

Biosystematic Studies  
of Ceylonese Wasps,  
V: A Monograph of the Ampulicidae  
(Hymenoptera: Sphecoidea)

KARL V. KROMBEIN

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## ABSTRACT

Krombein, Karl V. Biosystematic Studies of Ceylonese Wasps, V: A Monograph of the Ampulicidae (Hymenoptera: Sphecoidea). *Smithsonian Contributions to Zoology*, number 298, 29 pages, 24 figures, 1979.—Thirteen species-level taxa belonging to three genera are reported from Sri Lanka; five of these belong to the Ampulicinae, eight to the Dolichurinae. Four taxa are known so far only from Sri Lanka, five also occur elsewhere in the Indian subcontinent, three are widely distributed in the Oriental Region, and one is adventive from the northeastern part of the Oriental Region. Four of the endemic species belong to species groups that are widely distributed in the Oriental Region, and two have no known close relatives. Six new species are described: *Ampulex ceylonica*, *Triragma regalis*, *Dolichurus lankensis*, *D. silvicola*, *D. albifacies*, and *D. aridulus*.

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# Biosystematic Studies of Ceylonese Wasps, V: A Monograph of the Ampulicidae (Hymenoptera: Sphecoidea)

*Karl V. Krombein*

## Introduction

The Ampulicidae is one of the smaller families of aculeate wasps in Sri Lanka. This monograph treats 13 species, five of which had not been collected prior to inception of the Smithsonian's Ceylon Insect Project. Some species are quite uncommon, being known from as few as a single pair or two, so it is possible that future collecting may result in the discovery of additional species, especially among the relatively small, black species of *Dolichurus*.

Members of the family are sometimes called cockroach wasps, because so far as is known, all species capture cockroaches to serve as food for the larva. One cockroach prey is provided in each cell for larval food. Some species are readily identified in the field by their metallic blue or black and red integument and habit of running rapidly up and down tree trunks hunting for their prey. Other species run or flit swiftly over leaf litter, occasionally disappearing beneath the fallen leaves to search for prey.

The earliest published record of an ampulicid from Sri Lanka was Motschulsky's (1863:24) inclusion of the widely distributed *Ampulex com-*

*pressa* (Fabricius) in his lengthy article listing Ceylonese insects collected by Nietner. He also described on the same page a new species from Nuwara Eliya, *Ampulex? annulipes*, which is quite possibly a bethylid for he gives the length as 1 line (=ca. 2 mm), much too small to be an ampulicid. The first ampulicid described from Sri Lanka was *Dolichurus taprobanae* Smith (1869).

The preceding number in my series "Biosystematic Studies of Ceylonese Wasps" is "IV, Kudakrumiinae, a New Subfamily of Primitive Wasps (Hymenoptera: Mutillidae)," *Transactions of the American Entomological Society*, 1979, 105:67-83.

COMPOSITION AND AFFINITIES OF THE CEYLONESE FAUNA.—The 13 species of Ampulicidae known from Sri Lanka are either wide-ranging species (1, 7, 12) throughout the Oriental Region, or appear to be confined to the Indian subcontinent (3, 5, 6, 8, 10), or, if endemic (4, 9, 11, 13), belong to species groups known only from that region, and one species (2) is adventive from the northeastern Oriental Region. The apparent high degree of endemism (31%) may just reflect the inadequacy of collecting done elsewhere in the Oriental Region, for the three species of *Dolichurus* are small, black forms that are readily confused with the much more abundant small species of Larridae.

The following tabulation of species includes notes on distribution within Sri Lanka, the actual

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distribution for the wide-ranging species and remarks on affinities.

1. *Ampulex compressa* (Fabricius): Occurs in both Wet and Dry zones and ranges from sea level to at least 4000 feet; widely distributed in Oriental and Ethiopian regions and now adventive in many other areas; not at all closely related to other Ceylonese species.

2. *Ampulex dissector* (Thunberg): Adventive and known in Sri Lanka only from Colombo; normal range apparently Taiwan, China, and Japan; not at all closely related to other Ceylonese species.

3. *Ampulex approximata* Turner: Occurs in both Wet and Dry zones and at low altitudes; occurs also in India (Bombay); not closely related to other Ceylonese species.

4. *Ampulex ceylonica*, new species: Occurs only in the Udawattakele Sanctuary, Kandy, 2100 feet, an area of moderate rainfall; not known outside of Sri Lanka; belongs to a species group with three representatives in India, Singapore, and Taiwan.

5. *Ampulex ruficornis* Cameron: Occurs mostly at low altitudes and in areas of very light to moderate rainfall; occurs also in India; an aberrant species with no known close relatives.

6. *Trirogma regalis*, new species: Occurs in both Wet and Dry zones at low to moderate altitudes; occurs in Sri Lanka and Madras; belongs to species group *prismatica* with two representatives in Borneo and the Philippines.

7. *Trirogma caerulea* Westwood: Occurs in both Wet and Dry zones in areas of light to moderate rainfall and from sea level to 3000 feet; widely distributed in the Oriental Region and in Iraq; not closely related to other species of the genus.

8. *Dolichurus taprobanae* Smith: Occurs in both Wet and Dry zones in areas of light to moderate rainfall; occurs also in the Indian subcontinent and in Burma; belongs to species group *taprobanae* with at least four other representatives in Singapore, Taiwan, and the Philippines, and *D. lankensis*, new species, from Sri Lanka.

9. *Dolichurus lankensis*, new species: Known only from two Dry Zone areas with very light rainfall; not known to occur outside of Sri Lanka; most closely related to *D. taprobanae* Smith.

10. *Dolichurus silvicola*, new species: Occurs in both Wet and Dry zones in areas of very light to moderate rainfall and at low to moderate altitudes; occurs in both Sri Lanka and South India; related

to *D. albifacies*, new species, from Sri Lanka, but not a member of that species group.

11. *Dolichurus albifacies*, new species: Occurs in both Wet and Dry zones in areas of very low to moderate rainfall and at low to moderate altitudes; not known to occur outside of Sri Lanka; belongs to species group *ombrodes* with two or three representatives in Taiwan and the Philippines.

12. *Dolichurus amamiensis* Tsuneki and Iida: Occurs sparingly in the Wet Zone in areas of moderate to heavy rainfall and at low to moderate altitudes; occurs also in Thailand, Taiwan, Philippines, and Ryukyu Islands; not closely related to other species.

13. *Dolichurus aridulus*, new species: Occurs only in Dry Zone in areas of low rainfall and at low altitudes; not known to occur outside of Sri Lanka; not closely related to other species.

The comprehensive article by Brinck et al. (1971) discusses the terrestrial habitats, division of Sri Lanka into Wet and Dry zones, and the several ecozones. The map (fig. 7) showing annual rainfall and division into Wet and Dry zones is especially helpful.

BIOLOGY.—Williams (1942) provided detailed rearing notes on several females of *Ampulex compressa* that he captured in New Caledonia and transported to Hawaii for release of the progeny. The captive *A. compressa* were usually provided adults or large nymphs of *Periplaneta americana* (Linnaeus), the American cockroach, but other prey on which *A. compressa* was reared were *P. australasiae* (Fabricius) and *Neostylopyga rhombifolia* (Stoll). After paralyzing the prey by stinging, the wasp amputated the antennae and dragged the cockroach into a corrugated cardboard tube provided as a nesting site. She then laid a relatively small egg, 2 mm long, next to one of the mid coxae and finally plugged the tube adjacent to the prey with small bits of debris. The egg hatched in about three days, and the wasp larva completely gutted its prey in four or five days. The cocoon was spun within the exoskeleton of the cockroach and consisted of three layers, an outer of loosely woven silk, then a fine layer of silk, and the inner ovoid cocoon of rather brittle varnished material that had a small nipple at each end. The entire life cycle ranged from 24 to more than 140 days if the resting larva underwent a period of diapause.

Tsuneki (1972:8) recorded in Taiwan a female



*Trirogma caerulea* Westwood, 25 mm long, which was transporting a nymphal cockroach, *Periplaneta australasiae* (Fabricius), 18 mm long.

We made no nesting or life history notes on the Ceylonese ampulicids but we obtained the following prey records and behavioral notes.

G. Ratnavira collected a female *Ampulex compressa*, 20 mm long, in Kollupitiya, Colombo, on 21 March 1978. It was carrying a bulky, paralyzed cockroach nymph near maturity, a species of *Periplaneta*, 20 mm long.

We obtained one probable prey record of *Ampulex approximata* in the Sinharaja Jungle. P. B. Karunaratne captured a female (61876 C), 12 mm long, on a large fallen tree trunk. He noted several meters away on the trunk a paralyzed blattid nymph, 11 mm long, a species of *Dorylaea* or genus near that.

On 18 January 1977 while collecting in Udawatkele Sanctuary, Kandy, I noted a *Trirogma regalis* female (11877 A), 14 mm long, on an almost vertical mud bank a foot above a small ditch along a road. It disappeared beneath a piece of dry leaf and emerged a few seconds later, walking backward and dragging a paralyzed black cockroach, 20 mm long. The prey was an adult wingless blattid male, *Neostylopyga* or genus near, a species recorded previously from Kandy as the South Indian *N. parallela* (Bolivar).

I watched several females of *Dolichurus taprobanae* hunting for prey in the Udawattakele Sanctuary Jungle, Kandy, on 9–10 September 1977. The females were active at least as early as 9:40 AM and as late as 3:35 PM. All four females were searching on and under leaf litter in narrow shallow ditches at the base of a steep bank. I found the first female, 9.5 mm long (9977 A), at 12:07 PM and observed her behavior for 43 minutes before she flushed a prey. While hunting, she moved rapidly and jerkily, wings folded over her back, and antennae rapidly palpating the substrate. She crawled under dry leaves and inside curled leaves during the search. Occasionally she flew for a few centimeters just above the ground to a new section of ditch or paused motionless on the upper surface of a leaf sunning herself for a few seconds while rubbing her hind legs together. At 12:50 she flushed a cockroach nymph, 10 mm long, which ran rapidly over the leaves. The wasp caught it once but lost her grip and the cockroach ran up

onto the gravelly road. The wasp leaped on it quickly and the two fell back into the ditch, where the wasp finally paralyzed the cockroach and dragged it under a leaf. I removed the leaf and the wasp began to walk backward, dragging the cockroach by its antennal bases. I captured both wasp and prey at this time. The cockroach was a nearly mature adult of a species of Blattellidae. This wasp covered some 8 meters of ditch with some backtracking during her hunting. I watched three other hunting females (9977 C and E, 91077 A) for periods up to 20 minutes but none flushed a prey. One female searched 13 meters of the ditch with no doubling back.

P. B. Karunaratne, T. Wijesinhe, and V. Kulasekare observed a female, *Dolichurus albifacies* (7678 B), 6.5 mm long, in Ekgal Aru Sanctuary Jungle on 6 July 1978. It was dragging its paralyzed cockroach prey over a rock. This flattened nymph, 5.5 mm long and 4.2 mm wide, was a blattellid, *Margattea ceylanica* (Saussure).

TREATMENT OF INDIVIDUAL TAXA.—In the section following the key are detailed treatments of each of the Ceylonese taxa. The references cited beneath each specific heading include the original description and those of any synonyms, notes on type fixation when appropriate, and papers citing the taxon from Ceylon. References to the taxon in extralimital areas only are normally not included.

Several paragraphs of discussion follow on such subjects as distribution, synonymy, and differentiating characters. Next are descriptions of the female and male. Finally, there is a listing of the specimens examined arranged by Province and District.

Label data are given in full for the type series of all new taxa. Label data for specimens of previously described taxa have been consolidated insofar as possible. For example, one consolidated record under *Ampulex compressa* (Fabricius) reads: "20 ♀, 3 ♂, Colombo (includes Museum Garden, Kollupitiya, Dehiwala, Papiliyana), 15 Jan, 26 Feb, 21 Mar, 16, 23 and 25–26 May, 5 and 7–8 Jul, 1 Aug, 29 Sep, 6, 10–20 and 29–30 Oct, 4 Nov, Henry, Karunaratne, Krombein et al., Messersmith et al., Ratnavira (USNM, Colombo)." The names in parentheses following the city are within or in the immediate vicinity of Colombo. Specific dates of collection are given next except that the year is

omitted. Dates are followed by the names of collectors except that only the name of the first collector is cited from a label bearing the names of two or more collectors. Finally, the depositories in which the specimens are found are cited in parentheses; the only abbreviations are USNM (former United States National Museum) for specimens in the National Museum of Natural History, Smithsonian Institution, and BMNH for the British Museum (Natural History), London.

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I am particularly grateful to my colleague, K.

Tsuneki, Mishima, Japan, for the loan of some of his holotypes and other identified specimens of Taiwanese *Dolichurus*.

C. O'Toole, Oxford University, was most helpful in clarifying the confusion involving the holotypes of *Rhinopsis ruficornis* Cameron and *R. constanceae* Cameron.

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Figures 1-18 are by Mary-Jaque Mann and Susann G. Braden, Scanning Electron Microscope Laboratory, Smithsonian, and Figures 19-24 are by George L. Venable, Department of Entomology.

### Key to Ceylonese Ampulicidae

1. Antennal bases each with an overhanging frontal lobe (Figures 1-10); metasternum Y-shaped, arms of Y extending posteriorly one on each side of abdominal petiole; apex of marginal cell of forewing bent away from wing margin. *Ampulex* Jurine .....3
- Antennal bases overhung by a single broad frontal lobe (Figures 13-16); metasternum elongate triangular, apex slightly overlying hind coxae; apex of marginal cell of forewing contiguous with wing margin .....2
2. Integument of body metallic blue or purple; abdomen with a short basal petiole; occipital carina not extending onto venter of head. *Trivogma* Westwood .....7
- Integument of body black, a few species with small white maculations on clypeus, frontal platform, pronotum, and tegula; occipital carina extending onto venter of head and terminating just short of hypostomal carina. *Dolichurus* Latreille .....8
3. Integument brilliant metallic blue; larger species, body more robust .....4
- Integument red and black or entirely black; smaller species, body more slender; forewing with two submarginal cells .....5
4. Forewing with three submarginal cells; mid and hind femora red; front (Figures 1, 2) with a keel originating at antennal tubercles, extending upward and surrounding anterior ocellus; pronotum with a median tubercle on posterior margin.....
- .....1. *Ampulex compressa* (Fabricius)
- Forewing with two submarginal cells; only hind femur red; front (Figures 3, 4) not keeled; pronotum not tuberculate .....2. *Ampulex dissector* (Thunberg)
5. Integument entirely black; head (Figures 5, 6); notauli deep, crenulate; sternaulus present, crenulate; posterolateral angle of propodeal dorsum blunt, short; first flagellar segment of male slender, as long as second and third combined, longer than second and third combined in female; head beneath in female with small tubercle near posterior articulation of mandible .....3. *Ampulex approximata* Turner

- Thorax red and black, head and abdomen black; notauli shallow, narrow, at most weakly crenulate; first flagellar segment of male stouter, noticeably shorter than second and third combined, in female more slender, longer than second and third combined; female head not tuberculate beneath .....6
6. Head (Figures 7, 8) elongate behind eyes, that of male with a prominent median pit near occipital margin; mandible normal, that of female with rather evenly rounded outer margin, that of male with a strong tooth on inner margin two-thirds distance to apex; pronotum anteriorly with a pair of tubercles; sternaulus present; scutum and mesopleuron with large punctures (♀) or pits (♂); posterolateral angle of propodeal dorsum with a slender elongate tooth; forewing with a broad, vaguely defined dark infumation in radial cell, both submarginals and apical two-thirds of second discoidal, and a smaller infumated spot at apex of submedian; first abdominal tergum with sides diverging at apex.....  
.....4. *Ampulex ceylonica*, new species
- Head (Figures 9, 10) not elongate behind eyes; mandible abnormal, that of female abruptly angulate at basal third of outer margin, that of male with only an apical tooth; pronotum not tuberculate; sternaulus absent; scutum and mesopleuron with minute punctures and a few scattered small ones; posterolateral angle of propodeal dorsum with a small blunt tubercle; forewing with a weak infumation in second submarginal cell and at apex of first, and a small spot at apex of submedian; first abdominal tergum nodose at apex.....  
.....5. *Ampulex ruficornis* (Cameron)
7. Upper mesopleural groove simple. FEMALE: Abdomen purplish, second sternum (Figure 11) with semicircular groove on anterior half extending beyond tubercle; front (Figure 13) with confluent, larger punctures, thickened side of frontal platform with several fine, shallow grooves; median lobe of clypeus broader. MALE: Mandible ivory on basal half, black at apex; pronotal tubercles (Figure 17) smaller; clypeal lobe (Figure 15) dentate laterally .....6. *Trirogma regalis*, new species
- Upper mesopleural groove crenulate. FEMALE: Abdomen bluish, occasionally with greenish or purplish reflections, second sternum (Figure 12) with bisinuate groove on anterior third, terminating at tubercle; front (Figure 14) with separated larger punctures and interspersed, scattered smaller ones, thickened side of frontal platform with a single, deep, broad groove; median lobe of clypeus narrower. MALE: Mandible entirely black; pronotal tubercles (Figure 18) larger; clypeal lobe (Figure 16) rounded laterally.....  
.....7. *Trirogma caerulea* Westwood
8. FEMALES: Abdomen with six exposed segments, the apex conical, surface glossy and with very sparse delicate punctures; antenna 12-segmented .....9  
MALES: Abdomen normally with only three exposed segments, the posterior segments telescoped and hidden, apex rounded, surface duller because of dense, small punctures; antenna 13-segmented .....14
9. Mesopleuron below with sternaulus running from omaulus to mid coxa .....10  
Mesopleuron without sternaulus .....12
10. Apex of first abdominal tergum without two rows of close, tiny punctures; sides of second and third terga, and all of fourth and fifth with short, decumbent, relatively dense cinereous setae; vertex with small, moderately dense punctures .....11  
Apex of first abdominal tergum with two rows of tiny, close punctures; succeeding terga with only very scattered short setae except laterally on second through fourth; vertex with relatively few, larger scattered punctures; length 7.2-10.7 mm.....  
.....8. *Dolichurus taprobanae* Smith
11. Head and tegula without white markings; clypeus, front and pronotum with usual stout macrochaetae; mesopleuron mostly with close, fine wrinkles; front with sparser larger punctures; frontal platform quadrate, apical width subequal to height at macrochaetae....  
.....10. *Dolichurus sibiricola*, new species
- The following white: mandible except extreme base and apex reddish, clypeus at apex in middle, broad margin of frontal platform and spot on tegula; normal macrochaetae lacking; mesopleuron with tiny, delicate scattered punctures; front mostly with closer, delicate punctures; frontal platform transverse, greatest width twice the height.....  
.....11. *Dolichurus albifacies*, new species
12. Vertex with very scattered small punctures; pronotal disk margined anteriorly by a transverse flange, the surface smooth and with scattered fine punctures; scutum and scutellum similarly punctate .....12. *Dolichurus amamiensis* Tsuneki and Iida  
Vertex with quite dense small punctures, many separated from each other by the diameter

## Key to Ceylonese Ampulicidae (Cont'd)

- of a puncture; pronotal disk not flanged anteriorly, the basal half with close, fine transverse ridges; scutum and scutellum with moderately dense, fine punctures except in center of disk .....13
13. Vertex flat; front more closely sculptured, adjacent to ocelli with larger, subcontiguous punctures; mandible except tip and fore tibia dark.....9. *Dolichurus lankensis*, new species
- Vertex gently arched; front more delicately and sparsely sculptured, adjacent to ocelli with small punctures separated from one another by at least half the diameter of a puncture; mandible and fore tibia beneath light red .....13. *Dolichurus aridulus*, new species
14. First and second abdominal terga with large impunctate areas, at least along posterior margin .....15
- Abdominal terga relatively closely and uniformly punctate .....16
15. Posterior half of first and second terga with much of area impunctate, remainder of first and second and all of third with small punctures mostly separated by not much more than the diameter of a puncture; white markings restricted to narrow anterior rim of frontal platform, pair of small lateral spots on pronotal disk and tiny spot on tegula; genitalia (Figure 21).....10. *Dolichurus sibiricola*, new species
- First three terga with minute punctures, which are virtually lacking on most of disk of first and second; laterally on these terga and on all of third the minute punctures denser though separated by several times the diameter of a puncture; white markings as follows: mandible except apical third, clypeus except narrow basal margin and a short median bar, wider margin of frontal platform, larger spots on pronotum and tegula, and small to tiny spot on scutellum; genitalia (Figure 22) .....11. *Dolichurus albifacies*, new species
16. Mesopleuron with scattered tiny punctures, otherwise smooth and glossy; posterior surface of propodeum margined above and laterally by a strong ridge that ends in a blunt tooth halfway down the side; flagellar segments 3-10 slightly swollen in middle on inner surface, the swelling bearing a longer erect seta; genitalia (Figure 19) .....8. *Dolichurus taprobanae* Smith
- Mesopleuron rugulosoreticulate; posterior surface of propodeum margined only above by a weak ridge, laterally without a tooth; flagellar segments 3-10 not so modified .....17
17. Vertex with small punctures, mostly separated from each other by the diameter of a puncture; mid and hind basitarsi much paler than the remaining tarsal segments; rugulose reticulations of front and mesopleuron of smaller mesh; genitalia (Figure 24) .....13. *Dolichurus aridulus*, new species
- Vertex with very scattered fine punctures; mid and hind basitarsi not conspicuously paler than remaining tarsal segments; rugulose reticulations of front and mesopleuron of coarser mesh .....18
18. Greatest interocular distance 2.5 times as wide as frontal platform; propodeal sculpture relatively coarser, carinae on dorsal enclosure, and lateral and posterior surfaces stronger; genitalia (Figure 20) .....9. *Dolichurus lankensis*, new species
- Greatest interocular distance 2.5-2.8 times as wide as frontal platform; propodeal sculpture relatively more delicate, carinae on dorsal enclosure weaker to almost evanescent on posterior and lateral surfaces; genitalia (Figure 23) .....12. *Dolichurus amamiensis* Tsuneki and Iida

## Subfamily AMPULICINAE

1. *Ampulex compressa* (Fabricius)

FIGURES 1, 2

*Sphex compressa* Fabricius, 1782 [1781]:445-446 [Malabar; type in London].

*Ampulex compressa* (Fabricius).—Motschulsky, 1863:24 [Ceylon].—Kohl, 1893:474, 491, figs. 11, 22, 71 [Oriental and Ethiopian regions].—Bingham, 1897:254-255 [India, Burma, Ceylon to Africa and China].—Dalla Torre, 1897:373-374.

—Williams, 1942:221-233, 20 figs. [biology].—Bohart and Menke, 1976:77 [Ethiopian and Oriental regions, Australia, East Indies, New Caledonia, Cook, Midway, Hawaii, St. Helena, Mauritius, Réunion, Chagos Archipelago, Seychelles].

*Ampulex sinensis* Saussure, 1867:43, pl. 2: fig. 25 [♂; China; type in Vienna].

*Chlorampulex striolata* Saussure, 1892:443, 446 [♀; Zanzibar; type in Paris].—Kohl, 1893:502-503.—Dalla Torre, 1897:377.

REMARKS.—*Ampulex compressa* is the more common of the two large metallic blue species of Sri

Lankan *Ampulex*, the other taxon, *A. dissector* (Thunberg), being known from only a few specimens. This species is readily distinguished from *A. dissector*, and indeed all other Ceylonese *Ampulex*, by the presence of three submarginal cells in the forewing and by having both the mid and hind femora bright red, the rest of the legs metallic blue.

It is the most widely distributed and adaptable ampulicid in Sri Lanka, where it occurs from sea level to at least 4000 feet in elevation, and in areas having as little as 50 inches of rainfall annually to those with over 200 inches. The original range of *A. compressa* was probably restricted to the Oriental and Ethiopian regions. However, it has become adventive in many other areas due to commerce, and, occasionally, has been deliberately introduced into some areas, e.g., Hawaii, for cockroach control.

In Sri Lanka both sexes of *A. compressa* are frequently seen crawling rapidly up and down the trunks of large trees in the jungle. Females presumably find their cockroach prey beneath loose bark on these trees.

**FEMALE.**—Length 15–22 mm. Body and legs shining metallic blue, abdomen sometimes purplish, mid and hind femora light red, antenna and mandible black, wings slightly infumated, vestiture whitish.

Head with temple narrow, not thickened and angulate beneath posteriorly, eyes converging above, least interocular distance equal to length of second flagellar segment; face (Figure 1) with narrow median area delimited below by a strong carina from antennal tubercle extending upward, becoming evanescent above where it passes behind fore ocellus; frontal punctures moderately large, more separated on median area than laterally; vertex with moderately large, subcontiguous punctures and a short median groove; occiput with fine, close punctation; first flagellar segment 0.9 times combined length of second and third segments.

Pronotal disk with a median furrow, some delicate transverse rugulae on anterior two-thirds, a low, rounded anterolateral tubercle and a stronger, narrower median tubercle on posterior margin; mesopleuron without sternaulus; forewing with three submarginal cells.

Abdominal petiole short, extending two-thirds distance to apex of hind coxa; most of disk of sec-

ond tergum with scattered small punctures, dense fine punctures only on narrow lateral strip.

**MALE.**—Length 13–16 mm. Color and vestiture as in female.

Head narrowed behind eyes, not elongate; eyes converging above, least interocular distance 0.7 times length of second flagellar segment; front (Figure 2) with enclosed area broader, delimiting carinae stronger; punctation of front and vertex closer and coarser than in female, vertex with evanescent median groove; occiput with fine, close punctures; first flagellar segment three-quarters as long as combined lengths of second and third segments.

Conformation of pronotal disk as in female but anterolateral tubercle weaker, rugulae stronger and covering most of surface; mesopleuron without sternaulus; forewing with three submarginal cells.

Abdominal petiole shorter, extending only half the length of hind coxa; discal punctation of second tergum coarser and closer than in female, dense, fine punctation only on narrow lateral strip.

**SPECIMENS EXAMINED.**—NORTH CENTRAL PROVINCE. ANURADHAPURA DISTRICT: 1 ♂, Cheddikulam, Malaratu Oya, 15–16 Jun, Messersmith et al. (USNM).

EASTERN PROVINCE. TRINCOMALEE DISTRICT: 1 ♂, Niroddumunai, May (Colombo). AMPARAI DISTRICT: 2 ♀, 1 ♂, Ekgal Aru Sanctuary Jungle, 140 m, (1 ♂ in Malaise trap), 10 Jun, 11–15 Sep, Krombein et al. (USNM).

CENTRAL PROVINCE. KANDY DISTRICT: 11 ♀, 22 ♂, Kandy (includes Udawattakele Sanctuary, Reservoir Jungle), 2100 ft, (4 ♂ in Malaise trap, 1 ♂ in UV light trap, several ♀, ♂ running on tree trunk), 1 Jan, Feb, 4 Mar, 26–28 and 29–30 May, 20–30 and 27 Jul, 2–13 and 16–31 Aug, 5, 8–10 and 20–27 Sep, Dec, Karunaratne, Krombein et al., Laravoire, Messersmith et al., Roth, Wickwar (USNM, Colombo, Geneva, BMNH); 1 ♀, Peradeniya, 23 Jan (Colombo); 1 ♀, 1 ♂, Thawalammenne, 740–760 m, 16–18 Sep, Krombein et al. (USNM).

WESTERN PROVINCE. COLOMBO DISTRICT: 20 ♀, 3 ♂, Colombo (includes Museum Garden, Kollupitiya, Dehiwala, Papiliyana), 15 Jan, 26 Feb, 21 Mar, 16, 23 and 25–26 May, 5 and 7–8 Jul, 1 Aug, 29 Sep, 6, 10–20 and 29–30 Oct, 4 Nov, Henry, Karunaratne, Krombein et al., Messersmith et al., Ratnavira (USNM, Colombo); 2 ♀, 3 ♂, Labugama Reservoir Jungle, 400 ft, 7 and 23 Jun, 15–18 Jul, 2–3 and 13–14 Oct, Henry, Hevel et al., Krombein et al. (USNM, Colombo); 1 ♀, Battaramulla, 10 Jun, Henry (Colombo); 1 ♀, Kelani Valley, near Colombo, Braine (BMNH).

SABARAGAMUWA PROVINCE. KEGALLA DISTRICT: 1 ♀, 1 ♂, Kitulgala, 12 Apr, Henry (Colombo). RATNAPURA DISTRICT: 1 ♀, Gilimale Jungle, 17 Jun, Krombein et al. (USNM); 1 ♂, Rakwana, 2 May, Henry (Colombo).

UVA PROVINCE. BADULLA DISTRICT: 1 ♀, Namunkulu, Tonacombe Estate, 4000 ft, 23 Aug, Phillips (BMNH).

SOUTHERN PROVINCE. GALLE DISTRICT: 2 ♀, 5 ♂, Kanne-liya, Sinharaja Jungle, 200–400 ft, (1 ♂ at UV light trap), 16 July, 13–16 Aug, 6–12 and 15 Oct, 3–13 Nov, Davies et al., Hevel et al., Krombein et al. (USNM, Colombo); 1 ♀, Haycock Mt., 21 mi NNE of Galle, 1100 ft, 29 Jan, Brinck et al. (Lund). MATARA DISTRICT: 1 ♂, Deniyaya, 28 Dec, Henry (Colombo). HAMBANTOTA DISTRICT: 2 ♂, Ranna, 17 Jul, Henry (Colombo); 1 ♂, Katagamuwa, 17 Sep, Henry (Colombo).

MISCELLANEOUS. 4 ♀, no specific locality (Colombo, BMNH).

## 2. *Ampulex dissector* (Thunberg)

FIGURES 3, 4

*Ichneumon dissector* Thunberg, 1822:272, 341 [♀; Japan; type in Upsala].—Roman, 1912:251 [synonymizes *novaræ* under *dissector*].

*Ampulex amoena* Stål, 1857:63 [China].—Kohl, 1893:489.—Dalla Torre, 1897: 372.

*Ampulex novaræ* Saussure, 1867:44, figs. 26, 26a [♂, ♀; Hong Kong; type in Vienna].

*Ampulex (Rhinopsis) Japonica* Kohl, 1893:467 [♀; Japan; type in Budapest].

*Ampulex (Rhinopsis) Novaræ* Saussure.—Kohl, 1893:468, 481, figs. 8, 39, 53 [Hong Kong, Darjeeling].

*Ampulex (Rhinopsis) consimilis* Kohl, 1893:468 [♀; Hong Kong; type in Vienna].

*Ampulex dissector* (Thunberg).—Bohart and Menke, 1976:77 [Taiwan, China, Japan].

REMARKS.—*Ampulex dissector* and *A. compressa* (Fabricius) are the only metallic blue Ceylonese *Ampulex*. They are readily distinguished from each other because the former species has two submarginal cells and light red hind femora, whereas the latter species has three submarginals and both mid and hind femora light red.

The normal range of *A. dissector* appears to be the Far East (Taiwan, China, Japan). Kohl's record of a female *A. novaræ* from Darjeeling may be based on a misidentification, for he noted that both mid and hind femora were red. I have seen only three Ceylonese specimens, all from Colombo. I suspect that *A. dissector* is an adventive species that emerged from cargo brought in by ship. *Ampulex compressa* also is known to be adventive in many areas in its present range.

FEMALE.—Length 13–15 mm. Body and legs shining metallic blue, antenna and mandible black, hind femur light red; forewing very slightly infumated; vestiture on head and thorax sparse, erect, whitish, that on third abdominal tergum dense, appressed and silvery except on a narrow median strip.

Head (Figure 3) with temple thickened, angulate beneath posteriorly; eyes converging above, interocular distance across posterior ocelli 0.8 that at antennal insertions and 0.9 the length of first flagellar segment; front with a short weak carina above antennal insertion, the surface with small, subcontiguous punctures and more scattered larger ones; vertex with closer large punctures.

Pronotal disk with transverse rugulae interrupted by a shallow median groove, not tuberculate; mesopleuron with sternaulus complete, crenulate; forewing with two submarginal cells.

Abdominal petiole short, not extending to apex of hind coxa; most of disk of second tergum with scattered fine punctures, dense fine punctures only on narrow lateral strip.

MALE.—Length 9–12 mm. Color and vestiture as in female.

Head (Figure 4) narrowed behind eyes, not elongate, temple not thickened; eyes converging slightly above, least interocular distance 0.8 times that distance at antennal insertions and 0.8 times the length of first flagellar segment; the latter 0.94 times the combined length of second and third segments; front without enclosed area, the surface with strong, close longitudinal rugulae; much of vertex with large, subcontiguous punctures, median groove lacking; occiput with fine close punctures.

Conformation of pronotal disk as in female but rugae comparatively coarser; mesopleuron as in female; forewing with two submarginal cells.

Abdominal petiole short, not extending to apex of hind coxa; second tergum with scattered fine punctures, dense fine punctures only on narrow lateral strip.

SPECIMENS EXAMINED.—WESTERN PROVINCE. COLOMBO DISTRICT: 1 ♀, Colombo, Dec, Henry (Colombo); 2 ♂, Kollupitiya, Colombo, 21 Mar, Ratnavira (USNM). In addition to the Ceylonese specimens, I have studied a series of 1 ♀, 6 ♂ from Hong Kong (type ♂, ♀), Taiwan, and Cochin China (all in Vienna). The descriptions above are based on all of these specimens.

## 3. *Ampulex approximata* Turner

FIGURES 5, 6

*Ampulex approximata* Turner, 1912:367 [♀, W. India, Bombay Presidency, type in British Museum (Natural History)].—Bohart and Menke, 1976:77 (W. India).

REMARKS.—Until now this rare *Ampulex* was

known only from the unique female holotype from Bombay Presidency, West India. We collected two females in the Sinharaja Jungle, an area of over 200 inches of rainfall, and I found two specimens of the undescribed male in the Colombo Museum collection from Pulmoddai, where the annual rainfall is less than 50 inches.

The species is readily distinguished from other Ceylonese *Ampulex* by the almost totally black integument, patch of dense, appressed silvery pubescence above the hind coxa, similar vestiture on almost all of third abdominal tergum in female, and presence of a small tubercle near posterior articulation of the mandible in female.

**FEMALE.**—Length 10–12 mm. Black, mandible, clypeus, and scape light red, trochanters, mid and hind femora, and abdominal petiole darker red in varying extents; vestiture mostly inconspicuous and appressed except very dense, silvery patches above hind coxa and on third abdominal tergum except narrow median strip; wings hyaline except for a weak infumation in marginal cell, apical half of first submarginal, all of second submarginal, and apical half of second discoidal.

Head (Figure 5) not elongate behind eyes; front dull from fine shagreening and with scattered small punctures, without carinae above antennal insertions; vertex with denser tiny punctures and some scattered small punctures; a small tubercle on venter adjacent to posterior mandibular articulation; mandible normal, outer margin evenly curved, ventral surface smooth; eyes converging above, least upper interocular distance 0.86 times that distance across antennal insertions and 0.95 times as long as first flagellar segment; first flagellar segment 1.18 times combined lengths of second and third.

Pronotal disk with shallow median furrow, tubercles absent, surface finely punctate and with a few weak, transverse rugulae on side; scutum finely punctate, notauli deep and crenulate; mesopleuron finely punctate, a few close pits in middle and sternaulus complete and crenulate; posterolateral angle of propodeal dorsum blunt, short; forewing with two submarginal cells.

Petiole of first abdominal segment short and stout, not quite reaching apex of hind coxa; apical half of first segment with sides diverging slightly, not nodose at apex; fifth and sixth segments compressed.

**MALE.**—Length 8–9 mm. Black, mandible except tip, apex of clypeus and scape dark red, petiole testaceous, legs mostly brownish; vestiture as in female except third abdominal tergum without conspicuous dense patches; wings hyaline, infumation weaker and less extensive.

Head (Figure 6) strongly narrowed behind eyes, not elongate; front with a strong short carina above antennal insertion and a shorter median carina; eyes converging above, least interocular distance 0.88 that distance across antennal insertions and 0.62 times as long as first flagellar segment; first flagellar segment 1.05 times combined lengths of second and third segments.

Pronotum with transverse rugulae better developed than in female; sculpture elsewhere as in female but somewhat denser and coarser.

First abdominal segment shaped as in female.

**SPECIMENS EXAMINED.**—EASTERN PROVINCE. TRINCOMALEE DISTRICT: 2♂, Pulmoddai, 15–17 Aug, Henry (Colombo).

SABARAGAMUWA PROVINCE. RATNAPURA DISTRICT: 2♀, Sinharaja Jungle, 3 mi S of Weddagala, 10–11 Feb, 18 Jun, Karunaratne, Krombein et al. (USNM).

#### 4. *Ampulex ceylonica*, new species

FIGURES 7, 8

**REMARKS.**—Superficially this taxon looks like a large *A. ruficornis* (Cameron), but it is quite distinct in having normal mandibles, the first abdominal segment with the sides diverging toward the apex, and the female abdomen strongly compressed at the apex. We have collected it only in Udawattakele Sanctuary Jungle, Kandy, on the ground surface of banks or low vegetation but not on tree trunks, and never in association with the similarly colored ant, *Tetraponera rufonigra* (Jerdon).

*Ampulex ceylonica* belongs to a small group of species characterized in both sexes by having an elongate, slender posterolateral tooth on the dorsal propodeal surface and the head elongate and strongly narrowed behind the eyes. The females have a pair of small, anterolateral acute tubercles on the pronotal disk; these tubercles are smaller, weaker, and blunter in the males and are entirely absent in *A. alisanus* Tsuneki. The males of the group are also unique in having a deep median

pit on the occiput. In addition to *A. ceylonica*, I have seen both sexes of a rather similarly colored, undescribed species from Singapore (USNM) and a male of a similarly colored, undescribed species from Bombay (USNM).

There is an all black species of the *alisanus* group in Taiwan. The female was described as *A. denticollis* by Tsuneki (1967:1-3), a name preoccupied by *Rhinopsis denticollis* Cameron; subsequently, Tsuneki (1976b) proposed *A. bidenticolis* as a replacement for his homonym. The probable male is *A. alisanus* Tsuneki (1967:3-5); the emendation to *A. alisana* by Bohart and Menke (1976:77) is incorrect for the specific name is a noun in apposition. In passing it is of interest to note that there is also an all black species of *Hylomesa* in Taiwan, a genus in which all other species are black and red.

**HOLOTYPE.**—♀, Sri Lanka, Central Province, Kandy District, Kandy, Udawattakele Sanctuary, 2100 ft, 2-13 August 1976, S. Karunaratne (USNM Type 76040).

**FEMALE.**—Length 12 mm. Black, the following light red: mandible, clypeus, antenna, pronotum, mesonotum except sides of scutum and scutellum and lower third of pleuron, metanotum except lower half of pleuron, propodeum, hind coxa, all trochanters, tibiae except apex of hind, and all tarsi; propodeal spine and petiole testaceous. Appressed vestiture on thorax and abdomen short, relatively dense, silvery, inconspicuous. Forewing with a broad, vaguely defined dark infumation in radial cell, both submarginals and apical third of second discoidal, and a smaller infumated spot at apex of submedian cell.

Head (Figure 7) elongate behind eyes and strongly narrowed; front dull and granulate from fine, close punctation, with larger, moderately scattered punctures and without carinae above antennae; vertex similarly punctate, occiput with virtually no larger punctures; mandible normal, outer margin evenly curved, ventral surface smooth; eyes diverging above, least interocular distance at antennal insertions three-fourths that across posterior ocelli; first flagellar segment as long as combined lengths of second and third segments.

Pronotal disk with delicate close punctation, scattered larger punctures on posterior half, a weak median furrow, and a pair of small acute tubercles anteriorly; scutum with dense fine punctures and

interspersed, mostly subcontiguous larger punctures, notauli weakly crenulate; mesopleuron similarly punctate, sternaulus crenulate; propodeal dorsum with a slender, curved elongate tooth.

Petiole of first abdominal segment slender, extending to apex of trochanter; apical third of first tergum with sides diverging toward second, not nodose; fifth and sixth segments strongly compressed.

**ALLOTYPE.**—♂, same locality data, 510-580 m, 8-10 September 1977, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, M. Jayaweera (USNM).

**MALE.**—Length 9 mm. Coloration and vestiture as in female, but base of mandible and clypeus black, as are apical half of antenna, lateral third and anterior fourth in middle of scutum, most of legs except tarsi and petiole. Forewing infumation lighter.

Head (Figure 8) much as in female except front and vertex pitted, a short carina above antennal tubercle; eyes diverging above, interocular distance across posterior ocelli 1.08 times the distance across antennal bases and 1.8 times the length of second flagellar segment; occiput with deep median pit behind which are two transverse rugae; first flagellar segment 0.6 times the combined lengths of second and third segments.

Pronotal disk with subcontiguous large punctures, tubercles lower and weaker; scutum and mesopleuron closely pitted, notauli and sternaulus scarcely distinct; propodeal tooth as in female.

First abdominal segment as in female, petiole extending slightly beyond trochanter.

**PARATYPES.**—4 ♀, 22 ♂, same locality data. 3 ♀, 1 ♂, same collector as holotype, 2 ♀, 5-15 Jul 76, and 1 ♀, 1 ♂, 20-30 Jul 76. 1 ♀, 20 Jan 77, K. V. Krombein, P. Fernando, D. W. Balasooriya, V. Gunawardane. 6 ♂, 6-11 May 75, P. B. and S. Karunaratne. 11 ♂, 8-10 Sep 77, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, M. Jayaweera, 3 ♂, 4 Nov 77, T. Wijesinhe, M. Jayaweera. 1 ♂, 8 Jun 78, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, V. Kulasekare, L. Jayawickrema. 1 ♀, 1 ♂, 9-11 Feb 79, K. V. Krombein, P. B. Karunaratne. Females are 10-12 mm long, males 8-10 mm. Females are fairly uniform in color and sculpture, but males are variable, some specimens having almost as much red as the females but the petiole is always dark. Paratypes have been placed in the Colombo Museum.



5. *Ampulex ruficornis* (Cameron)

FIGURES 9, 10

*Rhinopsis ruficornis* Cameron, 1889:115-116 [♀; Barrackpore; type in Oxford].—Rothney, 1889:354.—Cameron, 1891:193-194.—Rothney, 1903:113.

*Ampulex (Rhinopsis) ruficornis* (Cameron).—Kohl, 1893:500.

*Ampulex constanceae* (Cameron).—Bingham, 1897:255, fig. 68 [misidentification].

*Ampulex ruficornis* (Cameron).—Dalla Torre, 1897:376-377.—Bohart and Menke, 1976:78.

REMARKS.—*Ampulex ruficornis* is one of two slender Ceylonese species having black head and abdomen and mostly red thorax. It is a mimic of the ponerine ant, *Tetraoponera rufonigra* (Jerdon), a vicious stinger, and occurs with the ant on the trunks or limbs of trees containing crevices and cavities in which both species nest. Rothney captured the holotype in Barrackpore, India, in association with this ant, which he placed in the genus *Sima*. In Colombo, Sri Lanka, we captured more than a dozen *A. ruficornis* on the trunk and limbs of a small ehala tree (*Cassia nodosa*) in the Museum Garden, where it occurred with the ant. Three specimens of a shorter series collected by Henry at Horowupotana bear a second label: "associated with *Sima rufonigra* which it mimics."

The apically nodose first abdominal segment and the abnormal mandibles distinguish *A. ruficornis* from the other species of Ceylonese *Ampulex*. In describing *A. ruficornis*, Cameron noted that the basal abdominal segment was nodose at apex, and later in describing *A. constanceae*, he noted again that *A. ruficornis* differed from that species in the nodose apex of the petiolar segment and figured *A. constanceae* (1891, fig. 6) as having the sides of the basal segment diverging gradually toward the second. The type labels of *A. ruficornis* and *A. constanceae* probably were interchanged during the several years after description of the species, for Bingham (1897) confuses the two species and characterizes and figures *A. constanceae* as the taxon with a nodose apex of the first abdominal segment. *Ampulex constanceae*, which so far as I know does not occur in Sri Lanka, also was collected in association with the ant, *T. rufonigra* (Rothney, 1903). C. O'Toole confirmed my suspicion as to the confusion of the types of these two species in Oxford University. He wrote that the alleged type of *R. constanceae* bore a label in Bingham's hand, but that it agreed with Cameron's type of *R. ruficornis*

and with the original description of that species. A specimen in the Rothney collection bearing a label by Cameron, "Ampulex/ruficollis/Cam." agreed exactly with the original description of *R. constanceae* and must be the type of that species.

FEMALE.—Length 8-9 mm. Black, the following light red: mandible, clypeus, antenna, dorsum of pronotum, and upper half of side, mesothorax entirely except scutum posterolaterally and mesopleuron beneath tegula, metathorax, propodeum except small apical area on dorsal surface, fore tibia and all tarsi; petiole of first abdominal segment testaceous. Appressed vestiture on thorax and abdomen very short, relatively dense, silvery, inconspicuous; body and legs with scattered, longer, erect silvery setae. Forewing with a weak infumation in second submarginal cell and at apex of first, and a small spot at apex of submedian cell.

Head (Figure 9) not elongate behind eyes, with dense fine punctures on front so that it appears granulate, vertex with slightly sparser punctation; front without carinae or enclosure above antennal insertions; mandible abruptly angulate at basal third of outer margin, ventral surface with numerous, fine, oblique incised lines; eyes diverging above, least interocular distance across antennal bases 0.8 times the interocular distance across posterior ocelli; first flagellar segment 0.9 times combined length of second and third segments; vertex with unusually long seta adjacent to inner posterior margin of eye.

Pronotal disk with delicate close punctation, a strong median furrow and no tubercles; scutum and mesopleuron similarly punctate and with scattered small punctures; notauli very weakly crenulate; sternaulus lacking; posterolateral angle of propodeal dorsum with a small, blunt tubercle.

Petiole of first abdominal segment slender, two-thirds the length of entire segment, extending slightly beyond hind trochanter; apical third of first segment enlarged, nodose; fifth and sixth segments very little compressed.

MALE.—Length 6-7 mm. Color varying from the same pattern as female to a phase in which the normal light red is replaced by medium brown except for antenna. Vestiture similar to female. Forewing infumated as in female but occasionally more weakly so and extent reduced.

Head (Figure 10) not elongate behind eyes, sculpture as in female; front with a short longi-

tudinal carina above antennal tubercle and a small median carina just above antennae; mandible without preapical tooth along inner margin; eyes slightly converging above, interocular distance across posterior ocelli 0.93 times that distance across antennal bases and 2.15 times the length of second flagellar segment; first flagellar segment three-fifths as long as combined lengths of second and third segments; vertex with unusually long seta adjacent to inner posterior margin of eye.

Thoracic characters as detailed for female except notauli strongly crenulate.

First abdominal segment as in female.

**SPECIMENS EXAMINED.**—NORTH CENTRAL PROVINCE. ANURADHAPURA DISTRICT: 1♀, 8♂, Horowupotana, (1♀, 2♂ associated with *Sima rufonigra*), Henry (Colombo, BMNH).

WESTERN PROVINCE. COLOMBO DISTRICT: 2♀, 11♂, Colombo, Museum Garden, 50 ft, (all on trunk and limbs of chala (*Cassia nodosa*) and associated with *Tetraoponera rufonigra*), 15 and 24 Jan, 7 and 9 Feb, 7 Sep, 10-20 Oct, Karunaratne, Krombein (USNM).

UVA PROVINCE. MONARAGALA DISTRICT: 1♂, Mau Aru, 10 mi E of Uda Walawe, 26 Sep, (on trunk of *Terminalia* species), Krombein et al. (USNM).

### Subfamily DOLICHURINAE

#### 6. *Trirogma regalis*, new species

FIGURES 11, 13, 15, 17

**REMARKS.**—The characters in the foregoing key are quite adequate to separate this endemic Ceylonese species from the widely distributed *T. caerulea* Westwood that occurs together with *T. regalis* in at least two localities in Sri Lanka. *Trirogma regalis* belong to the *prismatica* Smith section of *Trirogma*, a group distinguished by the white mandibles of the males. It is, however, quite distinct from that Bornean species and from an undescribed Philippine species.

The specific name *T. regalis* is particularly appropriate for this handsome species. It is clothed in royal raiment and part of the type series was collected in Udawattakele Sanctuary, Kandy, the Royal Jungle of the last native kingdom.

*Trirogma regalis* is known from several localities at low to moderate altitudes in both the Wet and Dry zones. It occurs in areas of light to moderate rainfall (50-100 in). The species also occurs in Madras, South India.

**HOLOTYPE.**—♂, Sri Lanka, North Western Province, Kurunegala District, Kurunegala, Badagamuwa Jungle, 24-27 January 1975, K. V. Krombein, P. B. Karunaratne, P. Fernando, N.V.T.A. Weragoda (USNM Type 76041).

**MALE.**—Length 14 mm. Integument metallic purplish, flagellum black, mandible ivory at base, black on apical half; wings clear hyaline; vestiture erect, silvery, denser on clypeus and side of head.

Head (Figure 15) with upper and lower least interocular distances equal, and 1.3 times as long as first flagellar segment; clypeal lobe with rounded lateral angles; lateral edge of frontal platform with several fine, shallow grooves; front immediately above platform with a deep, transverse bisinuate groove, elsewhere coarsely pitted, median groove evanescent; ocellar triangle with a deep posterior groove; second and third flagellar segments equally long, and 1.1 times as long as first.

Pronotal disk (Figure 17) more delicately punctate, posterolateral tubercles smaller; notauli very weakly crenulate; upper mesopleural groove simple, sternaulus lacking.

Second abdominal sternum with only a short, curved lateral groove.

**ALLOTYPE.**—♀, Sri Lanka, Central Province, Kandy District, Kandy, Udawattakele Sanctuary, 1700 ft, 18 January 1977, K. V. Krombein, 11877 A with prey (USNM).

**FEMALE.**—Length 14 mm. Coloration and vestiture as in male except mandible black.

Head (Figure 13) less strongly arched above eyes; eyes converging above, least interocular distance above three-fourths the least interocular distance below and 1.1 times as long as first flagellar segment; clypeal lobe more broadly rounded; frontal platform more shallowly depressed, thickened lateral edge with several fine, shallow grooves; front closely pitted, immediately above platform with a pair of small, oblique pits; posterior ocelli margined by a deep posterior groove; second and third flagellar segments equal in length and combined are 1.5 times as long as first segment.

Pronotal disk with scattered small punctures, posterolateral angles weaker, more rounded; upper mesopleural groove simple, sternaulus absent.

Second abdominal sternum (Figure 11) with a semicircular groove passing well behind basal tubercle.

**PARATYPES.**—8♂, 3♀, from Sri Lanka. 1♂,

same data as holotype. 2 ♀, same locality as allotype, but 1-3 Oct 73, K. V. Krombein, P. B. Karunaratne, P. Fernando, and 14-20 Apr 75, P. B. and S. Karunaratne. 4 ♂, Eastern Province, Amparai District, 2 from Ekgal Aru Sanctuary Jungle, 140 m, 21 Feb 77, K. V. Krombein, P. B. Karunaratne, P. Fernando, D. W. Balasooriya, and 2 from Maha Oya, 6-13 Mar 40 (Colombo). 1 ♀, 1 ♂, Uva Province, Monaragala District, ♂ from Bibile, 7 Jun 75, S. L. Wood, J. L. Petty, and ♀ from Monaragala, 4-5 Sep 75, D. M. Davies, S. Karunaratne, D. W. Balasooriya. 1 ♂, Western Province, Labugama, 9 Jun 38, Henry, (Colombo). 1 ♂, Mirigama Boy Scout Camp, 9 July 1978, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, V. Kulasekare, L. Jayawickrema. 5 ♀, 1 ♂, South India, Madras State, Anamalai Hills, Kadamparai, 3500 ft, May 1963, P. S. Nathan (Leiden). Males are 10-15 mm long, females 15-16 mm. There are no significant differences in sculpture or color. Paratypes have been deposited in the Colombo and Leiden museums.

### 7. *Trirogma caerulea* Westwood

FIGURES 12, 14, 16, 18

*Trirogma caerulea* Westwood, 1841:152 [♂; India; type in Oxford].—Kohl, 1893:512, figs. 69, 70, 73, 74, 76, 77, 81, 82, 87, 90.—Bohart and Menke, 1976:73 [Iraq and Oriental Region].

*Trirogma* (?) *caerulea* Westwood.—Bingham, 1897:261-262, fig. 71 [India, Burma, Tenasserim].—Dalla Torre, 1897:371.—Tsunek, 1972:8.

REMARKS.—Although this widely distributed Oriental wasp is well dispersed in Sri Lanka, it appears to be abundant nowhere. It occurs in both Dry and Wet Zone areas from sea level to at least 3000 ft.

FEMALE.—Length 17-18 mm. Body and legs shining metallic blue, abdomen sometimes greenish or purplish, antenna and mandible black; wings clear hyaline; vestiture white.

Head (Figure 14) more strongly arched above eyes; eyes converging above, least interocular distance above 0.8 times least interocular distance below, and 1.1 times as long as first flagellar segment; clypeal lobe narrower; frontal platform more deeply furrowed, thickened lateral edge with a broad, deep groove; front with shallow, slightly

separated punctures; posterior ocelli margined by a shallow posterior groove; second and third flagellar segments subequal in length and combined are 1.7 times as long as first segment.

Pronotal disk with scattered minute punctures, posterolateral tubercles more acute; upper mesopleural groove crenulate, sternaulus absent.

Second abdominal sternum (Figure 12) with a bisinuate groove beginning at anterolateral angle and crossing basal tubercle.

MALE.—Length 12-13 mm. Coloration and vestiture as in female.

Eyes not converging above, least interocular distances above and below subequal and 1.2 times as long as first flagellar segment; clypeal lobe (Figure 16) rounded laterally; lateral edge of frontal platform with several fine, shallow grooves; front immediately above platform not grooved, closely pitted and with a short, shallow median groove; ocellar triangle with a shallow posterior groove; first three flagellar segments subequal in length.

Pronotal disk (Figure 18) more coarsely punctate, posterolateral tubercles larger and angulate; notauli strongly crenulate; upper mesopleural groove and sternaulus crenulate.

Second abdominal sternum with a bisinuate groove interrupted only on median tubercle.

SPECIMENS EXAMINED.—NORTH CENTRAL PROVINCE. ANURADHAPURA DISTRICT: 1 ♀, Anuradhapura, Feb (Colombo).

EASTERN PROVINCE. TRINCOMALEE DISTRICT: 1 ♀ China Bay, Ridge Bungalow, 0-100 ft, 30 Jan, Krombein et al. (USNM).

CENTRAL PROVINCE. KANDY DISTRICT: 6 ♀, 7 ♂, Kandy (includes Udawattakele Sanctuary, 2100 ft), (♀ in UV light trap), 20 Jan, 9-13 Feb, Jul, Sep, 19 Nov, Hevel et al., Krombein et al., Wickwar (USNM, Colombo).

WESTERN PROVINCE. COLOMBO DISTRICT: 1 ♀, Labugama Reservoir Jungle, 400 ft, 2-3 Oct, Hevel et al. (USNM).

SABARAGAMUWA PROVINCE. RATNAPURA DISTRICT: 1 ♀, Gilimale, (in Malaise trap), 19-22 Jun, Krombein et al. (USNM); 1 ♂, Balangoda (Colombo).

UVA PROVINCE. BADULLA DISTRICT: 1 ♀, Badulla, 3000 ft (Colombo).

MISCELLANEOUS. 1 ♀, no specific locality (BMNH).

### 8. *Dolichurus taprobanae* Smith

FIGURE 19

*Dolichurus taprobanae* Smith, 1869:304 [♀ cited incorrectly as ♂; Ceylon; type in British Museum (Natural History)].

—Kohl, 1893:511 [misspelled *tapronabae*].—Bingham, 1897:260 [Burma, Tenasserim, Ceylon].—Dalla Torre, 1897:371.

- Turner, 1912:367 [Ceylon, Nicobar Island, Sikkim]; 1917: 175 [Pusa, India].—Bohart and Menke, 1976:69 [Sri Lanka, India, Burma, Sikkim].
- Dolichurus bipunctatus* Bingham, 1896:439-440 [♂; Pegu Hills, Burma; type in British Museum (Natural History)]; 1897:260.—Turner, 1912:364-365 [Burma, Assam, Sikkim, NW India].—Bohart and Menke, 1976:69. [Ntw synonymy.]
- Dolichurus* (l) *clavipes* Cameron, 1897:18-19, pl. 16: fig. 4 [♂; Barrackpore, India; type in Oxford University].—Bohart and Menke, 1976:69. [New synonymy; preoccupied by Dahlbom.]
- Dolichurus reticulatus* Cameron, 1899:56-57 [♂; Khasia Hills, Tenasserim; type in British Museum (Natural History)]. [New synonymy.]

REMARKS.—This is representative of a wide-ranging species group that includes two undescribed species from Singapore and the Philippines and *D. maculicollis* and *D. abbreviatus* Strand from Taiwan. In both sexes the pronotal disk is not margined anteriorly by a transverse carina, and the clypeus has a strong median carina; males have delicate sparse punctures on vertex, scutum, and mesopleuron, the digitus conical at apex rather than rounded, front ruguloso-reticulate, and third through tenth flagellar segments slightly swollen in middle on inner surface, the swelling bearing a longer erect seta, and first three abdominal terga with relatively dense punctures; females have the mesopleuron with sternaulus and close, small punctures, occasionally with fine oblique wrinkles and at least first two abdominal terga with several rows of close fine punctures at apex, at least on sides.

Females of *D. taprobanae* range in length from 7.2 to 10.7 mm. Correlated with a decrease in size are variations in certain sculptural details. The largest females have the front with strong, close irregular wrinkles forming small pits laterally, the vertex flat and slightly depressed below eyes, interocular distance across posterior ocelli 0.68 times the greatest interocular distance, and apical lamella on dorsal propodeal disk only slightly lower in middle than laterally. There is a gradation in these characters with decreasing size, and the smaller females have the front smooth with only a few scattered small punctures laterally, the vertex gently rounded above the eye level, interocular distance across posterior ocelli 0.62 times the greatest interocular distance, and apical lamella of propodeal disk substantially higher at the sides than in the middle. *Dolichurus taprobanae* is typical of the large forms, *D. clavipes* Cameron of the small.

Similar variational trends apparently are true in

males also, although only three specimens are available. The lengths are 5.5, 7.0, and 8.0 mm. The largest has the front more coarsely ruguloso-reticulate but the mesh is of comparable size to that of smaller specimens, the median clypeal carina is stronger, the interocular distance across the posterior ocelli is 2.0 times, rather than 1.76, the length of the second flagellar segment, and the propodeal rugulae are comparatively coarser.

In Sri Lanka *D. taprobanae* has been collected in areas of light to moderate rainfall but never in the southwestern part with the heaviest rainfall.

FEMALE.—Length 7.2-10.7 mm. Black, the following red: apical third of mandible, scape and fore tarsus beneath occasionally; tarsi brownish; tibial spurs brownish, rarely dirty white. Heavy black macrochaetae present in normal position; vestiture otherwise short, silvery, decumbent on lower front, erect mostly elsewhere on head and thorax, very sparse and decumbent on sides of posterior abdominal terga.

Head with eyes converging above, vertex flat and slightly depressed below eyes in large specimens, moderately rounded and not depressed in smaller specimens; clypeus with strong median carina extending almost to apex; frontal platform as long as broad, surface concave, smooth, with a few scattered punctures, sides and apex thickened, latter not emarginate in middle; front mostly with strong, close irregular wrinkles forming small pits laterally in large specimens, mostly smooth with a few scattered punctures in small specimens; interocular distance across posterior ocelli 0.62-0.68 times the greatest interocular distance; first flagellar segment 0.44 times as long as combined second and third, which are subequal in length; vertex with scattered small punctures; occiput with dense minute punctures.

Declivity of pronotum with a tendency toward close, transverse fine wrinkles, transverse ridge lacking, disk with fine punctures, lateral tubercle low and rounded; scutum with small, close punctures; mesopleuron with subcontiguous larger punctures tending to coalesce in oblique rows, sternaulus well developed; scutellum with sparse, small punctures except closer posteriorly; dorsal propodeal surface with subrectangular enclosure with sides rounding slightly to apex, medially with two or three longitudinal rugulae and short oblique rugulae laterad of these; transverse lamella at apex of dorsal sur-

face strong, higher at sides in smaller specimens than in larger specimens; lateral surface with close oblique rugulae; posterior surface with strong acute tooth on middle of lateral margin, the surface with well-separated radiating rugulae.

First four terga with disk glossy, impunctate, first two to four with two or three rows of close, tiny punctures at apical margin, sides of third and fourth terga with patches of relatively dense punctures bearing short decumbent setae.

**MALE** (composite description based on one specimen from Sri Lanka and holotypes of *D. bipunctatus* and *D. reticulatus*).—Length 5.5–8.0 mm. Black; mandible red in part, as are fore tibia and tarsus in one specimen, tegula reddish; mid and hind tibiae and tarsi brown in two specimens; tibial spurs light brown to ivory; the following white to ivory: narrow apical margin of clypeal platform (evanescent in *D. reticulatus*) and small transverse spot on pronotal tubercles; vestiture silvery, much as described for females; wings clear hyaline.

Head moderately arched above eyes; clypeus with a median carina ending in a tooth on margin, a pair of tiny denticles on either side of median tooth; frontal platform with apical margin rounded, surface concave and smooth, sides thickened, three-fourths as long as basal width; front with ruguloso-reticulations of relatively fine mesh, coarser in largest specimen; eyes converging slightly below, least interocular distance above 1.02–1.09 times least distance below and 0.88 times the greatest interocular distance and 1.76–2.00 times as long as first flagellar segment; third through tenth flagellar segments slightly swollen in middle on inner surface, the swelling bearing a longer erect seta; vertex with scattered tiny punctures.

Pronotal disk margined anteriorly by fine transverse carinae, marginal lamella lacking, posterior surface shallowly depressed except for low, rounded lateral tubercle; lateral pronotal surface smooth, with scattered fine punctures; scutum and mesopleuron with small punctures separated by more than the diameter of a puncture, sternaulus evanescent; enclosure of propodeum subrectangular, sides rounded and converging slightly to apex, surface with irregular, mostly transverse rugulae; lamella between dorsal and posterior surfaces straight, evenly developed; a weak, blunt lateral tooth halfway down posterior surface; lateral surface with moderately close, oblique rugulae.

Three exposed terga with moderately large punctures, mostly separated by the diameter of a puncture; apex of third tergum moderately reflexed; second sternum without subbasal ridge; genitalia (Figure 19).

**SPECIMENS EXAMINED.**—NORTHERN PROVINCE. VAVUNIYA DISTRICT: 1 ♂, Parayanalankulam, Irrigation Canal, 25 mi NW of Medawachchiya, 100 ft, 20–25 Mar, Davis et al. (USNM). MANNAR DISTRICT: 1 ♀, Silavathurai, Kondachchi, 26 Jan, Karunaratne et al. (in Malaise trap) (USNM).

CENTRAL PROVINCE. MATALE DISTRICT: 2 ♀, Kohongahawella (=Kongahawela, 6 mi E of Naula), Wickwar (Colombo). KANDY DISTRICT: 12 ♀ (includes Udawattakele Sanctuary, 510–580 m, 2100 ft), 9–13 Feb, 8 June, 20–30 and 29 Jul, 8–10 Sep, Karunaratne, Krombein et al., Wickwar (USNM, Colombo). 1 ♀, 5 mi NW of Mahiyangana, Hasalaka Irrigation Bungalow, 30 Mar–9 Apr, Spangler et al. (in Malaise trap) (USNM).

### 9. *Dolichurus lankensis*, new species

FIGURE 20

**REMARKS.**—*Dolichurus lankensis* appears to be more closely related to *D. taprobanae* Smith than it is to any of the other Ceylonese species of the genus. The females agree in having the vertex flat (true only in larger specimens of *D. taprobanae*), the pronotum lacking an anterior flange and having close transverse wrinkles at apex of declivity and several rows of tiny dense punctures on apices of first two abdominal terga. The males agree in the shape of the frontal platform, sculpture of the front, a longer erect seta on the middle of the third through at least the sixth flagellar segments, and density of punctation on the abdominal terga. Both sexes of *D. lankensis* differ, however, in having the mesopleuron finely ruguloso-reticulate and lacking a sternaulus, and the clypeus without a median carina. In addition, the male genitalia of *D. lankensis* have the digitus rounded at apex rather than being conically produced.

*Dolichurus lankensis* is known presently only from a pair of specimens taken at two localities in the Dry Zone.

**HOLOTYPE.**—♀, Sri Lanka, Eastern Province, Amparai District, Ekgal Aru Sanctuary Jungle, 140 m, 11–15 September 1977, in Malaise trap, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, M. Jayaweera (USNM Type 76042).

**FEMALE.**—Length 7.0 mm. Black, apical half of mandible red, tegula, and fore tibia and tarsus be-

neath brownish, tibial spurs dirty white. Wings slightly infumated. Vestiture silvery except black specialized macrochaetae, decumbent, short and relatively dense adjacent to frontal platform and on pronotal disk, longer, sparser, and erect beneath head and on rest of thorax, abdomen virtually without setae.

Head in frontal view rounded except vertex flat, not raised above eyes; clypeus without median carina, margin of apical lobe slightly rounded; frontal platform with apex slightly rounded, length to median macrochaetae 1.28 times greatest width, basal third with broad shallow groove and scattered small punctures, above with weak, irregular transverse rugulae; front above platform with moderately large, contiguous punctures except for a pair of smooth areas a little larger than an ocellus; eyes converging above, least interocular distance above 0.86 times least distance below, and 2.5 times the length of first flagellar segment; first flagellar segment 0.55 times the combined lengths of the subequal second and third segments; vertex with small punctures mostly separated by less than the diameter of a puncture.

Pronotum with weak, close transverse wrinkles on upper part of declivity and anterior half of disk, transverse flange absent; posterior part of disk with fine scattered punctures, median groove lacking, lateral tubercle smaller than in *D. taprobanae*; scutum and scutellum with small punctures, most of them separated by more than the diameter of a puncture; postscutellum with close longitudinal rugulae; mesopleuron with rugulosoreticulations of fine mesh, sternaulus absent; propodeal enclosure with basal width 1.25 times apical width, median and lateral carinae strong, enclosure otherwise with transverse rugulae, posterior flange quite strong except medianly; lateral surface with close, oblique rugulae; posterior surface with irregular, close, mostly radiating rugulae, and a strong acute tooth on middle of lateral margin.

First two abdominal terga each with two or three rows of tiny close punctures at apical margin, which are absent on middle of terga; second sternum with a strong, arcuate subbasal ridge.

ALLOTYPE.—♂, Sri Lanka, Eastern Province, Amparai District, Lahugala Sanctuary, 13–14 June 1976, K. V. Krombein, P. B. and S. Karunaratne (USNM).

Length 4.5 mm. Black, apical half of mandible and fore tibia and tarsus beneath red; fore tibia and tarsus above and mid tibia and tarsus and tegula brown; apical margin of frontal platform, spot on pronotal tubercle and tibial spurs white. Wings slightly infumated. Vestiture much as in female but appressed pubescence lacking on pronotum, and longer, erect setae generally more abundant, abdominal segments with moderately dense, short, subcumbent setae.

Head rounded in frontal aspect, vertex more strongly arched above eyes than in *D. taprobanae*; clypeus without median carina; frontal platform with rounded apical margin, surface concave, smooth and with tiny, well-separated punctures, 0.8 times as long as greatest width; front with rugulosoreticulations of relatively fine mesh; eyes converging slightly above, least interocular distance above 0.81 times the least distance below and 3.2 times the length of first flagellar segment; third through sixth flagellar segments not widened in middle but with a longer erect seta in middle of inner surface, remaining segments collapsed and such setae, if present, not visible; second and third flagellar segments subequal in length, each 1.4 times as long as first; vertex with scattered small punctures.

Pronotal disk margined anteriorly by a weak carina behind which are a few weak transverse wrinkles, rest of surface with scattered small punctures, median groove absent, lateral tubercle less developed than in *D. taprobanae*; lateral pronotal surface with a weak anterior ridge, elsewhere smooth with scattered small punctures; scutum with fine punctures separated by more than the diameter of a puncture; mesopleuron with rugulosoreticulations of fine mesh, sternaulus absent; propodeal enclosure with basal width about 1.25 times apical width, lateral carinae stronger than median, rest of area with a few oblique rugulae, disk laterad of enclosure with transverse rugulae, apex with a weak transverse flange; lateral surface with oblique rugulae; posterior surface with radiating rugulae, no tooth laterally and lateral surface not separated by a ridge.

Three exposed abdominal terga with moderately large punctures, mostly separated by the diameter of a puncture, apex of third tergum moderately reflexed; second sternum without subbasal ridge; genitalia (Figure 20).

### 10. *Dolichurus silvicola*, new species

FIGURE 21

REMARKS.—This distinctive species has been collected in Sri Lanka mostly in the Udawattakele Sanctuary, 2100 ft, where it is the most abundant of the several species of *Dolichurus* occurring in that jungle. It has also been collected in two localities of much lower rainfall. Both sexes run rapidly on or make short low flights over leaf litter in shaded areas that receive intermittent sunlight. They do not fly upward into a net lowered over them and must be collected by a rapid sideward sweep of the net gathering in some of the leaves on which they are found. Although I have watched and collected them for hours during several visits to Udawattakele, I never observed one with prey.

Both sexes are more closely related to *D. albifacies*, new species, than to any of the others occurring in Sri Lanka, but they differ in characters of the sculpture and color. Both sexes of *D. albifacies* have white markings on the head and at least the tegula, whereas the female of *D. silvicola* has no white maculations and the male has more restricted markings only on the frontal platform, pronotal tubercles, and tegula. The mesopleuron of female *D. silvicola* has mostly fine wrinkles and scattered larger punctures, while *D. albifacies* has the mesopleuron smooth with smaller scattered punctures. The male of *D. albifacies* has the first two abdominal terga virtually impunctate, whereas *D. silvicola* has moderately large, close punctures on these terga except smooth median areas on the posterior half of each tergum. Both of these species are unique among Ceylonese *Dolichurus* in having dense, short, decumbent silvery vestiture on the side of the second and third abdominal terga in both sexes.

*Dolichurus silvicola* occurs also in South India, for I have seen a female from Anamalai Hills, 3100 ft, May 1951, P. S. Nathan (USNM).

HOLOTYPE.—♀; Sri Lanka, Central Province, Kandy District, Udawattakele Sanctuary, Kandy, 1800 ft, 3–5 June 1976, K. V. Krombein, P. B. and S. Karunaratne, D. W. Balasooriya (USNM Type 76043).

FEMALE.—Length 8.8 mm. Black, mandible with subbasal ivory spot and reddish apex, palpi, tegula, tibial spurs, and tarsi brownish. Forewing very slightly infumated. Specialized macrochaetae black,

rest of vestiture silvery, sparse, long and erect beneath head, short, dense, and appressed laterad of frontal platform, sparse and suberect elsewhere on head, dense, very short and subreclinate on pronotal disk and scutum; sides of second and third terga and all of fourth and fifth with relatively dense, short decumbent setae.

Head in frontal view roughly circular, vertex slightly rounded above eyes; basal half of clypeus convex, ecarinate, margin of lobe slightly convex; frontal platform moderately thickened apically and laterally, 1.15 times as long as broad, apical margin truncate, the angles rounded; eyes converging above, upper interocular distance three-fourths the lower interocular distance and 1.09 times length of first flagellar segment, frontal platform with weak median groove, lower half slightly concave, upper half flat, surface with scattered weak pits interspersed with irregular weak wrinkles; above platform the front with a weak median carina, and scattered, moderate-sized punctures that become closer and smaller laterad of ocelli, which are in an equilateral triangle; vertex with close small punctures separated by about the diameter of a puncture; second and third flagellar segments together 1.61 times as long as first.

Pronotum with a few close evanescent wrinkles posteriorly on declivity, discal surface with shallow median groove, rest of disk with close fine punctures, posterolateral tubercle low and rounded; side of pronotum anteriorly with a ridge above, surface smooth; scutum with slightly larger punctures separated by the diameter of a puncture; scutellum with very sparse, small punctures; mesopleuron with punctures tending to be arranged in oblique rows, sternaulus present; dorsal surface of propodeum with a U-shaped enclosure bearing a complete median carina and several incomplete lateral carinae and a few very short or oblique carinae apically with an irregular lamella that is higher laterally than in middle; lateral propodeal surface smooth except for a few close wrinkles above and posteriorly; posterior surface irregularly ruguloso-reticulate with small mesh, a strong acute tooth halfway up lateral margin, no complete ridge between lateral and posterior surfaces.

First tergum without an apical row of tiny close punctures; side of second and third and all of fourth and fifth terga with moderately dense, mi-

nute punctures; second sternum with arcuate sub-basal ridge stronger than in *D. albifacies*.

ALLOTYPE.—♂, same locality data as holotype, but 2100 ft, 20–30 July 1976, S. Karunaratne (USNM).

Black, the following reddish: apex of mandible, tegula except base, fore and mid tarsi; the following brownish: palpi, flagellum beneath and hind tarsi; the following white: narrow apical rim of frontal platform, large paired spots on pronotal tubercles, tiny spot at base of tegula, and tibial spurs. Forewing very slightly infumated. Vestiture of head and thorax similar to female except not so dense on pronotal disk and scutum, abdominal terga with short, suberect setae arising from relatively dense punctures.

Head rounded in frontal aspect, the vertex more arched above eyes than in female; clypeus with weak median carina ending in a small tooth at apex, the lobe with rounded lateral angles; frontal platform broader than in female, the length 0.69 times greatest width, apical and lateral margins thinner than in female, disk with very weak median groove, more concave than in female and with scattered small punctures; upper and lower interocular distances equal; front above platform with median carina extending to anterior ocellus, most of surface rugulosoreticulate with small mesh; ocelli in an equilateral triangle, area laterad of ocelli with small punctures separated by about diameter of a puncture; vertex with small, somewhat more separated punctures than laterad of ocelli; second and third flagellar segments together 1.79 times as long as first.

Pronotum with a few close transverse wrinkles at apex of declivous section, no transverse flange at base of dorsal surface, the latter with a broad, shallow median groove, fine scattered punctures and prominent posterolateral tubercle; side of pronotum smooth, anteriorly with a strong flange; scutum as finely but more sparsely punctate than female; scutellum similarly punctate; mesopleuron with scattered small punctures separated by twice or more the diameter of a puncture except along mesometapleural suture, where they are confluent in short rows of several punctures, sternaulus present; enclosure of propodeal dorsum with strong median and lateral carinae, the surface with a few short, irregular carinae, apical lamella low, straight, of uniform height; posterior and lateral surfaces not

separated by a ridge but with a weak blunt tubercle in middle; lateral surface smooth except for a few close rugulae anteriorly; posterior surface irregularly rugulosoreticulate with very small mesh.

First three abdominal terga with moderately large dense punctures mostly separated by less than the diameter of a puncture except for the following smooth, glossy areas: on first tergum the declivity, a narrow median strip, and a wider transverse strip at apex, and second tergum with a narrower, shorter transverse strip at apex, and reflexed rim of third tergum finely punctate; genitalia (Figure 21).

PARATYPES.—20 ♀, 31 ♂, from Sri Lanka. 13 ♀, 19 ♂, same locality data as holotype, 1800–2100 ft; 1 ♂, 1–3 Oct 73, K. V. Krombein, P. B. Karunaratne, P. Fernando; 1 ♀, 9–13 Feb 75, K. V. Krombein, P. B. and S. Karunaratne, P. Fernando; 1 ♀, 8–11 May 75, P. B. and S. Karunaratne; 3 ♀, 15 ♂, 3–5 Jun 76, K. V. Krombein, P. B. and S. Karunaratne, D. W. Balasooriya; 2 ♂, 20–30 Jul and 20–27 Sep 76, S. Karunaratne; 4 ♀, 1 ♂, 20 Jan 77, K. V. Krombein, P. Fernando, D. W. Balasooriya, V. Gunawardane; 1 ♀, 8–10 Sep 77, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, M. Jayaweera; 1 ♀, 8 Jun 1978, K. V. Krombein; 2 ♀, 29 Jul 1978, K. V. Krombein, T. Wijesinhe, V. Kulasekare, L. Jayawickrema. 5 ♀, 2 ♂, Central Province, Matale District, Kibissa Jungle, ½ mi W of Sigiriya, 30 Jun–3 Jul 1978, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, V. Kulasekare, L. Jayawickrema; 2 ♀, 8 ♂, 9–11 Feb 1979, K. V. Krombein. 2 ♂, Eastern Province, Amparai District, Ekgal Aru Sanctuary Jungle, 6 Jul 1978, in yellow pan trap, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, V. Kulasekare, L. Jayawickrema. 1 ♀, South India, Madras State, Anamalai Hills, 3100 ft, May 1951, P. S. Nathan (K. V. Krombein coll. in USNM).

Female paratypes usually range from 7.4 to 8.8 mm but one is 11.5 mm long, and males are 4.6–8.1 mm. Females are quite uniform in sculptural details, but a few lack the pale subbasal spot on the mandible and have dark tegulae. The pale markings are slightly reduced in some males, and the frontal sculpture is occasionally more delicate than in the allotype.

### 11. *Dolichurus albifacies*, new species

FIGURE 22

REMARKS.—This unusual species is readily dis-



tinguished in both sexes by the much greater extent of white integumental markings and short, broad frontal platform, and in the female by the absence of the usual stout, black macrochaetae on the clypeus, front, and pronotal disk. It is the most western representative of a small species group that also includes the Taiwanese *D. ombrodes* Nagy, 1971, based on a male, and *D. apiciornatus* Tsuneki, 1977, based on a female, and an undescribed species from the Philippines.

Ceylonese females differ from the holotype of *D. apiciornatus* in the following details: mandible partly white basally rather than entirely black; median frontal keel evanescent or absent; first flagellar segment 0.60 times combined lengths of next two segments (0.26 in *D. apiciornatus*); clypeus with comparatively larger and noticeably denser punctures; and shallow oblique groove on lateral surface of pronotum not crossed by transverse rugulae. The Ceylonese males differ from Nagy's brief description of *D. ombrodes* in having the mandible white on basal half rather than reddish and in lacking a strong median frontal keel. The concordance of color characters between both sexes of *D. albifacies* with *D. ombrodes* and *D. apiciornatus* suggests that the two Taiwanese taxa may eventually prove to be opposite sexes of the same species.

In Sri Lanka, *D. albifacies* has been collected only in the Udawattakele Sanctuary Jungle, Kandy, an area of moderately heavy rainfall and at an altitude of some 2100 feet, and in Ekgal Aru Sanctuary Jungle, an area of very low rainfall and an elevation of 100 meters.

**HOLOTYPE.**—♀, Sri Lanka, Central Province, Kandy District, Kandy, Udawattakele Sanctuary, 2100 ft, 5–15 July 1976, S. Karunaratne (USNM Type 76044).

**FEMALE.**—Length 5.5 mm. Black, the following white: palpi, mandible except base and apex, clypeal lobe, broad margin of frontal platform, anterior half of tegula and mid and hind tibial spurs; the following light red: base and apex of mandible, inner surface of fore tibia and lower surface of fore tarsi; rest of tarsi brownish. Black macrochaetae lacking, vestiture silvery, short, erect and moderately dense on front, vertex, pronotal disk and scutum, longer and erect on temple and mesopleuron, appressed and moderately dense on sides of second and third and all of fourth and fifth terga. Wings hyaline.

Viewed from in front, hind margin of head slightly arched above eyes; clypeus with apical margin of lobe moderately emarginate, median ridge absent; eyes converging slightly above, least interocular distance above 0.93 least interocular distance below and 1.39 the length of first flagellar segment; frontal platform delicately punctate, short, twice as broad as high; front with a few weak wrinkles above platform, median keel evanescent, surface with small punctures separated by less than the diameter of a puncture; ocelli in an equilateral triangle; vertex with fine, moderately dense punctures; first flagellar segment 0.6 times combined lengths of next two segments.

Pronotum with a few close, delicate transverse wrinkles on anterior declivity, disk with minute, moderately dense punctures, tubercles large, low, rounded, lateral surface smooth except for a short curved ruga in middle; scutum with small punctures separated by about twice the diameter of a puncture; scutellum and postscutellum with scattered small punctures; mesopleuron with scattered small punctures; dorsal surface of propodeum irregularly rugulosoreticulate, posterior ruga weaker than usual; lateral propodeal surface smooth except for several longitudinal rugulae on upper third; posterior surface of propodeum smooth, with scattered punctures and a few vague, short radiating rugulae, lateral margin with a moderate blunt tooth halfway from dorsum.

First tergum without an apical row of tiny punctures; sides of second and third and all of fourth and fifth terga with moderately dense, minute punctures; second sternum with a weaker, gently arcuate subbasal ridge than in *D. amamiensis*.

**ALLOTYPE.**—♂, same data as holotype but 8–10 September 1977, K. V. Krombein, P. B. Karunaratne, T. Wijesinha, M. Jayaweera (USNM).

**MALE.**—Length 5 mm. Black, the following white: palpi, mandible except base and apex, clypeus except for narrow basal margin and median bar, broad lateral and apical margin of frontal platform, pronotal dorsum except narrow median strip, anterior half of tegula, small spot in middle of scutellum in one specimen, and mid and hind tibial spurs; the following light red: base and apex of mandible, trochanters beneath, inner surface of fore and mid tibiae, fore and mid tarsi except apical segment; rest of tarsi brownish. Vestiture much as described for female except first tergum also with a

small patch of appressed pubescence on side. Wings hyaline.

Head shaped much as in female; clypeal lobe very slightly emarginate; eyes converging slightly below, least interocular distance above 1.07 times least distance below, and 1.59 the length of first flagellar segment; frontal platform as in female; frontal sculpture as in female, median keel extremely short and weak; ocelli similar; vertexal sculpture a little sparser than in female; first three flagellar segments subequal in length, segments 4–8 not swollen in middle on inner surface, specialized seta absent.

Pronotal disk shorter and more sparsely punctate than in female, tubercles low, rounded; punctation elsewhere on thorax sparser than in female; propodeal sculpture similar but more delicate, tooth on lateral margin of posterior surface weak.

First tergum posterolaterally, side of second and all of third with minute, more dispersed punctures than in female; genitalia (Figure 22).

PARATYPES.—2 ♀, 1 ♂, same locality as holotype; 1 ♀, 2–13 August 1976, S. Karunaratne; 1 ♀, 1 ♂, 8–10 September 1977, 510–580 m, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, M. Jayaweera. 1 ♀, Kandy, July, O. S. Wickwar (Colombo). 1 ♀, Eastern Province, Amparai District, Ekgal Aru Sanctuary Jungle, 6 July 1978, P. B. Karunaratne, T. Wijesinhe, V. Kulasekare (USNM). A pair of paratypes has been deposited in the Colombo Museum.

The male paratype is 6 mm long and agrees in all details with the allotype. Female paratypes are 5–8 mm long; the least interocular distance above may be as little as 0.80 the least distance below and 1.65 times as long as first flagellar segment.

## 12. *Dolichurus amamiensis* Tsuneki and Iida

### FIGURE 23

*Dolichurus amamiensis* Tsuneki and Iida, 1964:41–43, 13 figs. [♀; Ryukyu Islands; type in Tsuneki collection].—Tsuneki, 1967:13 [♀; Taiwan].—Tano and Tsuneki, 1970:40 [synonymy of *puliensis*].—Tsuneki, 1974: 591–592 [Thailand].—Bohart and Menke, 1976:69.—Tsuneki, 1976a: 34–35 [Philippines].

*Dolichurus puliensis* Tsuneki, 1967:10–11, figs. 51–59 [♂; Taiwan; type in Tsuneki collection].

REMARKS.—This wide-ranging species is known in Sri Lanka from only a single pair taken in two areas of moderate to heavy rainfall.

The single female from Weddagala agrees very

well with a female I collected in August 1945 on Ie Shima, Ryukyu Islands, the earliest record of capture for the species, and with the female holotype from Amami-Oshima. Tsuneki (1976a) notes some variation in the female in the shape of the frontal platform, the relative strength of the mesopleural punctures and rugae, and in the variable sculpture of the sides and posterior surface of the propodeum. The female description that follows is based on my specimens from Weddagala and Ie Shima. The female is readily distinguished from females of the other Ceylonese species by the rugulose-reticulate mesopleuron, which lacks a sternaulus, by the sparse delicate punctation of upper front and vertex, and by having the pronotal disk margined anteriorly by a transverse flange.

Tsuneki (1976a) also notes variation in the male in the shape of the frontal platform, relative strength of the frontal sculpture, and the variable sculpture of the posterior and lateral surfaces of the propodeum. My Ceylonese male differs from his holotype of *D. puliensis* in some details, which may be due to its smaller size: upper interocular distance 1.2 times lower interocular distance in his specimen, 1.3 in mine; the pronotum with a weak median impression in his, which is lacking in mine; and the propodeum relatively more strongly rugulose in his specimen.

FEMALE.—Length 5.2–9.2 mm. Black, mandible at apex and tibial spurs red to light brown, scape and legs sometimes castaneous; wings evenly and slightly infumated; vestiture, except for stout, black macrochaetae, silvery, sparse except relatively dense and appressed above clypeus and on temple, erect and scattered elsewhere on head and on thorax.

Head with height from apex of clypeus subequal to width; viewed from side the front weakly convex, temple half as wide as eye; clypeus with a weak median carina on basal half; eyes converging slightly above, least interocular distance above 0.94 times least interocular distance below and 1.32 the length of first flagellar segment; frontal platform with apex gently rounded, greatest width twice the upper width at frontal macrochaetae, lower surface smooth with a few scattered punctures, upper half with delicate, irregular rugulae; front with a few delicate longitudinal rugulae, elsewhere with very sparse small punctures, vertex with scattered, minute punctures; first flagellar segment 0.61–0.64 times combined lengths of next two segments.

Pronotal disk anteriorly with a strong transverse carina, posteriorly with a weaker carina, surface with scattered, minute punctures, anteriorly with weak to evanescent transverse rugulae, posterolateral tubercles rounded toward apex, slightly diverging from midline; side of pronotum smooth on upper half, with a few longitudinal rugulae on lower half; scutum with very scattered minute punctures, notauli deeply impressed, not crenulate; scutellum similarly punctate; postscutellum with moderately close, longitudinal rugulae and dense small punctures; mesopleuron with rugulose reticulations of small mesh, sternaulus absent; metapleuron smooth except for a few longitudinal rugulae above; dorsal surface of propodeum with five carinae slightly converging toward apex to form a U-shaped area, surface between and laterad with transverse carinae, posterior margin with a strong transverse lamella interrupted along median area; lateral propodeal surface with slightly oblique rugulae, which become sparser below; posterior surface of propodeum irregularly rugulosoreticulate in center, transversely rugulose elsewhere, lateral margin with a moderate acute tooth halfway from dorsum.

Abdomen virtually impunctate, first tergum without one or more rows of close, tiny punctures; second sternum with a strong, gently arcuate subbasal ridge.

**MALE.**—Length 3.6 mm (Tsuneki gives 4.0–5.5 mm). Black, apex of frontal platform ivory, posterolateral spot on pronotum and tibial spurs white, apical half of mandible light red, tibiae and tarsi medium brown. Vestiture whitish, sparse, mostly erect and long on head and thorax, short and decumbent on abdominal dorsum.

Head in frontal view with vertex arched above eyes; clypeus strongly convex with a well-developed median carina ending in a small apical tooth, the lobe emarginate on each side of median tooth and ending in weak rounded angle; eyes diverging slightly above, least interocular distance on vertex 1.3 times that across antennal insertions and 1.3 times as long as first flagellar segment; frontal platform gently concave with tiny, scattered punctures, slightly longer than greatest breadth; most of front delicately rugulose-reticulate, the mesh rather small, laterally the rugulae tending to be irregularly longitudinal; ocelli in a low triangle; vertex glossy, with scattered small punctures; first flagellar segment 0.9 times combined lengths of second and third.

Pronotal disk anteriorly with a weak transverse carina, surface gently convex with scattered fine punctures, posterolateral tubercles prominently raised; side of pronotum mostly smooth, a few weak wrinkles below; notauli deeply impressed and parallel, scutal surface glossy with scattered small punctures; mesopleuron irregularly and finely rugulose, sternaulus lacking; propodeum very weakly sculptured, dorsal surface with a low posterior carina, the median area smooth and delimited by a pair of lateral and one median rugulae, laterad of this a few oblique rugulae; no carina separating lateral and posterior surfaces and no indication of a tooth on the margin; lateral surface virtually smooth, only faint indications of rugulae above; posterior surface with a faint median carina and faint indications of oblique rugulae.

Anterior aspect of first abdominal tergum smooth; dorsum of first and all of second and third, except depressed apical rim of third, with moderately large punctures, separated by more than the diameter of a puncture on the first and becoming increasingly closer on the second and third; genitalia (Figure 23).

**SPECIMENS EXAMINED.**—CENTRAL PROVINCE. KANDY DISTRICT: 1 ♂, Udawattakele Sanctuary, 2100 ft, 16–31 Aug, Karunaratne (USNM).

SABARAGAMUWA PROVINCE. RATNAPURA DISTRICT: 1 ♀, Sinharaja Jungle, 3 mi S of Weddagala, 18–21 Jun, K. V. Krombein et al. (USNM).

### 13. *Dolichurus aridulus*, new species

#### FIGURE 24

**REMARKS.**—This small species is known from a few specimens from three localities in the Dry Zone. Both sexes are distinguished at once from most other Ceylonese species of *Dolichurus* by a combination of the presence of small dense punctures on the vertex, separated from each other by less than the diameter of a puncture, and by the lack of a sternaulus. The female of *D. lankensis*, new species, which has the characters noted above, lacks the red mandible and red ventral surface of the fore tibia and has the vertex flat instead of gently rounded.

**HOLOTYPE.**—♀, Sri Lanka, Eastern Province, Trincomalee District, Trincomalee, China Bay Ridge Bungalow, 0–100 ft, 13–17 May 1976, K. V. Krombein, P. B. and S. Karunaratne, D. W. Bala-sooriya (USNM Type 76045).

**FEMALE.**—Length 7.7 mm. Black, the following light red: palpi, mandible except extreme tip, scape beneath, tegula except base, and fore tibia beneath; the following white: small basal spot on tegula and tibial spurs; the following brown: fore tibia above, mid and hind tibiae, and all tarsi. Wings clear hyaline. Vestiture silvery except for black macrochaetae on head and thorax, very short, moderately dense and appressed on head except beneath, less dense on thoracic dorsum, head beneath and sides and venter of thorax with longer, sparse erect setae.

Head subcircular in frontal aspect, vertex moderately arched above eyes; basal half of clypeus convex, ecarinate, apical lobe subtruncate and rounded laterally; frontal platform with margins moderately thickened, length to macrochaetae 1:15 times greatest width, sides delimited by carinae slightly converging above, lower half slightly concave and with scattered small punctures, the upper half flat and with closer, delicate arched rugulae; eyes converging above, least interocular distance above 0.93 times least interocular distance below, and 1.3 times the length of first flagellar segment; front adjacent to frontal platform with dense, tiny punctures, above with larger punctures confluent in longitudinal rows laterally, elsewhere separated by about half the diameter of a puncture except for a pair of small impunctate areas halfway between anterior ocellus and frontal platform; ocelli in an equilateral triangle, area laterad of them and vertex with small dense punctures separated by less than the diameter of a puncture; first flagellar segment two-thirds the combined lengths of the subequal second and third segments.

Anterior declivity of pronotum with close transverse wrinkles; dorsal surface with similar wrinkles on basal half, anterior flange absent, median groove absent, posterior half with small, moderately close punctures, posterolateral tubercle low, conically rounded; lateral surface of pronotum with a short anterior flange, upper half with close rugae, which are oblique anteriorly and longitudinal elsewhere, lower half with scattered small punctures; scutum with small punctures mostly separated by more than the diameter of a puncture; scutellum very sparsely punctate except closer on lateral and posterior margins; postscutellum with close longitudinal ridges; mesopleuron rugulosoreticulate with fine mesh, sternaulus lacking; dorsal propodeal enclosure subrectangular with strong median and lateral rugae,

the area between with a few transverse rugae, area laterad of enclosure with a few weaker transverse rugae; lamella separating dorsal and posterior surfaces irregular, low on median half, higher on sides; posterior surface with weak, irregular, mostly transverse rugae, separated from lateral surface by a ridge on upper two-thirds, which terminates below in a strong acute tooth; lateral surface with fine, close oblique rugulae.

First tergum of abdomen without an apical row of tiny punctures; all terga with extremely sparse vestiture; arcuate subbasal ridge of second sternum as strong as in *D. silvicola*.

**ALLOTYPE.**—♂, Sri Lanka, North Central Province, Anuradhapura District, Hunuwilagama near Wilpattu National Park, 200 ft, 28 October–3 November 1976, in Malaise trap, G. F. Hevel, R. E. Dietz IV, S. Karunaratne, D. W. Balasooriya (USNM).

**MALE.**—Length 4.7 mm. Coloration much as in female but only apical half of mandible red, fore and mid tarsi almost completely red, hind basitarsus red, scape not red beneath, and apical margin of frontal platform and apex of pronotal tubercle white. Forewing slightly infumated. Vestiture much as in female but thoracic dorsum with some scattered, longer erect setae, and first three abdominal terga with short, moderately dense decumbent setae.

Head rounded in frontal view, vertex more arched above eyes than in female; clypeus with a median carina ending in a small denticle, lateral angles of lobe rounded; frontal platform with margins thinner than in female, length 1.1 times greatest breadth, sides not converging above, disk with median groove extending almost to apex, weakly and irregularly rugulose except apical third smooth, gently concave and with scattered punctures; eyes diverging above, least interocular distance above 1.19 times the least interocular distance below and twice the length of first flagellar segment; front adjacent to platform with dense small punctures, above this with a weak median carina becoming evanescent near anterior ocellus, the surface with delicate rugulosoreticulations of fine mesh; ocelli in a low triangle; area laterad of ocelli and vertex with small close punctures separated by about half the diameter of a puncture.

Pronotal disk without anterior lamella, anterior half with small punctures confluent in several trans-

verse rows, median groove absent, tubercles prominent, directed laterad; lateral surface of pronotum above with a short anterior flange behind which are two longer carinae, rest of surface smooth and with scattered fine punctures; scutum with small punctures mostly separated by less than the diameter of a puncture; scutellum with small discal punctures separated by about the diameter of a puncture, lateral and posterior punctation closer; post-scutellum with ridges more separated than in female; mesopleuron rugulosoreticulate with fine mesh, sternaulus absent; dorsal propodeal enclosure with weak median and lateral carinae, the latter converging slightly toward apex, areas between carinae virtually smooth, areas laterad of enclosure weakly, irregularly, transversely rugulose, a very weak rugula separating dorsal and posterior surfaces; posterior and lateral surfaces not separated by a ridge, median tubercle lacking; lateral surface mostly smooth except for a few weak, oblique rugulae anteriorly and one posteriorly; posterior surface weakly rugulosoreticulate with fine mesh.

Disk of first abdominal tergum and all of second

and third terga except narrow depressed apical margin of third with moderate large punctures mostly separated by half the diameter of a puncture; second sternum with very weak subbasal ridge; genitalia (Figure 24).

PARATYPES.—1 ♀, 1 ♂, same locality data as holotype but 7–9 October 1977, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, M. Jayaweera; 1 ♂ Eastern Province, Amparai District, Ekgal Aru Sanctuary Jungle, 11–12 June 1976, in Malaise trap, K. V. Krombein, P. B. and S. Karunaratne. A pair of paratypes has been deposited in the Colombo Museum.

The female paratype agrees with the holotype in length, color, and sculpture except that the upper front has very scattered punctures. One male paratype is 5.7 mm long, the other lacks an abdomen. In both male paratypes the mandibles are red except extreme apex and the scape is red beneath. Also, the propodeal sculpture is stronger in both male paratypes, the dorsal enclosure has some weak, irregular transverse rugulae and the rugulae on the lateral surface are stronger and more numerous.

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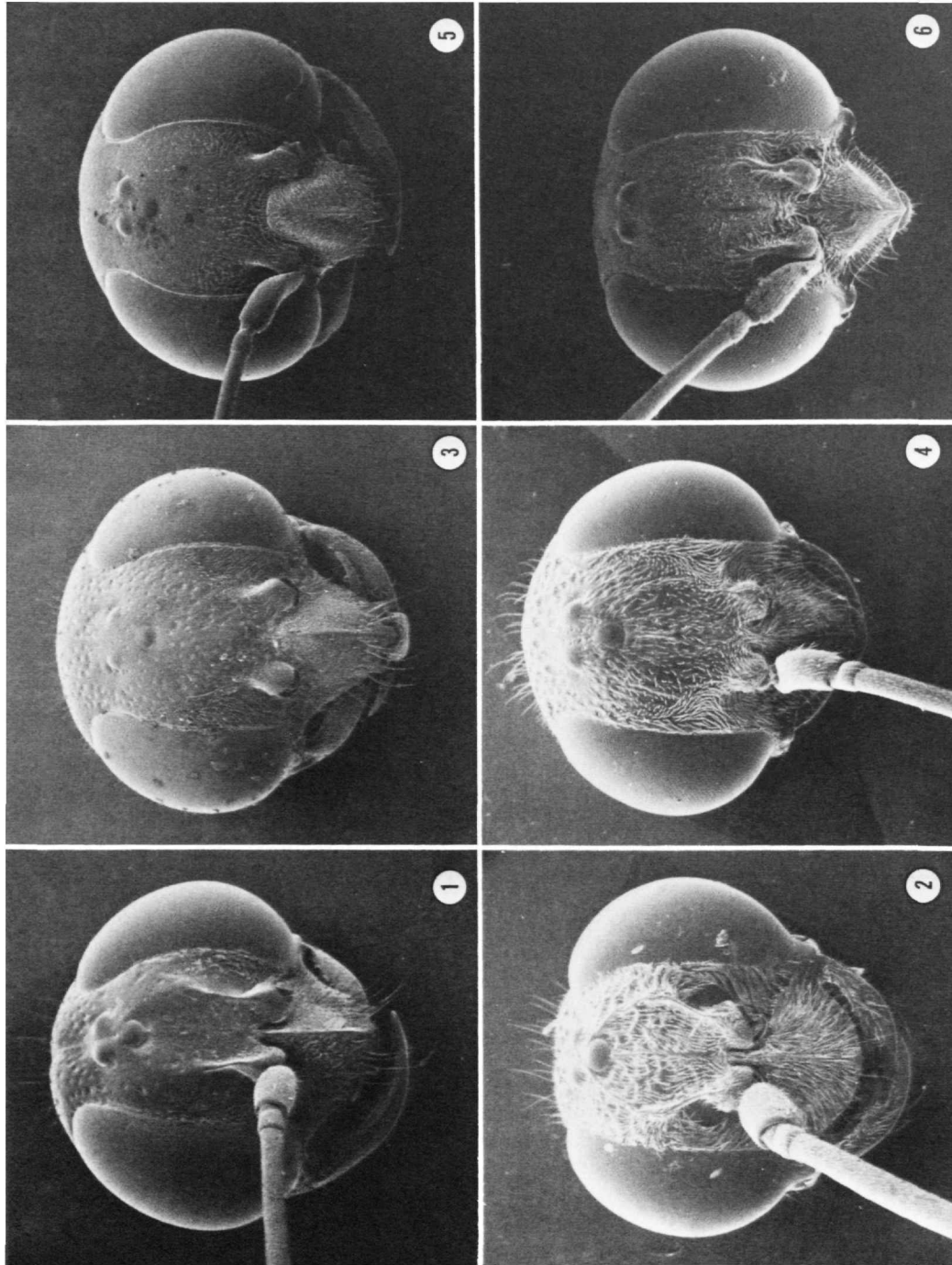
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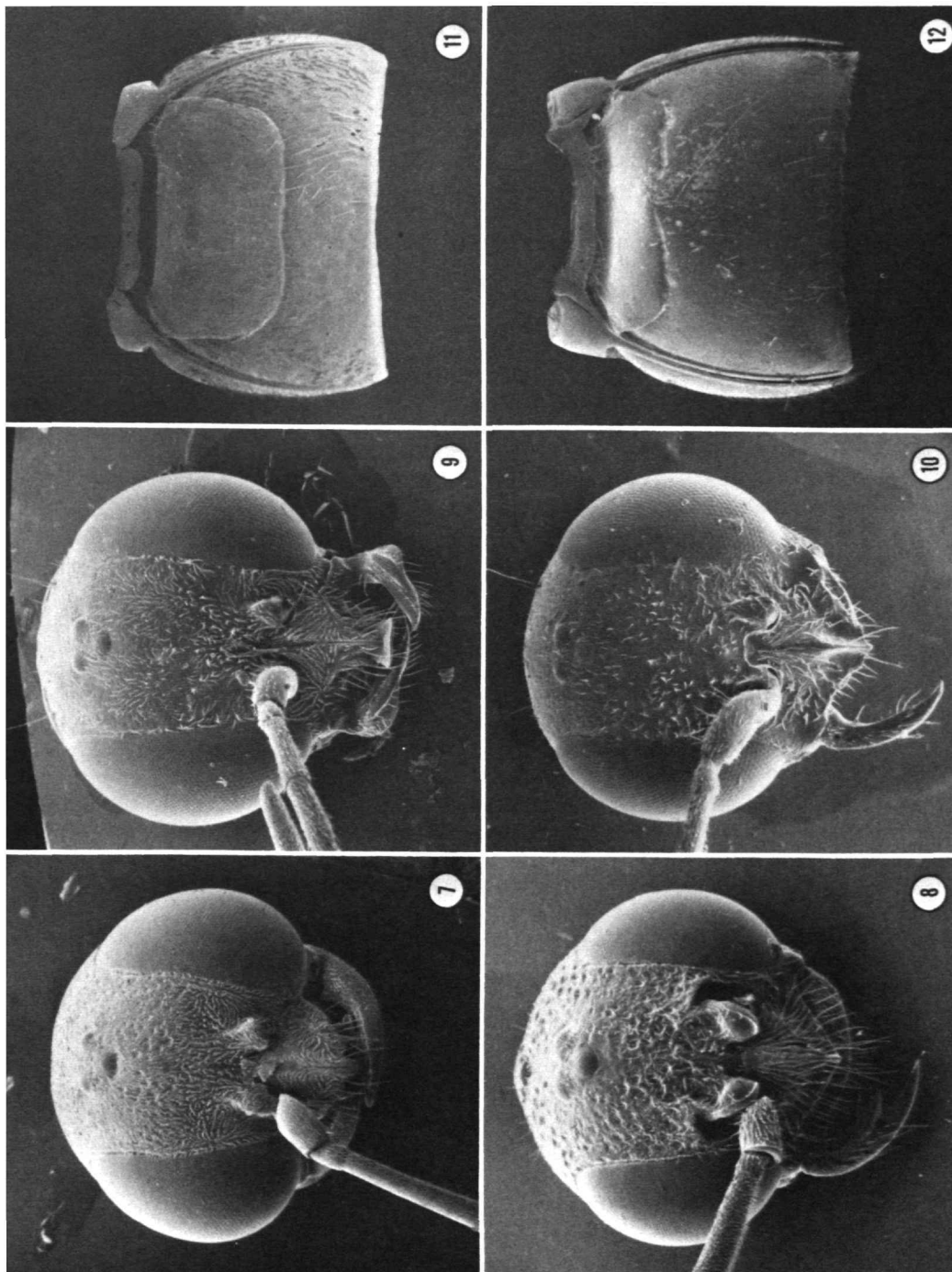
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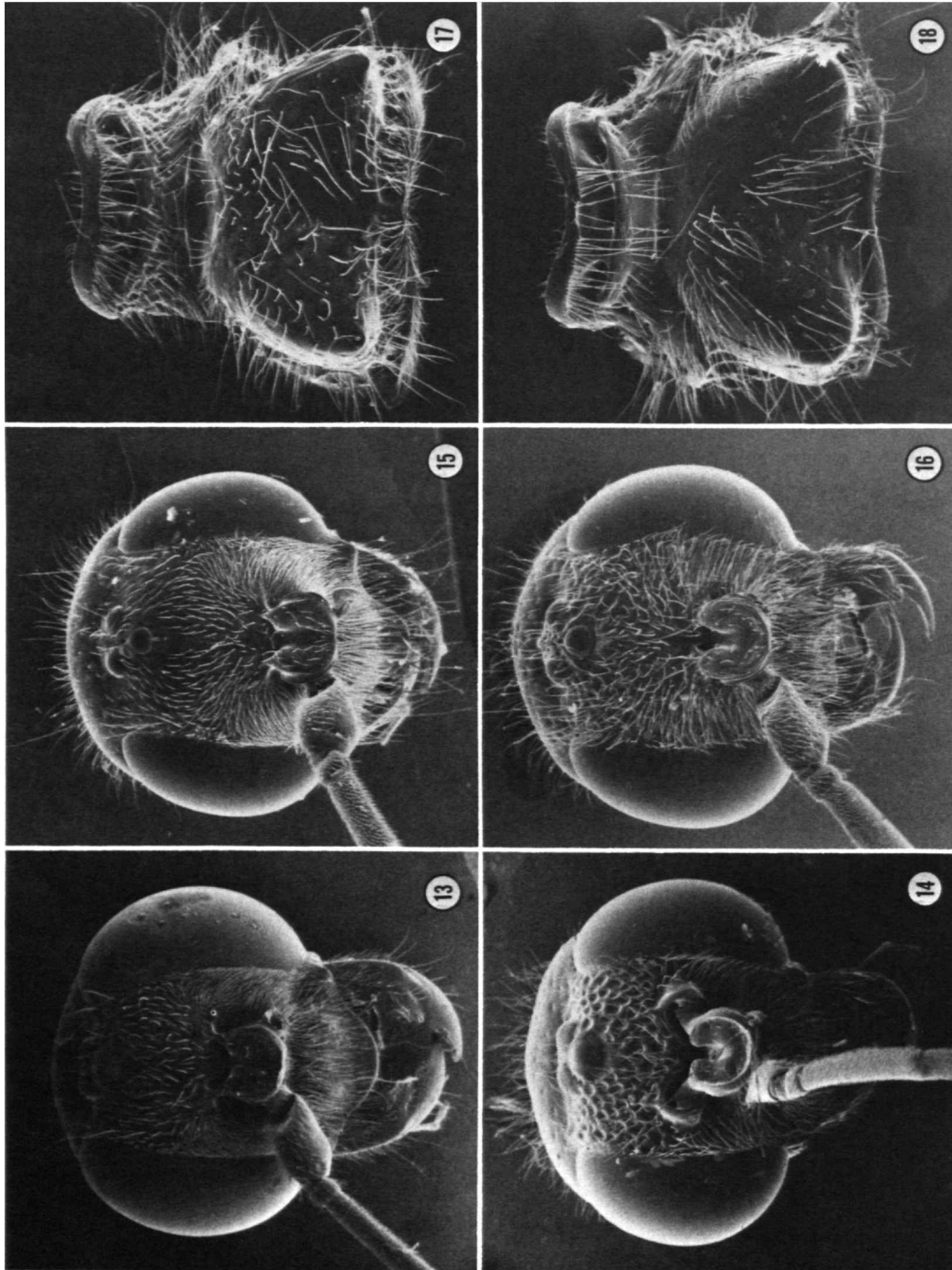


FIGURES 1-6.—Frontal view of *Ampulex* species: 1, ♀ *A. compressa* (Fabricius), ×17; 2, ♂ *A. compressa* (Fabricius), ×19; 3, ♀ *A. dissector* (Thunberg), ×19; 4, ♂ *A. dissector* (Thunberg), ×27; 5, ♀ *A. approximata* Turner, ×23; 6, ♂ *A. approximata* Turner, ×29.

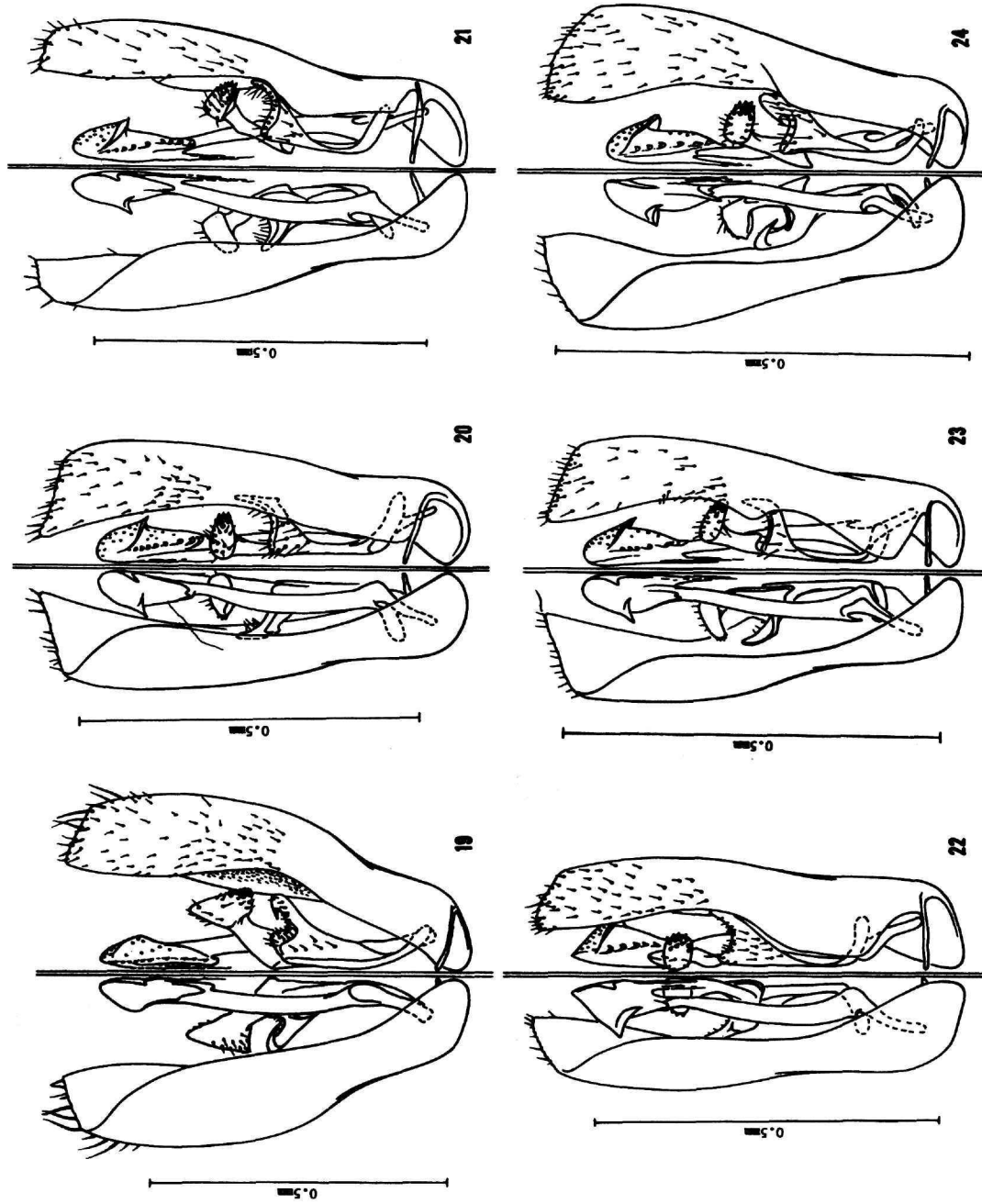




FIGURES 7-12.—Frontal view of *Ampulex* species: 7, ♀ *A. ceylonica*, new species, X26; 8, ♂ *A. ceylonica*, new species, X30; 9, ♀ *A. ruficornis* (Cameron), X35; 10, ♂ *A. ruficornis* (Cameron), X44. Second abdominal sternum, *Tritrogma* ♀ 9; 11, *T. regalis*, new species, X16; 12, *T. caerulea* Westwood, X18.



FIGURES 13-18.—Frontal view of *Trivogma* species: 13, ♀ *T. regalis*, new species, ×16; 14, ♂ *T. regalis*, new species, ×20; 15, ♀ *T. caerulea* Westwood, ×19; 16, *T. caerulea* Westwood, ×20. Dorsal aspect of pronotum, *Trivogma* ♂ ♂: 17, *T. regalis*, new species, ×37; 18, *T. caerulea* Westwood, ×32.



FIGURES 19-24.—Male genitalia of *Dolichurus* species, dorsal aspect at left, ventral aspect at right: 19, *D. laprobanae* Smith; 20, *D. lerkenis*, new species; 21, *D. situcola*, new species; 22, *D. albifacies*, new species; 23, *D. emamiensis* Touneki and Iida; 24, *D. aridulus*, new species.







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**Text-reference system** (author/year/page within the text, with the full reference in a "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all scientific series and is strongly recommended in the history and technology series: "(Jones, 1910:122)" or ". . . Jones (1910:122)."

**Bibliography**, depending upon use, is termed "References," "Selected References," or "Literature Cited." Spell out book, journal, and article titles, using initial caps in all major words. For capitalization of titles in foreign languages, follow the national practice of each language. Underline (for italics) book and journal titles. Use the colon-parentheses system for volume/number/page citations: "10(2):5-9." For alignment and arrangement of elements, follow the format of the series for which the manuscript is intended.

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**A few points of style:** (1) Do not use periods after such abbreviations as "mm, ft, yds, USNM, NNE, AM, BC." (2) Use hyphens in spelled-out fractions: "two-thirds." (3) Spell out numbers "one" through "nine" in expository text, but use numerals in all other cases if possible. (4) Use the metric system of measurement, where possible, instead of the English system. (5) Use the decimal system, where possible, in place of fractions. (6) Use day/month/year sequence for dates: "9 April 1976." (7) For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc.

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