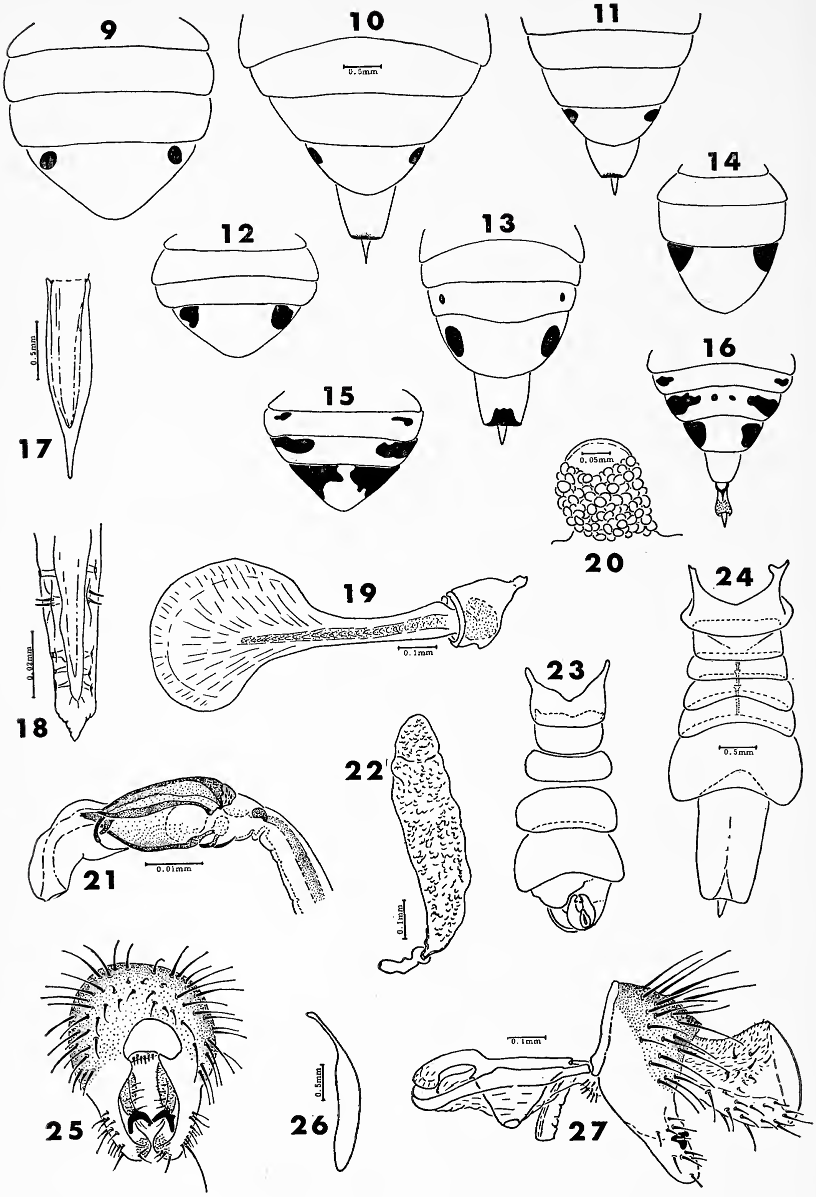
[3] Although no type could be located for *electa,* Say's original description is clear enough to leave no doubt as to the identification of the type species. A neotype was not designated pending a more thorough search for the type.

GENERIC DESCRIPTION. *Head* (Fig. 30): subquadrate in profile; about 1.1 times wider than high; all regions, including palps and mentum, light yellow to yellowish-orange; ocellar triangle light brown to brownish-black; vertex measured across anterior margin of ocellar plate, narrower than maximum width of eye; eye about 1.5 times higher than wide; frons convex in profile, prominent at antennae, slightly wider at vertex than at antennae; antennae .5 - .6 length of face; third segment with sharp awl-shaped tip, more than twice length of second; artista black or dark brown, pubescent, grading to yellow at base; face minutely pubescent. Genae moderately narrow, .23-.26 height of head. Postcranial region and head slightly concave; foveae and carina moderately developed; epistome slightly upturned; postgenae bulging. Usually four pairs convergent black fronto-orbitals, occasionally only three pairs or with one or two extra bristles on one side or both; two pairs black reclinate divergent upper fronto-orbitals, upper approximately two-thirds length of lower; ocellars strongly proclinate, divergent, approximately same length as upper fronto-orbitals. Comb translucent yellow. Outer verticals black, about two-thirds length black inner verticals; postorbitals yellow, short; genal bristles variable, yellow or black when present, occasionally undifferentiated; yellow gular bristle weak or undifferentiated. *Thorax:* entirely yellow or with brown and black maculations; halteres yellow. Dorsum and scutellum covered with short decumbent yellow or black setae, lacking any trace of pollinose microtrichia. Normally one pair outer scutellars, rarely one or two minute scapulars present; dorsocentrals in line or slightly before line drawn between posterior supraalars; two mesopleurals; all other bristles normal for Trypetinae. *Legs:* all segments yellow except for black shading along posterior surface of metathoracic tibia. Prothoracic femur with one posterior-ventral and two dorsal rows of stout bristles. Mesothoracic tibia with row of three to five short semierect bristles on posterior surface. Metathoracic tibia with row of short semierect bristles along posterior-lateral surface. *Wing:* pattern consisting of transverse brown crossbands; R_1 setulose over entire length including node; R4 + 5 setulose; usually one to three setae dorsally at junction of R4 + 5 and R2 + 3; anal cell drawn out to point along Cu2 + 2nd A. *Abdomen:* tergites covered with fine long decumbent setae; long black bristles along posterior and lateral margins of tergites III-V in male and III-VI in female (Fig. 24) with well developed internal apodemes. Sternite VI about .55 length of ovipositor sheath. Sternites of male (Fig. 23) without well developed internal apodemes. *Genitalia: male* —-epandrium globose,



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usually black, covered with long bristles; surstyli short with prensisetae (or spurs) subterminal (Fig. 25); genital ring circular, without apodemes (Fig. 27); ejaculatory apodeme fan-shaped (Fig. 19). Vesica of aedeagus (Fig. 21) tubular, without convolutions or appendages. *Female* — ovipositor sheath approximately same length as tergite IV in dorsal view. Ovipositor (Fig. 17) short, margins slightly convex with minute trifurcate tip and two pairs of subterminal minute setae (Fig. 18); two elongate cylindrical spermathecae covered with irregularly shaped minute scale-like papillae (Fig. 22); two elongate accessory glands. Ventral receptacle as in Fig. 20, without central spine as in *Rhagoletis*. *Egg:* micropyle end elongated into stalk (Fig. 26).

KEY TO THE GENUS ZONOSEMATA

The characters most readily used to distinguish the various species in this genus are found in the wing pattern and distribution of black maculations on the body. Other than size, little variation was noted in such structural characters as the male and female genitalia and the number, color, and position of major chaetae.

1. A pair of black presutural spots on the dorsum (Fig. 36) and a black spot or stripe on the sternopleuron (Fig. 35). Host: *Solanum eleagnifolium* .... *vittigera* Coquillett (SW U.S.A., N Cent. Mex.)

No distinct black spots before the transverse suture or on the sternopleuron 2

2. Last three segments of the abdomen each with large, irregularly shaped dark brown to black spots (Figs. 15-♂, 16-♀); dorsum with broad U-shaped maculation with unforked arms (Fig. 33). Host unknown .... *minuta* n. sp. (Jamaica)

Pair of well developed spots on last one or two segments (i.e., Figs. 9-10); black U-shaped maculation on dorsum reduced or

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EXPLANATION OF PLATE 23

Figs. 9-16. Abdomen of *Zonosemata* spp., dorsal view: (9) ♂ *electa,* N. J., U. S. A.; (10) ♀ *electa,* N. J., U. S. A.; (11) ♀ vittigera, Texas, U. S. A.; (12) ♂ *vittigera,* Texas, U. S. A.; (13) ♀ *cocoyoc,* Morelos, Mex.; (14) ♂ *vidrapennis,* type, Mexico, Mex.; (15) ♂ *minuta,* type, Jamaica, W. I.; (16) ♀ *minuta,* paratype, Jamaica, W. I.

Figs. 17-27. *Zonosemata electa,* N. J., U. S. A.: (17) ovipositor; (18) detail of ovipositor tip; (19) ejaculatory apodeme; (20) ventral receptacle; (21) aedeagus; (22) spermatheca; (23) ♂ sternites of abdomen; (24) ♀ sternites of abdomen; (25) posterior view of ♂ genitalia; (26) egg; (27) lateral view of ♂ genitalia showing details of fultella and genital ring.

absent; if present then usually with forked arms (i.e., Figs. 37-38) 3

3. Apical wing band recurved along R4 + 5 but not reaching subapical band, forming the letter P (Fig. 6); last two segments of abdomen each with pair of black spots (Fig. 13). Host unknown .... *cocoyoc* n. sp. (Mexico)

Apical crossband forming the letter V; not recurved along R4 + 5; a single pair of black spots on last segment 4

4. Crossbands of wing narrow (Fig. 8); microtrichia lacking between medial and subapical crossbands in cells R_1, R_3, R_5 and 1st M_2; spot on last abdominal segment large, triangular shaped (Fig. 14). Host unknown .... *vidrapennis* n. sp. (Mexico)

Crossbands of wing broad (Fig. 4); microtrichia present in all cells between medial and subapical crossbands; spot on last abdominal segment small, round (Figs. 9-10). Host: *Solanum* spp. .... *electa* (Say) (E. U.S.A., SE Canada)

Zonosemata electa (Say)

Trypeta electa Say, 1829-30, Jour. Acad. Nat. Sci. Phil. 6: 185-186. [Type not examined, apparently lost[4]; type locality: Indiana]. —Osten Sacken, 1858, Smith. Misc. Coll., Art. 1, 3: 79. —Loew, 1862, Smith. Misc. Coll., Art. 1, 6: 58, 71. Stone, 1951, Proc. Ent. Soc. Wash. 53: 45-46.

Tephritis flavonotata Macquart, 1855, Dipt. Exot. Suppl. 5: 125. [Type not examined[5]; type locality: De l'Amerique septintrionale. Baltimore (in collection of J. E. Collin, Newmarket, England)].

Zonosema electa Coquillett, 1899, Jour. N. Y. Ent. Soc. 7: 261. —Phillips, 1923, Jour. N. Y. Ent. Soc. 31: 127-128, fig. 8.

Spilographa electa Loew, 1873, Smith. Misc. Coll. 256: 244, 336. —Snow, 1903, Kans. Univ. Quart. 11: 161. —Williston, 1905, Kans. Univ. Quart. 13: 307. —Peterson, 1923, N. J. Expt. Sta. Bull. 373: 1-23, pl. 1-3

Zonosemata electa Benjamin, 1934, U. S. Dept. Agri. Tech. Bull. 401: 19-20, fig. 15. —Burdette, 1935, N. J. Expt. Sta. Bull. 585: 3-24, pl. 1-3. —Phillips, 1946, Mem. Amer. Ent. Soc. 12: 96-98, 129, figs. 44, 89, 93, 191. —Anonymous, 1959, U. S. Dept. Agri., Agri. Res. Serv., Copp. Econ. Insect Rept. 9: 721-722. —Foote, 1960, Proc. Biol. Soc. Wash. 73: 114-116.

DIAGNOSIS. Excellent detailed descriptions of both larval and adult stages have been presented by Peterson (1923), Benjamin (1934),

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[4] See foot-note, p. 310.

[5] Macquart's type has been discussed by Stone (1951) who has established its identity with certainty with the help of Mr. J. E. Collin.

and Phillips (1946) and will not be repeated here. Body and wing measurements are presented in Table 1. This predominantly yellow species can be distinguished by the following combination of characters: (1) large body size (Table 1); (2) absence of black markings before the transverse suture on the dorsum and on the sternopleuron (Figs. 29, 37); (3) yellow postscutellum; (4) presence of only a single pair of spots on the last segment of the preabdomen (Figs. 9-10); (5) crossbands of wing broad with medial and subapical bands joined along the posterior margin (Fig. 4); (6) microtrichia present between medial and subapical bands in cells R_1, R_3, R_5, and 1st M_2. Other morphological features of *electa* are illustrated as follows: genitalia (Figs. 17-22, 25, 27); sternites (Figs. 23-24); head (Fig. 30).

VARIATION. There is a great deal of individual variation in this species, particularly in the extent of black shading on the thorax and hind femora. Figs. 29 and 37 therefore represent only the most frequently encountered pattern in well-aged specimens whose color has had time to develop fully. The U-shaped pattern of the dorsum, for example, is often reduced to a small region along the sulcus between the dorsum and scutellum, or is entirely absent. There is also a tendency for individuals from Florida to be somewhat smaller than those from either the North or Texas. A few of the Florida specimens were as small as the average sized *vittigera*. Although most specimens had four pairs of lower fronto-orbitals, numbers ranging from three to as many as seven on one or both sides of the frons were not uncommon.

HOSTS. *Solanum carolinense* Linn., *S. aculeatissimum* Jacq., *S. melongena* Linn., *Capsicum annum* Linn., and infrequently *Lycopersicum esculentum* Mill. (Peterson 1932, Benjamin 1934).

PARASITE. *Opius sanguineus* (Ashmead) (Cazier 1962).

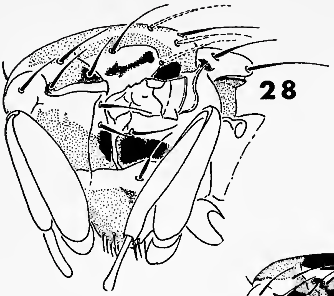
DISTRIBUTION (Map 1). This species ranges from central Florida north to Massachusetts, southern Ontario, southern Illinois, eastern Kansas, and northeastern Texas. The range of *electa* apparently overlaps that of *vittigera* in the transition zone of eastern Texas as far south as Brownsville (see also Foote 1960).

Zonosemata vittigera (Coquillett)

Zonosema vittigera Coquillett, 1899, Jour. N. Y. Ent. Soc. 7: 261. [Lectotype by present designation; locality: Eagle Pass, Texas; (J. Cram coll.) (USNM, type no. 4398)].

Spilographa vittigera Aldrich, 1905, Smith. Misc. Coll. 46: 604.

Zonosemata vittiigera Benjamin, 1934, U. S. Dept. Agri. Tech. Bull. 401: 18, fig. 15. —Phillips, 1946, Mem. Amer. Ent. Soc. 12: 100-101, figs.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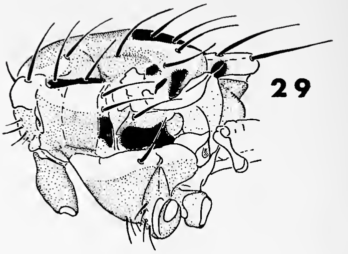
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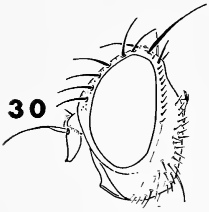
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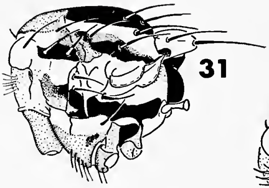
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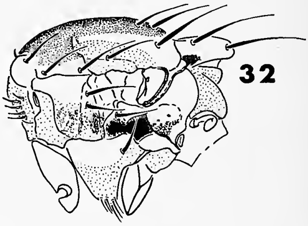
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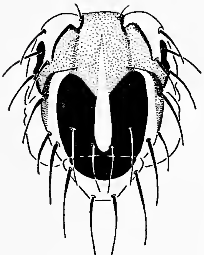
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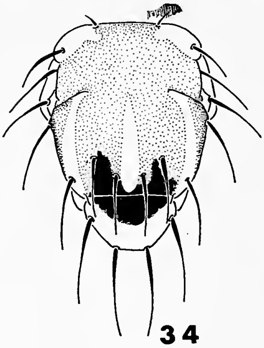
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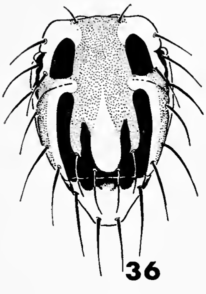
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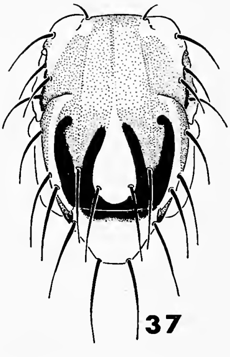
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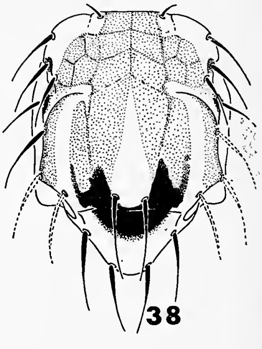
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43, 88, 98, 190. — Aczél, 1954, Dusenia 5: 152-157, figs. 19-27. — Foote, 1960, Proc. Biol. Soc. Wash. 73: 114-116.

Zonosemata variegata[6] Aczél, 1954, Dusenia 5: 162, 164 figs. 19-27; estampa II. C (nomen nudum).

DIAGNOSIS. Detailed descriptions of this species have been presented by Aczél (1954) (adult), and Phillips (1946) (larva). Body and wing measurements are presented in Table 1. *Z. vittigera* can be distinguished readily from all other members of this genus by the presence of a pair of black dots before the transverse suture (Fig. 36), and by the presence of a black stripe or distinct spot on the sternopleuron (Fig. 35). The abdomen has a pair of baso-lateral spots on the last segment in both sexes (Figs. 11, 12). Occasional individuals may also have small brown spots on the penultimate segments. The wing pattern of *vittigera* (Fig. 5) is very similar to that of *minuta* (Fig. 7), but usually can be distinguished from that of *electa* (Fig. 4) by the fact that the medial and subapical bands are joined in the latter species.

VARIATION. The intensity of the black pigmentation of the presutural spots varied a great deal in the specimens available for study, particularly in those from Texas. Many of these specimens have the presutural and sternopleural black spots generally diluted and the postscutellum often predominantly yellow. Hybridization beween *electa* and *vittigera* could account for the reduction in the degree of black coloration in the latter species. However, this seems unlikely as there is no indication of introgression, such as a tendency toward reduction in size or an increase in the intensity or distribution of

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[6] Although Aczél used the name *vittigera* throughout the text of his 1954 paper, he labelled the accompanying illustrations *variegata*. I have also examined specimens bearing the name *variegata* on a type label in Aczél's handwriting in the USNM collection. Dr. Alan Stone of the USNM found Aczél's manuscript species *variegata* to be synonymous with Coquillett's *vittigera* after comparing the types at Aczél's request (from correspondence between Stone and Aczél, 1952, USNM). Aczél therefore apparently made the necessary change in the text but failed to do so for the plate before the paper was published.

EXPLANATION OF PLATE 24

Figs. 28-29, 31-32, 35. Thorax, lateral view, *Zonosemata* spp.: (28) ♀ *cocoyoc*, paratype, Morelos, Mex.; (29) ♂ *electa*, N. J., U. S. A.; (31) ♂ *minuta*, type, Jamaica, W. I.; (32) ♂ *vidrapennis*, paratype, Mexico, Mex.; (35) ♂ *vittigera*, Texas, U. S. A.

Figs. 33-34, 36-38. Thorax, dorsal view, *Zonosemata* spp.: (33) ♂ *minuta*, type, Jamaica W. I.; (34) ♂ *vidrapennis*, paratype, Mexico, Mex.; (36) ♂ *vittigera*, Texas, U. S. A.; (37) ♂ *electa*, N. J., U. S. A.; (38) ♀ *cocoyoc*, paratype, Morelos, Mex.

Fig. 30. Head, *electa* ♂, N. J., U. S. A.

Species	n	HL	HW	HH	TL	WW	WL	OL
electa								
♂	20	1.47± .03 1.16−1.64	2.31± .04 2.00−2.56	2.10± .04 1.88−2.44	3.40± .04 3.00−3.96	2.56± .05 2.24−2.92	4.99± .09 4.28−5.68	
♀	20	1.51± .02 1.28−1.72	2.37± .03 2.00−2.60	2.11± .03 1.80−2.32	3.47± .05 2.92−3.84	2.69± .05 2.32−3.12	5.13± .07 4.56−5.80	1.67± .03 1.44−2.16
vittigera								
♂	20	1.19± .03 .96−1.32	1.84± .03 1.56−2.04	1.67± .03 1.40−1.92	2.49± .06 2.04−2.84	1.86± .03 1.60−2.08	3.83± .07 3.20−4.36	
♀	20	1.20± .03 .92−1.36	1.90± .04 1.52−2.10	1.70± .05 1.24−2.00	2.53± .07 1.84−2.96	1.95± .05 1.48−2.24	4.00± .08 3.00−4.52	1.12± .02 1.00−1.28
vidrapennis								
♂ (Holotype)	1	1.12	1.88	1.60	2.80	2.32	4.68	
minuta								
♂ (Holotype)	1	1.04	1.76	1.60	2.40	1.60	3.48	
♀	1	1.04	1.76	1.60	2.24	1.64	3.60	
cocoyoc								
♀ (Holotype)	1	1.28	2.12	1.90	3.00	2.52	5.08	1.64
♀ (Paratype)	1	1.36	2.24	2.04	3.16	2.66	5.16	

Table 1. Body and wing measurements of *Zonosemata*. Figures represent mean, standard error, and range in mm. HL — head length; HW — head width; HH — head height; TL — thorax length; WL — wing length; WW — wing width; OL — ovipositor length.

black maculation, in the sympatric specimens of *electa* examined from Texas. Some specimens of *vittigera* were reared and appear to be teneral. This could account for their lack of intense black maculations.

Four specimens which appear to be *vittigera* have been examined, each bearing the label 'N.J., Sept. 7-8,' a locality well outside the normal range of this species. Some of these specimens have spots on both the penultimate and last segments. This has been noted in only a few other representatives of this species from Mexico. In all other respects, such as size, wing pattern, and body coloration, they resemble *vittigera*. Without host data or additional information concerning the collection of these specimens, it is impossible to decide if they represent a distinct species. They are therefore tentatively being treated as an adventive of *vittigera* to New Jersey until further information becomes available.

HOST. *Solanum eleagnifolium* Cav. (Aczel 1954, Foote 1960, Cazier 1962).

PARASITE. *Opius sanguineus* (Ashmead) (Cazier 1962).

DISTRIBUTION (Map 1). This species ranges from just north of Mexico, D.F. in the central highlands of Mexico and the southwest tip of Oklahoma to northeastern Texas. Its host plant now occurs as on advent in Indiana, Illinois, Ohio, and Florida, but *vittigera* has never been recorded from these areas. A single specimen from San Francisco, California has been examined, but was collected in a Santa Fe Pullman and therefore is not recorded on Map 1.

Zonosemata cocoyoc new species

TYPES. Holotype ♀, Cocoyoc, MORELOS, Mexico, 8-VIII-56; Trampa Cabo; (O. Hernandez) (USNM, type no. 68111). Paratype ♀, same data as holotype (USNM).

DIAGNOSIS. *Zonosemata cocoyoc* can be easily distinguished from other members of the genus by the wing pattern in which the apical and subapical bands form a letter P. The apical band extends along vein R4 + 5, but does not reach the subapical band (Fig. 6). The reduced black coloration of the thorax (Fig. 6). The reduced black coloration of the thorax (Figs. 28, 38) and the presence of paired spots on tergites V and VI of the female (Fig. 13) will also help to identify this species. The male is unknown.

DESCRIPTION. Body and wing measurements in Table 1. *Head* ♀: indistinguishable in shape from *electa;* all regions, including mentum and palps, golden yellow to light yellow except black ocellar triangle. Genal and gular bristles yellow, undifferentiated from other setae; all other bristles normal and black. *Thorax* (Figs. 28, 38): base color golden yellow; notopleural and sternopleural stripes and light region of dorsum and scutellum ivory. Black shading reduced on dorsum and pleural regions as figured. Postscutellum mostly golden yellow with some black shading along medial line and dorsal margin. *Legs:* normal color and complement of bristles for genus. *Wing* (Fig. 6): medial and basal bands joined by a faint infuscated area in cell R_1. Apical band joined to subapical band on costa and recurved along vein R4 + 5, but not reaching subapical band. Microtrichia present in all cells between medial and subapical crossbands; absent in cells between medial and basal crossbands from costa to $M_3 + Cu_1$. *Abdomen* (Fig. 13): base color yellow, covered with long black decumbent setae. Tergite V with small pair and tergite VI with large pair of black spots. *Genitalia:* ovipositor sheath golden yellow, darker than rest of abdomen. Ovipositor tip similar to *electa.*

HOST. Unknown; captured in a McPhail fermenting lure glass trap.

DISTRIBUTION (Map 1). Known only from the type locality.

Zonosemata minuta new species

TYPES. Holotype ♂, Montego Bay [Jamaica], 2-VII-57, (J. W. Boyes) (USNM, type no. 68112). Paratype ♀, same data as type (USNM).

DIAGNOSIS. This small species can be easily identified by the distinctive U-shaped black pattern on the dorsum (Fig. 33), the

Map 1. Distribution of *Zonosemata*

dark border around the humeral callus, and the presence of black spotting on the last three segments of the abdomen in both male and female (Figs. 15-16).

DESCRIPTION ♂. Body and wing measurements in Table 1. *Head:* indistinguishable in shape from that of *electa* (Fig. 30); all regions including mentum and palps golden yellow except black ocellar triangle; post ocellars yellow or black; gular undifferentiated, genal and all other bristles black. *Thorax* (Figs. 31, 33): notopleural and sternopleural stripes and light areas of dorsum and scutellum yellow; dorsum and base of scutellum with broad dark brown to black U-shaped pattern; humeral callus in dorsal view emarginated with black; pleural regions with black stripe extending from lower half of mesopleuron to base of postscutellum; dark brown to black shading also present on lower half of sternopleuron. Postscutellum brownish-black. Dorsum and scutellum covered with short light yellow to brown decumbent setae. *Legs:* normal color and complement of bristles for genus. *Wing* (Fig. 7): crossbands broad; basal band joined to medial band by faint infuscated area in cell R_1 (best seen in transmitted light); microtrichia present in all cells of wing. *Abdomen* (Fig. 15): golden yellow to light yellowish-brown covered with long black decumbent setae; tergite III with single pair of irregular shaped black spots; tergite IV with pair of elongated irregular bar-shaped markings; tergite V with large irregular triangular-shaped spots. *Genitalia:* exposed portion on type indistinguishable from *electa.*

Description of ♀: differs from male only in having more extensive black shading on thorax, legs, and abdomen, particularly on dorsum and metathoracic tibia. *Genitalia:* ovipositor tip exposed in paratype, similar to *electa.*

HOST. Unknown.

DISTRIBUTION (Map 1). Jamaica, West Indies. Known only from the type locality.

Zonosemata vidrapennis new species

TYPES. Holotype ♂, Oaxaca, OAXACA, Mexico, 16-IX-1933 (C.C. Plummer) (USNM, type no. 68113). Paratype ♂, entre Villa Guerrero y Tenanzingo, MEXICO, Mexico, 13-VIII-1961, sweeping (F. Pacheco), slide no. 110, G.L. Bush (USNM) (specimen badly damaged).

DIAGNOSIS. Differs from all other *Zonosemata* in having narrow wing bands and lacks the faint infuscated area joining the basal and medial crossbands in cell R_1 along vein R (Fig. 8). The short decumbent setae on dorsum are entirely black and the posterior margin of the dorsum and anterior margin of the scutellum show only a trace of the black horseshoe-shaped pattern (Fig. 34) normally found in other members of this genus. The pleural regions are almost entirely yellow except for black shading on the sternopleuron (Fig. 32). A pair of spots on the last abdominal segment are large and triangular-shaped (Fig. 14). This species is known only from two male specimens.

DESCRIPTION ♂. Body and wing measurements of type in Table 1. *Head:* indistinguishable in shape from that of *electa;* yellow to brownish-yellow except black ocellar triangle. Genal and gular bristles and setae on postgenae yellow; all other bristles black. *Thorax* (Figs. 32, 34): light brown to yellow; notopleural stripe, sternopleural stripe and light regions of dorsum, scutellum, and postscutellum golden yellow; small, ill-defined U-shaped black pattern on anterior margin of scutellum and posterior margin of dorsum in paratype, but almost absent in type. Dorsum and scutellum covered with short black decumbent setae. Black shading on pteropleuron becoming diffuse on mesopleuron. *Legs:* normal complement of bristles; entirely yellow. *Wing* (Fig. 8): glassy in appearance; crossbands narrow; basal band not joined to medial band in cell R_1, and latter not joined to subapical band along posterior margin of wing in cell Cu_1. Microtrichia present in all cells between subapical crossband and apex of wing; absent from regions between basal and subapical crossbands except along posterior margins of wing and in cell R_1 between short intercalary band and subapical band. Basal two-thirds of $R4+5$ setulose. *Abdomen* (Fig. 24): base color brownish-yellow, colored with short black decumbent setae. Tergite V with pair of distinct triangular-shaped black spots on baso-lateral surface. *Genitalia:* indistinguishable from that of *electa.*

HOST. Unknown.

DISTRIBUTION (Map 1). Known only from the two localities listed above.

ACKNOWLEDGMENTS

I would like to thank Mr. J. P. Reed of the New Jersey Agricultural Experiment Station, Rutgers University, and Mr. E. W. Johnson, U.S. Department of Agriculture, Brownsville, Texas for their assistance in locating suitable material for cytological studies.

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