

Biosystematic Studies
of Ceylonese Wasps, XIV:
A Revision of *Carinostigmus*
Tsuneki (Hymenoptera:
Sphecoidea: Pemphredonidae)

KARL V. KROMBEIN

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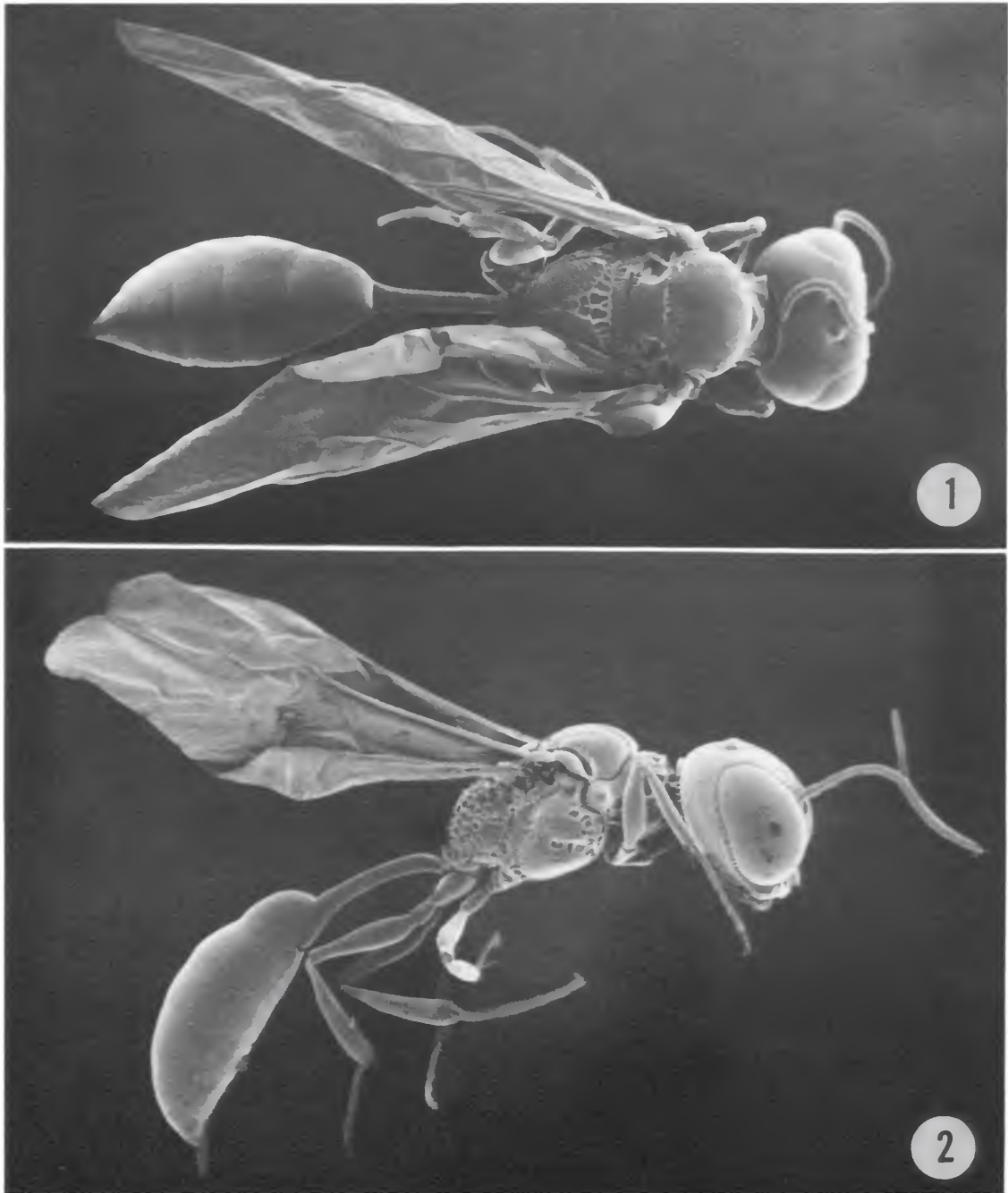
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FIGURES 1, 2.—*Carinostigmus (Carinostigmus) congruus* (Walker) (× 22): 1, female, dorsal view; 2, male, lateral view.

Biosystematic Studies of Ceylonese Wasps, XIV: A Revision of *Carinostigmus* Tsuneki (Hymenoptera: Sphecoidea: Pemphredonidae)

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Introduction

Wasps of the genus *Carinostigmus* have a characteristic habitus (Figures 1, 2) and are readily distinguished in the Ceylonese fauna. The combination of the small size (4.3–6.5 mm long), predominantly glossy black integument with conically produced white to ivory pronotal lobes, enlarged forewing stigma that is as long as the first submarginal cell (Figure 35), the usually slender elongate abdominal petiole (Figures 48–52) that is subequal in length to the hind femur or longer, and the presence of only two submarginal and two discoidal cells separate this genus from any other occurring in Sri Lanka.

Carinostigmus was proposed by Tsuneki (1954) as a subgenus of *Stigmus* Panzer. It was raised to generic rank by Bohart and Menke (1976:188) on the basis of the presence of a median ridge on the lower frons, the rather broad areolate groove and carina adjacent to the eye, absence of an acetabular carina anteriorly on the mesos-

ternum, and the media of the hindwing diverging beyond cubito-anal (cu-a) crossvein. *Stigmus* was distinguished by the absence of a frontal ridge, the eye margins simple or narrowly sulcate and rarely pitted, presence of an acetabular carina, and the media of the hindwing diverging before cu-a. All of these differentiating characters are found in what might be considered the typical members of each genus. The ocular grooves are not areolate in the Ceylonese *C. clypeolus*, new species, and *C. bucheilus*, new species, however, and they are narrower than usual in the latter species. Moreover, the acetabular carina is present in *C. bucheilus*. The frontal ridge is present in these two Ceylonese species, but it is weaker than in most *Carinostigmus* and lacks the normal projection near the middle (cf. Figures 18, 19). The females of all previously described species of *Carinostigmus* have the mandible tridentate at the apex and lack an acetabular carina anteriorly on the mesosternum. The unusual *C. bucheilus*, new species, however, has a bidentate mandible and an acetabular carina, and I am proposing the new subgenus *Perissostigmus* for it.

Species of *Carinostigmus* have been recorded principally from the Oriental and Ethiopian re-

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gions, but one has been described from Japan and another from Morocco. The previously known range in Africa is Ethiopia, Uganda, Zaire, Zimbabwe, South Africa, Lesotho, and Madagascar. In the Oriental Region the recorded range is Sri Lanka, India, Burma, Thailand, Sumatra, Hong Kong, China (Hainan), and Taiwan. In addition to these published records, I have seen specimens from Nigeria, Nepal, Malaya, Singapore, Laos, Cambodia, Vietnam, Borneo, Java, and the Philippines. Undoubtedly it occurs in other tropical countries in Africa south of the Sahara and in the Oriental Region. It may extend farther eastward in Indonesia but it is not known to occur in New Guinea, where extensive collections have been made.

The genus was presumably more widely distributed in Africa during the Pleistocene. It is possible that the Moroccan *C. marocensis* (Tsuneki) is a relict, stranded there by desertification of the Saharan area.

The preceding number in my series "Biosystematic Studies of Ceylonese Wasps" is "XIII: A Monograph of the Stizinae (Hymenoptera: Sphecoidea, Nyssonidae)," *Smithsonian Contributions to Zoology*, number 388, 37 pages, 30 figures, 1984.

ACKNOWLEDGMENTS.—My field work in Sri Lanka was funded by Smithsonian Research Foundation Grant SFG-0-6955, and travel was provided in part by grants from the Secretary's Fluid Research Funds.

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I am grateful to several specialists for sending information on specimens in collections under their care as follows: F. Koch, Zoologisches Museum, Berlin, East Germany, for information on the part of the Bingham collection in that institution; and Colin R. Vardy, British Museum (Natural History), for information on the syntypes of *Stigmus congruus* Walker.

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Finally, I am greatly indebted to my wife, Dorothy, for perceptive editorial comments.

Biology

Green (1903, 1908) was the first to publish brief accounts of the nesting of *Carinostigmus* under the name *Stigmus niger* Motschulsky. Green undoubtedly obtained his identification from Bingham, for the latter author based his interpretation of Motschulsky's species on material from Green. It is not at all certain that Green's notes are based entirely on *S. niger* or on both that species and *S. congruus* (Walker), which is far more common. What is certain, though, is that he described nests of *Carinostigmus* and not those of some other wasp. His nests are very similar to those of *C. monstrosus* Tsuneki described by Iwata (1964).

In Green's first note (1903) he stated that the female made her nest by excavating the soft pith from a grass stem, such as "mana grass" (*Andropogon nardus* Linnaeus), or in a slender, usually dead twig. The excavation was sometimes as much as 30 cm in length. Working from the bottom, the wasp made a series of cells provisioned with aphids; each cell was separated from the one below by a partition of pulped pith. The mature larva did not spin a cocoon, but transformed to a naked pupa. In a later paper (1908) he mentioned that *C. niger* nested in the pith of "stumped" *Hevea* rubber plants and provisioned the cells with aphids. The wasps used only the dead section of twig downward to the next node, and did not tunnel in the "living sappy stems."

Green's illustration of a seven-celled nest of *C. niger* (1903) shows a fully colored pupa in the first (lowest) cell, then a pale pupa in the next cell, a fully fed larva in the third, successively smaller larvae with some or many aphids in the next three cells, and finally just an egg in the bottom of the seventh cell. This suggests that provisioning of a single nest must continue during a rather lengthy period. This is very similar to the situation Iwata (1964:376-378, figures 36-38, 67) described for *C. monstrosus* Tsuneki

from Thailand. Those nests were in the dry pith of stems of a composite, *Eupatorium elephantus* (a nomen nudum), and were 8-14 cm long and 1.65 mm in diameter. The cells were 8-11 mm long and were separated by pith plugs 5-6 mm thick. Iwata said that the egg was laid in the bottom of the cell and that the aphids were provisioned progressively, thus creating a subsocial type of behavior. He also described a nest with cell occupants in various stages of development just as Green figured for *C. niger*. Lending additional credence to Iwata's theory of subsociality in *C. monstrosus*, he described a nest in which he found a worn female, presumably the mother, and her probable progeny consisting of two unworn females, four unworn males and a female pupa.

It is not certain whether Iwata's observations were made on *C. monstrosus*, or on *C. thailandinus* Tsuneki, or on both species. Tsuneki described both from Muang Fang where Iwata made his biological observations. The first species was described from a unique male and the latter from a unique female. The two are not synonymous, for I have seen both sexes of the two species from Thailand in the collection of the B.P. Bishop Museum.

I have seen two pairs of *C. congruus* in USNM intercepted in quarantine at Hoboken, New Jersey, 5 June 1950, in the flower stalk of an orchid, *Vanda* sp. The series consisted of a fully colored pair of newly emerged adults, a teneral male with the wings expanded but not hardened, and a nearly fully colored female pupa.

It is presumed that *C. congruus* preys upon aphids and nests in grasses or twigs with a soft pithy center as does *C. niger*. I found no nests, but I observed one female (12575 A) at 1100 hours on 25 January 1975 in the Badagamuwa Jungle, Kurunegala. She was visiting the leaf of an herbaceous plant, perhaps to feed on honeydew secretions of a colony of aphids. The latter, *Aphis gossypii* Glover, were located on the stem of the plant and were being tended by some *Oecophylla* ants for their honeydew secretions. It may be that the aphids also served as prey of this

female of *C. congruus*. A female in the British Museum from Bibile is labeled as having been collected "among aphids on orange tree."

Females of four of the Ceylonese *Carinostigmus*, *C. congruus*, and three new species, *C. clypeolus*, *C. griphus*, and *C. costatus*, have mandibles with three apical teeth that are well adapted to digging out the soft pith from plants or twigs in which they are known or presumed to nest. The female of the fifth species, *C. bucheilus*, new species, has only two apical teeth which suggests that its nesting habits may be different. This same variation in mandibular dentition is found in *Stigmus* in which females of the typical subgenus have tridentate mandibles and nest in soft pith or in abandoned tunnels of wood-boring insects. The female of *Stigmus* (*Atopostigmus*) *fulvipes*, Fox, however, has mandibles with only two teeth. It nests in the ground, presumably in abandoned tunnels of other ground-nesting wasps or bees. It lacks the modified fore tarsi associated with fossorial nesting (Krombein, 1967:218) and would be unable to dig its own nest.

At least one species of *Carinostigmus* nests in pre-existing cavities. Arnold (1924:41) reported that the African *C. gueinzius* (Turner) (as *Stigmus rugosifrons* Arnold) nested in straws of thatch in Rhodesia.

It is possible that the Sumatran *C. maior* (Maidl) nests in pre-existing cavities in wood, for Maidl (1925:379) noted that one female bore a label, "under rotten bark of *Erythrina lithosperma* Mig."

Iwata (1938:30–33, figure 5 [nest], plate 1, figure 5 [egg and prey]) published on the nest and prey of the Japanese *C. filippovi* (Gussakovskij). This species burrows in the soft pith of *Kerria japonica* (Linnaeus) and *Rubus palmatus* Thunberg, constructing a nest up to 0.5 m long. A linear series of as many as eight cells, 7.5–12.9 mm long and 2.3 mm wide, is constructed, the partitions between the cells consisting of a plug of pith chips, 1.0–6.0 mm thick. Unlike the Ceylonese and Thai species, this wasp practices mass provisioning. The wasp provides each cell with 19–49 nymphal and adult aphids, *Myzus* sp., *Agrioaphis kuricola* Matsumura, and *Amphorophora*

sp., and lays an egg 1.2–1.4 mm long, on one of the last prey brought into the cell.

I have collected both sexes of *C. congruus* and *C. costatus* visiting foliage of kenda, a euphorbiaceous shrub, *Macaranga digyna* (Roxburgh). Presumably they were visiting the foliage, attracted by the exudate from a pair of extrafloral nectaries on the upper surface of the cordate leaf near the attachment of the petiole on the lower surface. There were no aphids on the shrubs.

Genus *Carinostigmus* Tsuneki

Stigmus subgenus *Carinostigmus* Tsuneki, 1954:3.

Carinostigmus Tsuneki.—Bohart and Menke, 1976:41 [subgenus raised to generic rank].

Study of the five Ceylonese species and extensive material of other species from elsewhere in the Oriental Region demonstrates that some modifications are necessary in the generic diagnosis furnished by Bohart and Menke (1976:189). A revised diagnosis follows with changes indicated in italics, and comments in brackets. Figures cited are in this paper.

Mandible with two (male) or two to three (female) apical teeth (Figures 8, 14); labrum *variable in shape* (Figures 9–13), *usually narrow and subtriangular or subpentagonal, narrowly rounded at apex, sometimes broader and slightly rounded at apex*; face with shallow scapal basin, lower frons with median carina or ridge which may be produced *near middle* into a spine or T-shaped hook (Figure 18); clypeus *usually* without dense silvery hair; eyes broadly separated, sometimes converging a little below, especially in males; pitted *or not* and rather broad *to narrow* grooves along orbits (Figures 3–7); head well developed behind eyes (*female*) or *noticeably narrowed (male)* (Figures 15–17); occipital carina present, *adjacent groove weakly to strongly crenulate*, carina complete to midventral line of head and separated from hypostomal carina; *male flagellum beneath frequently with a row of longer curled setae* (Figure 28) [J.R. Walther states that these long curled setae are trichobothria, special sensitive tactile hairs (Figure 30)]; notauli developed but sometimes short, *crenulate or not*;

short, faintly impressed parapsidal lines present; omaulus present; no definitive episternal sulcus except below omaulus; acetabular carina and subomalus absent or present; pitted hypersternaulus present, extending obliquely posterad, sometimes joining pitted scrobal sulcus, latter usually present; female fore tarsus without a rake; hind tibia without a series of posterior spines; stigma large, about three times as long as high, covering considerably less area than marginal cell, a small rounded to oval fovea bearing a few setae near origin of radial vein (Figures 35–37); two submarginal cells; hind wing media diverging well beyond cuxa; petiole much longer than twice its diameter (Figures 48–52), in any case longer than hind coxa; female pygidial plate present, depressed, oval to teardrop-shaped in outline. [I have examined all genera of the Pemphredonidae (Pemphredoninae sensu Bohart and Menke) and find that this stigmal fovea occurs only in *Carinostigmus* Tsuneki and *Stigmus* Panzer, indicating the very close relationship between the two genera; the fovea is much larger, shallower and more setose in the latter genus (cf. Figures 32–37).]

Males may exhibit other secondary sexual

characters on the head in addition to the usual fringe of curled setae on the antennal flagellum, the more strongly narrowed head behind the eyes, and the bidentate mandibles. The palpi are usually very short, cylindrical in cross section, and do not extend beyond the posterior margin of the head. The maxillary palpi in *C. costatus*, new species, and in a new species from the Philippines, however, are broadened and flattened, very elongate, extending to the apex of the fore coxae, and bearing a fringe of long curled setae on the inner margin. The males of several undescribed Oriental species have dense setae on the head beneath which may be short and erect, or longer and curled. The male of the African *C. johannis* (Arnold) has long, dense curled setae on the outer surface of the mandible. In addition to long curled setae on the mandible, the male of an undescribed Philippine species has long, straight, dense, decumbent silvery hair on apical third of the clypeus. The males of several African species have from two to five of the basal flagellar segments dilated beneath near the middle. I have not noted any secondary sexual modifications on the legs.

Key to the Species of *Carinostigmus* Tsuneki*

1. Females [Figure 1]: antenna 12-segmented, flagellum beneath without fringe of short erect setae; abdomen with six exposed segments, sting usually protruding between sixth tergum and sternum; last tergum with small, oval depressed pygidium 2
- Males [Figure 2]: antenna 13-segmented, flagellar segments beneath with fringe of short erect, curved setae [Figure 28]; abdomen

* Males are unknown of *C. bucheilus*, new species, and *C. clypeolus*, new species. Females of these two species have a very weak median frontal carina lacking a projection near the middle, and a narrower groove along the inner eye margin. It is reasonable to assume that their males would have weaker, unarmed frontal carinae and a weaker ocular groove than males of *C. congruus* (Walker), *C. griphus*, new species, and *C. costatus*, new species. Considering the other characters of female *C. bucheilus*, it appears probable that the male will have an acetabular carina and subomalus anteriorly on the mesosternum, at least as many white markings on the head, predominantly testaceous to light reddish legs, and comparatively weak sculpture on the head. Characters of male *C. clypeolus* are more difficult to predict, but presumably it should have comparatively darker legs than males of other species, and weaker sculpture on the head and propodeum.

- with seven exposed segments, eighth sternum usually projecting as short blunt spine; last tergum convex, without differentiated apical area 6
2. Mandible with two teeth at apex [Figure 14]; face [Figure 7]; labrum very broad, apical margin broadly rounded; groove along inner eye margin narrow, crenulations evanescent; median lobe of clypeus broad and truncate, moderately produced, narrowly and semicircularly emarginate in middle [Figure 13]; clypeus laterally slightly produced into a blunt tooth; acetabular carina and subomalus present anteriorly on mesosternum; the following white: palpi, basal half of mandible, apex of labrum, underside of scape, and pronotal tubercle; the following testaceous or light reddish: underside of coxae, trochanters, fore and mid tibiae, and tarsi; male unknown
- 5. *Carinostigmus (Perissostigmus) bucheilus*, new species
- Mandible with three teeth at apex [Figure 8]; face [Figures 3–6]; labrum narrower [Figures 9–12], apical margin convex or narrowly rounded in middle, groove along inner eye margin wider, crenulate but weakly so in *C. clypeolus*, new species; median lobe of clypeus narrow but more strongly produced, clypeus without lateral tooth [Figures 9–11] or lobe broader and shallowly emarginate, and clypeus with a strong lateral tooth [Figure 12]; acetabular carina and subomalus lacking; only pronotal lobe white; coxae never testaceous 3
3. Face with median ridge weak, without projection near middle [Figure 19]; groove along inner eye margin weakly crenulate; labrum broader [Figure 12], its apical margin broadly rounded; propodeum [Figure 41] with large smooth area adjacent to enclosure and median groove; head beneath with scattered punctures and scarcely a trace of lateral carinae; abdominal petiole stouter [Figure 48], $\frac{1}{4}$ – $\frac{1}{5}$ as wide at middle as long, dorsal surface flattened and with lateral carina; male unknown
- 4. *Carinostigmus (Carinostigmus) clypeolus*, new species
- Face with median carina stronger and armed with an erect projection near middle [Figure 18], groove along inner eye margin strongly crenulate; labrum narrow [Figures 9–11], margin narrowly rounded in middle; propodeum [Figures 38–40, 42] either areolate and/or rugose adjacent to enclosure or with smaller smooth area; head beneath either entirely closely costate except narrowly in middle [Figure 21] or more densely punctate and with lateral carinae [Figures 20, 22]; abdominal petiole more slender [Figures 49–52], six to nine times as long as median width, dorsal surface gently rounded and with lateral carinae usually absent or only weakly developed 4
4. Underside of head [Figure 21] closely costate except small median area densely lineolate; labrum [Figure 11] narrowly rounded at

- apex, sides on apical half emarginate; pronotal crest emarginate in middle; propodeum [Figure 40] coarsely rugosoreticulate adjacent to enclosure and median groove; petiole stouter [Figure 51], about five times as long as median width, trochanters not testaceous 3. *Carinostigmus (Carinostigmus) costatus*, new species
- Underside of head [Figure 20] moderately densely punctate especially toward middle and usually with a few parallel carinae laterally; labrum [Figures 9, 10] more broadly rounded at apex; pronotal crest not emarginate in middle; propodeum [Figure 38] usually with small smooth area adjacent to enclosure, obliquely rugose anterolaterally, rugosoreticulate posteriorly; petiole more slender [Figures 49, 50], 7.5–8.5 times as long as width in middle; trochanters testaceous 5
5. Clypeus [Figure 9] glossy, median lobe more convex, narrower at apex, the width there 0.5–0.6 times distance between inner margins of antennal sockets; declivous surface of pronotum anterior to transverse ridge smooth or with only evanescent irregular rugulae; interocular distance at anterior ocellus 1.4 times that at antennal insertions. 1. *Carinostigmus (Carinostigmus) congruus* (Walker)
- Clypeus [Figure 10] delicately shagreened basally, median lobe not so convex, broader at apex, the width there 0.7–0.8 times distance between inner margins of antennal sockets; declivous surface of pronotum anterior to transverse ridge with vertical rugae; interocular distance at anterior ocellus 1.2–1.3 times that at antennal insertions. 2. *Carinostigmus (Carinostigmus) griphus*, new species
6. Maxillary palpi elongate, extending backward to apex of fore coxae, flattened and quite broad, sides fringed with long curled setae; underside of head closely costate except irregularly rugulose on small median area [cf. Figure 21]; pronotal crest emarginate in middle, lateral angles spicate viewed from above; trochanters black or dark brown 3. *Carinostigmus (Carinostigmus) costatus*, new species
- Maxillary palpi slender, short, not extending backward beyond head, not fringed with long curled setae; underside of head densely punctate except with parallel carinae laterally [Figures 24, 25]; pronotal crest not or only weakly emarginate in middle, lateral angles blunt viewed from above; trochanters testaceous 7
7. Viewed from above head not so strongly narrowed behind eyes [Figure 16], width at occiput half greatest width, occipital groove narrower and not so strongly crenulate; head beneath [Figure 24] with lateral rugae weaker or evanescent; median lobe of clypeus glossy, rarely delicately shagreened basally; pronotal ridge not emarginate in middle 1. *Carinostigmus (Carinostigmus) congruus* (Walker)
- Viewed from above head more strongly narrowed behind eyes [Fig-

ure 17], width at occiput 0.4 times greatest width, occipital groove broader and more strongly crenulate; head beneath [Figure 25] with stronger and more numerous lateral rugae; median lobe of clypeus strongly shagreened; pronotal ridge weakly emarginate in middle . . . 2. *Carinostigmus (Carinostigmus) griphus*, new species

Subgenus *Carinostigmus* Tsuneki

The typical subgenus has the characters mentioned above in the generic diagnosis except for the following: mandible with two (male) or two to three (female) teeth at apex; apical lobe of labrum narrower than least interocular distance, usually markedly so; and acetabular carina and submalus absent.

TYPE-SPECIES.—*Stigmus (Carinostigmus) congruus* Walker, by designation of Tsuneki (1954).

ETYMOLOGY.—The name is formed from the Latin *carina* (keel), presumably in allusion to the frontal carina, plus *Stigmus*, the name of a related genus. The gender is masculine.

1. *Carinostigmus (Carinostigmus) congruus* (Walker)

FIGURES 1–3, 8, 9, 15, 16, 18, 20, 24, 26, 28–31, 35–39, 44, 45, 49, 50

Stigmus congruus Walker, 1860:304, 305 [♀; Ceylon; syntypes in British Museum (Natural History)].—Walker in Tennent, 1861:454 [listed].—Kohl, 1890:63 [synonymized *S. niger* Motschulsky].—Dalla Torre, 1897:361 [listed *S. niger* as a synonym].—Bingham, 1897: 266, figure 74 [♀; Sikhim, Tenasserim, Ceylon].—Turner, 1917:174 [listed *S. niger* as a synonym].

Stigmus congruens [sic] Walker.—Motschulsky, 1863:23 [listed].—Bingham, 1896:447 [listed].

Stigmus niger Motschulsky, 1863:23 [sex not stated, but ♀; “des Montagnes de Nura-Ellia, Ceylan”; type in Zoological Museum, Moscow State University.]

Stigmus (Carinostigmus) congruus Walker.—Tsuneki, 1954:7–8 [♀; Tenasserim, Sikhim, India; republished Walker's and Bingham's descriptions of *S. congruus*].

Carinostigmus congruus (Walker).—Bohart and Menke, 1976:191 [Sri Lanka and South India; listed *S. niger* as a synonym].

Stigmus congruus Walker was one of the first sphecoid wasps to be described from Sri Lanka. I have studied the syntype series consisting of

three females and one male. Each bears a small, round, pale blue tag, blank on the upper side, and with “63/52” written on the lower side. C.R. Vardy advised me (in litt.) that 63/52 stands for accession 52 of 1863 (175 Coleoptera and 116 Hymenoptera from Ceylon) and includes type specimens described by Walker from 1858 through 1860. One female also is labeled “congruus” in script, perhaps in Walker's hand. It also has a small round tag with a green border bearing a printed “Type,” and a fourth label, “B.M.TYPE/HYM./21.879.” The four specimens are conspecific and agree with a species that is by far the most abundant at low altitudes in Sri Lanka. I have selected the specimen bearing the “congruus” label as the lectotype and have so labeled it.

Stigmus niger Motschulsky was described from the mountains of the Nuwara Eliya area. The material was collected by Nietner, a coffee planter and amateur coleopterist, whose home was at an altitude of 3880 ft (1183 m) (Nietner, 1859). The specimen labeled type is in deplorable condition, having been mostly destroyed, presumably by a dermestid beetle. Mounted on a card point are part of an antenna, several legs lacking some segments, and some small fragments of the thoracic sternum. Motschulsky did not mention the sex, but it is a female for the antenna does not bear the fringe of long curled setae beneath that are characteristic of the male. The trochanters are testaceous, rather than the coxae, as stated by Motschulsky; the fore tibia and tarsus are also testaceous. He gave the length as 2 lines (4.2 mm), smaller than any Ceylonese females that I have seen (the normal range is 4.5–6.0 mm long). The fore tibia of several female *C. congruus* is 0.6 mm long and the body length is 4.8–5.1 mm, giving a ratio of 8.0–8.5. Applying this ratio to the fore tibia of the type,

which is 0.5 mm long, one obtains a body length of 4.0–4.3 mm as compared to Motschulsky's measurement of 4.2 mm.

Associated with the type, and sent as "an additional specimen," is a headless female of *C. congruus* that has been attacked by mold. It bears a small label reading, "Ceyl," but no identification label. Motschulsky did not mention how many specimens were in his type series. This second female is 4.4 mm long without the head. That would make the entire length 5.0–5.1 mm. The coloration of the legs is like that of the type. I suspect that both specimens may have been collected around Nietner's home, and that the second female lacked a head when it reached Motschulsky. I exclude it as a possible syntype because of its size. Thus I believe that the two specimens are conspecific, and agree with Kohl's (1890) synonymizing of *S. niger* under *S. congruus*. Motschulsky (1863) mentioned the range in length when he had a series that showed this variation. For example, he stated that *Dolus opacicollis* Motschulsky was $1\frac{2}{5}$ – $1\frac{3}{4}$ lines (3.0–3.7 mm).

If it is maintained that the headless female is a syntype, it should be selected as the lectotype. The species will then be more certainly a synonym of *C. congruus*. There are only three species of *Carinostigmus* at higher altitudes in Sri Lanka, *C. clypeolus*, new species, *C. bucheilus*, new species, and *C. congruus*. The former can be eliminated at once; the trochanters are dark and the petiole is shorter and stouter than that of the headless female of *C. niger* (cf. Figures 48, 50). The female of *C. bucheilus* has the anterior part of the scutum with transverse to curved rugulae (Figure 42) that are lacking in the headless specimen of *C. niger* (cf. Figures 38, 39). This headless specimen agrees, moreover, with females of *C. congruus* that have the propodeum more coarsely sculptured adjacent to the enclosure and short longitudinal ridges posteriorly on the scutum (Figure 39).

The intriguing possibility exists that the type series of both *S. congruus* and *S. niger* were collected by Nietner. Walker (1860) did not men-

tion the collector of the 175 specimens of Coleoptera and 116 of Hymenoptera that he described from Sri Lanka. In his catalog of Ceylonese insects Motschulsky (1863) described many small Coleoptera, Hymenoptera, and representatives of other orders, as having been collected by Nietner. Nietner (1859:24) stated that he sent Ceylonese insects to various entomologists in Europe; he specifically mentioned a group of small insects he sent to Motschulsky. Although Nietner did not include Walker's name among the recipients of these collections, it seems almost incredible that there could have been two collectors of small Hymenoptera and Coleoptera in Sri Lanka during the late 1850s.

It is clear from Bingham's descriptive remarks (1897) that he had two species of *Carinostigmus*. Presumably he used Walker's type in his interpretation of *C. congruus*, although he recorded material from Sikhim and Tenasserim also. He based his description of *C. niger* on a specimen from Pundaluoya collected by Green. Pundaluoya is in the hill country near Nuwara Eliya (the type-locality of *C. niger*), but at a higher altitude of about 1285 m with surrounding hills to 1465 m. I have six females that agree very well, especially in the conformation of the clypeus (Figure 12), with Bingham's description of *C. niger*. They come from four localities ranging in altitude from 365 to 1770 m, and they are described below as *C. clypeolus*.

Convinced by the characters used by Bingham to separate *C. congruus* and *C. niger*, Kohl later recognized them as discrete species although he never published this conclusion. There are two males of *C. congruus* in the British Museum (Natural History) that were transferred from the Federated Malay States Museum in 1955. They are glued on a single card and were collected at Peradeniya, Ceylon, 30 Dec 1901 by Uzel. One label on the pin is "St. niger/Motsch./det. Kohl;" the "St. niger Motsch." is in Kohl's handwriting and the "det. Kohl" is printed.

Carinostigmus congruus exhibits considerable infraspecific variation in the development of body sculpture. For example, the scutum posteriorly

may be smooth or may have short longitudinal ridges (Figures 38, 39); the propodeum may be mostly smooth adjacent to the enclosure or rugulose to rugulosoreticulate (Figures 38, 39); and the abdominal petiole may be smooth or may have one or two weak lateral carinae (Figures 49, 50). These and other variations, such as in coloration, are noted in the descriptions that follow.

The species is extremely close to, if not identical with, *C. iwatai* (Tsuneki) from Hong Kong, China, and Taiwan, and *C. thailandinus* (Tsuneki) from Thailand. Additional associated males of those populations must be obtained before a decision may be made as to possible synonymy.

Carinostigmus congruus is more similar to *C. griphus* than to any of the other Ceylonese species. The male of *C. congruus* usually has the median clypeal lobe glossy rather than strongly shagreened as in *C. griphus*, in having the head less strongly narrowed behind the eyes (cf. Figures 16, 17) (occipital width 0.5 rather than 0.4 times head width), in having a narrower, less strongly crenulate occipital groove, and in having weaker lateral rugae on the venter of the head (cf. Figures 24, 25). The female is separated from that of *C. griphus* with considerable difficulty. The median lobe of the clypeus (cf. Figures 9, 10) is more convex, glossy rather than usually delicately shagreened at the base, and has a narrower apical margin. The declivous surface of the pronotum anterior to the transverse ridge is smooth or has evanescent irregular rugulae rather than vertical rugae, and the ratio of the interocular distance at the anterior ocellus to that at antennal insertions is slightly greater.

The female of *C. congruus* is distinguished at once from those of *C. clypeolus* and *C. bucheilus* by having a stronger frontal ridge with a projection near the middle (cf. Figures 18, 19). The female also has a narrower labrum and clypeal lobe than in those species. Both sexes of *C. congruus* differ from those of *C. costatus*, new species, in having the venter of the head with a larger median delicately punctured area with only a few rugae laterally (Figures 20, 24), rather than having a smaller lineolate or rugulose area medially

and many strong parallel costae adjacent to the punctate area (Figure 21). The trochanters are always testaceous in *C. congruus*, as well as additional parts of the legs, whereas the trochanters in *C. costatus* are dark and the rest of the legs have fewer parts testaceous. The pronotal crest is weaker than in *C. costatus* and does not have a median emargination. Finally, the male has short filiform maxillary palpi rather than elongate, flattened and broadened palpi fringed on the inner side by long curled setae as in *C. costatus*.

The present species is widely distributed in both the Wet Zone and the Dry Zone, but it has not been collected in a number of the most xeric areas of the Dry Zone, and is most common in areas with an average annual rainfall of 1100–3900 mm. We collected only one specimen at Palatupana Tank, an area we visited on nine trips, where the average annual rainfall is only 860 mm. *Carinostigmus congruus* occurs from near sea level to an altitude of at least 1830 m. It is found also in India and Nepal and may range more widely.

This is an extremely abundant species at lower altitudes in all but the more marginal xeric habitats. We collected nearly 450 specimens of *Carinostigmus* during the active years in the field of the Smithsonian Ceylon Insect Project (1970–1981), and only 37 of them belonged to the other four species known to occur in Sri Lanka. Dates of capture at such localities as Kandy, Labugama, Weddagala and Gilimale, suggest that *C. congruus* breeds throughout the year under favorable conditions.

FEMALE.—Length 4.5–6.0 mm. Black, glossy, vertical aspect of face dull from delicate shagreening, pronotal lobe white to ivory, mandible except base and apex, and labrum light red, the following testaceous: palpi, scape usually entirely but sometimes infuscated above, part or most of underside of flagellum, tegula, trochanters, at least underside of fore and mid tibiae, and also tarsi usually; fore and mid tibiae rarely dark brown, and apices of tarsi, fore femur beneath rarely, and hind tarsi rarely infuscated. Wings clear, stigma black, veins dark brown.

Head in frontal view (Figure 3); eyes diverging above, interocular distance at anterior ocellus 1.4 times that at antennal insertions; viewed from above head moderately narrowed behind eyes, width at occiput half the greatest width (Figure 15); clypeus (Figure 9) more convex in middle than in *C. griphus*, median lobe narrower, strongly produced, apex slightly emarginate, margin laterad of lobe gently incurved; labrum narrow, pentagonal, sides straight near apex; frontal ridge strong (Figure 18), present only on vertical surface of front, near middle with a T-shaped projection; ocular groove crenulate and moderately broad along vertical section of inner eye margin; vertical surface of face delicately shagreened, occasionally more roughened or with very short oblique rugulae adjacent to ocular groove; horizontal surface of front and vertex with sparse, tiny punctures, shallow groove before anterior ocellus evanescent or absent; occipital groove narrow, smooth, not crenulate; underside of head with a few weak rugae laterally which are occasionally evanescent, a large median area with small, moderately close punctures.

Thorax in dorsal (Figures 38, 39) and lateral (Figures 44, 45) views; anterior pronotal ridge weaker than in *C. costatus*, not emarginate in middle, lateral angles not so strong, declivous slope before ridge smooth or with irregular evanescent rugulae; notauli strongly impressed, crenulate, parapsidal lines weakly impressed; scutum with punctures stronger and denser than on head, posteriorly with short, well-developed ridges varying to almost without ridges; scutellum anteriorly with narrow crenulate groove, discally with a few scattered small punctures and occasionally a faint impressed median line; metanotum smooth in middle, irregularly rugulose laterally; stigmal fovea small, circular; propodeal enclosure with radiating rugae on basal section, elsewhere rugosoreticulate; area adjacent to enclosure varying from mostly obliquely rugose with a small smooth area posteriorly to obliquely rugose only anterolaterally and with a larger smooth area posteriorly (Figures 38, 39); posterior surface below enclosure irregularly ru-

gosoreticulate; lateral surface obliquely rugulose.

Abdominal petiole (Figures 48, 49) slender, 7.5–8.0 times as long as median width, laterally ecarinate or with a few weak carinae; pygidium depressed, oval, delicately shagreened.

MALE.—Length 4.3–5.3 mm. Black, glossy except vertical surface of face, and clypeus rarely slightly dull from shagreening on base, pronotal lobe white or ivory; specimens with the fewest testaceous areas have the following so colored: palpi, mandible except base and apex, underside of scape and pedicel, tegula, underside of coxae beneath, trochanters, underside of fore femur at base, fore and mid tibiae, and tarsi; specimens with the most testaceous areas have the following so colored: palpi, mandible except base and apex, scape and pedicel entirely, underside of flagellum, tegula, underside of coxae, trochanters, fore and mid femora, tibiae and tarsi, and base of hind tibia; some of apical abdominal sterna light brown in a few specimens. Wings clear, stigma black, veins dark brown.

Head from above (Figure 16) more strongly narrowed behind eyes than in female, width at occiput half greatest width; eyes diverging above more strongly than in female (cf. Figures 3, 26), interocular distance at anterior ocellus 1.8 times that at antennal insertions; clypeus usually glossy, sometimes delicately shagreened on base, clypeal lobe shaped as in female except surface flatter, not so convex; labrum variable in shape, sometimes subpentagonal, sometimes with apical margin subtruncate and broader; frontal ridge strong, present only on vertical surface, projection near middle weaker than in female; ocular groove as in female; vertical surface of face shagreened, weakly, obliquely to transversely wrinkled in part; upper horizontal section of front and vertex sculptured as in female; first four flagellar segments subequal in length; occipital groove narrower and more weakly crenulate than in *C. griphus*; underside of head as in female, the lateral rugae well developed or evanescent (Figure 24).

Thorax similar in sculpture to that of female and similarly variable in comparative strength

and extent of ridges and rugosoreticulations.

Abdominal petiole 6.9–8.3 times as long as median width, similar to that of female in presence or absence of weak carinae laterally; seventh tergum with lateral brush of hairs shorter than in *C. costatus*.

SPECIMENS EXAMINED (all collected by Krombein et al., USNM, except when specified otherwise).—**NORTH CENTRAL PROVINCE.** *Anuradhapura District:* 1♀, 2♂, Padaviya (including archeological site), 180 ft (55 m), 16–19 May (2♂) and 11–14 Oct (♀); 5♀, 8♂, Ritigala Natural Reserve, 24–25 Feb (5♀, 7♂) and 19 Sep (♂); 1♂, Mihintale, scrub forest, 20 Sep, Chandler (London).

EASTERN PROVINCE. *Trincomalee District:* 4♀, 1♂, China Bay Ridge Bungalow, 25–50 ft (8–15 m) and 0–100 ft (0–31 m), 26 Feb (4♀) and 13–17 May (♂). *Amparai District:* 1♀, 1♂, Lahugala Sanctuary, 13–15 Jun; 2♀, Ekgal Aru Sanctuary Jungle, 100 m, 19–22 Feb and 12 Jun; 1♀, Inginiyagala, 10 Jun.

CENTRAL PROVINCE. *Matale District:* 1♀, 2♂, Kibissa jungle, 0.5 mi (805 m) W Sigiriya, 1–3 Mar (♂) in Malaise trap and 28 Jun–4 Jul (♀, ♂) in Malaise trap. *Kandy District:* 1♀, Teldeniya, Bambaragala Rock, 10 May (P.B. Karunaratne et al.); 1♂, Woodside, Urugala, 16 Sep (Henry, Colombo); 28♀, 8♂, Thawalamtenne, 2200 ft or 740–760 m, 12–13 Mar (4♀, 3♂), 21 Mar (♀, ♂) 25 Mar (♀), 4 Sep (4♀, ♂), 7–8 Sep (10♀, 3♂), 16–18 Sep (8♀); 109♀, 18♂, Kandy (includes Udawattakele Sanctuary, 1800–2100 ft (549–640 m), Reservoir Jungle, Roseneath), 10 Jan (4♀, 4♂), 18–21 Jan (♀), 8–11 Feb (28♀), 9–13 Feb (12♀, 2♂), 10 Feb (2♀), 4 Mar (♀), 25 Mar (♀, Spangler et al.), 26–30 Mar (3♀), Mar (♀, Krauss), 25–27 Apr (4♀), 8–11 May (3♀), 29–30 May (5♀), 3–5 Jun (♀), 5–15 Jul (6♀, S. Karunaratne), 20–30 Jul (9♀, 2♂, S. Karunaratne), 26–30 Jul (5♀, 5♂), 16–31 Aug (♀, S. Karunaratne), Aug (♀, Krauss), 1–3 Sep (14♀, 2♂), 8–10 Sep (2♀), 21–22 Sep (3♀), 1–3 Oct (♂ in black light trap), 27–28 Oct (♂, S. Karunaratne), Oct (♀, Krauss), 29 Nov (♀, Henry, Colombo); 3♀, 4♂, Peradeniya, Mahaweli River, 5 mi (8 km) SW Kandy, 22–24 Feb (2♀, ♂, Stubbs et al., London), 15 Mar (♀, ♂,

Brinck et al., Lund), 30 Dec (2♂, Uzel, London); 3♀, 10 km W Kandy, 25 Feb (Sedlacek et al., Honolulu). *Nuwara Eliya District:* 1♀, Hakgala Botanical Gardens, 6000 ft (1829 m), 6–8 Oct (Hevel et al.); 2♀, 1♂, Diyagama West, 8 mi (12.9 km) S Nuwara Eliya, at 4800 ft (1463 m), 19 Mar (Brinck et al., Lund).

NORTH WESTERN PROVINCE. *Kurunegala District:* 8♀, 8♂, Kurunegala, Badagamuwa Jungle, 24–27 Jan (4♀), 25 Jan (♀, 12575A), 20 Sep (3♀, 8♂); 1♀, 1♂, Kurunegala, 25–26 Jan.

WESTERN PROVINCE. *Colombo District:* 9♀, 2♂, Labugama Reservoir Jungle, 24 mi (39 km) ESE Colombo, 400 ft (122 m), 21 Jan (2♀, 2♂, Brinck et al., Lund), 2–4 Feb (3♀), 16 Feb (♀), 9 May (♀), 2–3 Oct (1♀, Hevel et al.), 13–14 Oct (♀); 2♀, Godagama, 25 Oct (Robinson et al.); 1♀, Padukka, Arakawila Jungle, 26 Nov (P. B. Karunaratne); 6♀, 3♂, Colombo (includes Museum Gardens), 11–12 Feb (♀, Stubbs et al., London), 24 Mar (♂, Henry, Colombo), 16 Apr (♀, Halstead, San Francisco), 24–28 Apr (♀, P.B. Karunaratne), 2 Jul (♀, P.B. Karunaratne, Ottawa), 7 Jul (♂, Wijesinhe), 14 Aug (♂, Colombo), 5 Sep (♀, P.B. Karunaratne, Ottawa), 22 Sep (♀, Henry, Colombo); 3♂, Mirigama Scout Camp, primary jungle, 8–9 Jul; 6♀, 10♂, Gampaha Botanical Garden, 14 Jan (♀, 6♂), 28 Jan (2♂), 4 Mar (2♂), 8 Sep (4♀), 27 Sep (♀); 1♀, Kohuwala, 4 Oct (P.B. Karunaratne, Ottawa); 1♀, Narahenpitiya District Agricultural Extension Office, 22 Jul (Halstead, San Francisco); 1♂, Boralessgomuwa, 17 Feb (Stubbs et al., London). *Kalutara District:* 5♂, Alutgama, 16 Feb (4♂, Stubbs et al., London), 3 Mar (♂, in mangrove swamp, Chandler, London).

SABARAGAMUWA PROVINCE. *Kegalla District:* 5♀, Kitulgala, Bandarakele, 180–210 m, 3–4 Feb (3♀), 25–26 Oct (2♀). *Ratnapura District:* 2♀, Uggalkaltota, 23–26 Jun; 1♀, 3♂, Ratnapura, Pompakele, 25 Mar (2♂), 10 Oct (♀, ♂); 1♀, Panamure, 500 ft (154 m), 15–21 Oct (Flint et al.); 2♂, Belihuloya Resthouse, 10–11 Apr (Hubbard et al.); 1♀, 4♂, Kuruwita, Eratne, Adams Peak Trail, 1 in Malaise trap, 1 Feb; 3♀, 6♂, Sinharaja Jungle, 1♀ in Malaise trap, 8–9 Sep (P.B. Karunaratne et al.); 22♀, 36♂, 2–3 mi (3–5

km) S Weddagala, Sinharaja Jungle, 250–490 m, 10♀, 20♂ on foliage of *Macaranga digyna*, 8–12 Feb (11♀, 17♂), 13–15 Mar (♀), 18–21 Jun (5♀, 13♂), 22–23 Sep (5♀, 6♂); 17♀, 8♂, Gilimale, Induruwa Jungle, 6 mi (10 km) NE Raptnapura, 115–300 ft (35–91 m), 3♀ in Malaise trap, 2 Feb (3♀, 2♂), 5–7 Feb (♂), 20 Feb (♂, Brinck et al., Lund), 7–8 Mar (6♀, 2♂), 13–15 Mar (♀, ♂), 26 Mar (2♀), 3 Apr (♀, ♂), 16–19 Apr (♀), 17 Jun (♀), 10 Oct (♀), 22–24 Oct (♀); 2♀, 1♂, Bulutota Pass, 2 mi (3 km) SE Rakwana, 28 Feb (Brinck et al., Lund).

UVA PROVINCE. *Badulla District*: 1♀, Beauvais, 5 mi (8 km) WNW Haputale, 4500 ft (1372 m), 3 Mar (Brinck et al., Lund); 1♀, Heda Oya, 29 mi (47 km) SE Bibile, 7 Mar (Brinck et al., Lund); 1♀, Egodapitiya Nilgala, 1–13 Jul (P.B. Karunaratne et al., San Francisco); 1♀, Bibile, Agricultural Research Station, 21 Aug, among aphids on orange tree, Winney (London). *Monaragala District*: 1♀, Wellawaya, 10 Aug; 1♀, 6♂, Mau Aru, 12 mi (19 km) E Uda Walawe, 17–19 Jun (♀, 5♂), 24–26 Sep (♂); 13♀, 21♂, Angunakolapelessa, 100 m, 4♀, ♂ in Malaise trap, 21–23 Jan (7♀, 9♂), 27–28 Mar (2♀), 17–19 Jun (2♀, 6♂), 30 Sep–1 Oct (6♂), 8–9 Oct (2♀).

SOUTHERN PROVINCE. *Galle District*: 8♀, 6♂, Sinharaja Jungle, Kanneliya section, 400 ft (122 m), 11–16 Jan (2♀, ♂), 13–16 Jul (♀), 2–5 Oct (3♀, 2♂), 6–13 Oct (2♀, 3♂); 1♀, Udugama, 14 Feb (Stubbs et al., London). *Matara District*: 1♂, Enselwatte, ca. 1500 ft (457 m), 19–20 Oct (Hevel et al.). *Hambantota District*: 1♀, Palatupana Tank, 21–22 Jun, in Malaise trap.

MISCELLANEOUS. 3♀, 1♂, no locality label (London; syntype series of *S. congruus* Walker); 2♀, Ceylon (Moscow; syntype series of *S. niger* Motshulsky); 6♀ (London); Ceylon, Thwaites, accession 1867-25 (London); 1♂, no label (Colombo).

2. *Carinostigmus (Carinostigmus) griphus*, new species

FIGURES 4, 10, 17, 25, 27

This rare species is clearly most closely related to *C. congruus* (Walker). The male is more easily

distinguished by having the median lobe of the clypeus strongly shagreened rather than being usually glossy, in having the head more strongly narrowed behind the eyes (cf. Figures 16, 17) (occipital width 0.4 rather than 0.5 times head width), in having a broader, more strongly crenulate occipital groove, and in having stronger lateral rugae on the venter of the head (cf. Figures 24, 25).

The female is distinguished from that of *C. congruus* with more difficulty. The median lobe of the clypeus (cf. Figures 9, 10) is less convex, is very delicately shagreened basally rather than glossy, and has a broader apical margin. Also, the declivous surface of the pronotum anterior to the transverse ridge has vertical rugae rather than being smooth or with only evanescent irregular rugulae, and the ratio of the interocular distance at the anterior ocellus to that at antennal insertions is slightly less.

Carinostigmus griphus has a more restricted distribution than *C. congruus*. It is known from a short series from several localities in the Wet Zone at altitudes of not more than 120 m and with average annual rainfall of more than 2500 mm.

ETYMOLOGY.—The specific name is the Latin *griphus* (puzzle).

HOLOTYPE.—♂; Sri Lanka, Southern Province, Galle District, Kanneliya section, Sinharaja Jungle, 2–5 Oct 1980, K.V. Krombein, P.B. Karunaratne, T. Wijesinhe, L. Jayawickrema, V. Gunawardane (USNM Type 101120).

MALE.—Length 4.9 mm. Black, glossy except clypeus and vertical surface of face, pronotal lobe white, the following testaceous: palpi, mandible except extreme base and apex, labrum, scape and pedicel beneath, tegula, trochanters, fore tibia beneath, and fore and mid tarsi; the following light to medium brown: flagellum beneath, femora and mid and hind tibiae, fore tibia above, and hind tarsus. Wings clear except forewing slightly infumated beyond veins, stigma black, veins dark brown.

Head in frontal view (Figure 27); eyes diverging above, interocular distance at anterior ocellus 1.7 times that at antennal insertions; viewed from

above head more strongly narrowed behind eyes than in *C. congruus* (cf. Figures 16, 17), width at occiput 0.4 times greatest width; clypeus more strongly shagreened than in *C. congruus*, moderately convex in middle, apex of median lobe shallowly and broadly emarginate; labrum subrectangular, apical margin slightly rounded out; frontal ridge strong, extending almost to anterior ocellus and very weak on horizontal section, projection near middle present, but relatively weak as in *C. congruus*; ocular groove crenulate and moderately broad along vertical section of inner eye margin; vertical surface of front roughened, delicately obliquely carinate; horizontal surface of front and vertex with tiny scattered punctures, area immediately in front of occiput with traces of a few transverse ridges; broad, very shallow groove before anterior ocellus; first four flagellar segments subequal in length; occipital groove broader than in *C. congruus*, strongly crenulate; head beneath (Figure 25) with small close punctures on median area, laterally with a few ridges.

Anterior pronotal ridge weaker as in *C. congruus* but with a slight emargination in middle, lateral angles as in that species, not so strong as in *C. costatus*; notauli strongly impressed, crenulate, parapsidal lines better developed than in *C. congruus*; scutum with punctures stronger and denser than on head, posteriorly with strong ridges on apical sixth; scutellum anteriorly with narrow crenulate groove, discally with few scattered small punctures and median groove on basal two-thirds; metanotum smooth in middle, irregularly rugulose laterally; stigmal fovea small, circular; propodeal enclosure with radiating rugae on basal section, elsewhere rugosoreticulate; area adjacent to enclosure obliquely rugulose on horizontal section, posteriorly irregularly rugosoreticulate; lateral propodeal surface with delicate oblique rugulae.

Abdominal petiole slender, elongate, cylindrical in cross section, nine times as long as median width, ecarinate; seventh tergum with lateral brush of hairs shorter than in *C. costatus*.

ALLOTYPE.—Sri Lanka, Sabaragamuwa Province, Ratnapura District, Gilimale, Induruwa

Jungle, 13–15 Mar 1979, K.V. Krombein, T. Wijesinhe, S. Siriwardane, L. Jayawickrema (USNM).

FEMALE.—Length 5.4 mm. Black, glossy, except base of clypeus delicately shagreened and vertical surface of face dull from coarser shagreening, pronotal lobe white, the following testaceous: palpi, under side of scape at apex, underside of pedicel and first two flagellar segments, trochanters, and fore tarsi; the following brown: middle of mandible, labrum, underside of scape at base, tegula, fore tibia, mid tarsi, and middle of hind tarsi. Wings slightly infumated on apical third, stigma black, veins brown.

Head in frontal view (Figure 4), eyes diverging above, interocular distance at anterior ocellus 1.3 times that at antennal insertions; head viewed from above moderately narrowed behind eyes, width at occiput half the greatest width; clypeus (Figure 10) with median lobe not quite so narrow nor convex as in *C. congruus*, apical width 0.7 times distance between inner margins of antennal insertions, margin laterad of lobe gently incurved; labrum narrow, subpentagonal, sides straight near apex; frontal ridge strong, near middle with narrow blunt projection; ocular groove crenulate and moderately broad along vertical section of inner eye margin; vertical surface of front slightly more coarsely shagreened than in *C. congruus*, with some oblique rugulae laterally adjacent to ocular groove; horizontal surface of front and vertex with sparse tiny punctures, shallow groove before anterior ocellus weak; occipital groove narrow, smooth; underside of head with a few stronger rugae laterally than in most *C. congruus*, a large median area with small, moderately close punctures.

Anterior pronotal ridge weaker than in *C. costatus*, not emarginate in middle, lateral angles more prominent than in *C. congruus*, declivous slope anterior to ridge with vertical rugae; notauli strongly impressed, crenulate, parapsidal lines weakly impressed; scutum with punctures stronger and denser than on head, posteriorly with short, strong ridges; scutellum anteriorly with narrow crenulate groove, discally with a few scattered punctures and a faint median impressed

line; metanotum smooth in middle, irregularly rugulose laterally; stigmal fovea small, oval; propodeal enclosure with radiating rugae on basal section, elsewhere rugosoreticulate; area adjacent to enclosure with radiating rugae on horizontal section; posterior propodeal surface with a small smooth area above adjacent to enclosure, elsewhere irregularly rugosoreticulate; lateral surface obliquely rugulose.

Abdominal petiole slender, 7.5 times as long as median width, ecarinate; pygidium depressed, oval, delicately shagreened.

PARATYPES (all USNM except when specified otherwise).—2♀, same locality as holotype, 1 in Malaise trap, 11–16 Jan 1975, K.V. Krombein, P.B. Karunaratne, P. Fernando, N.V.T.A. Weragoda. 1♂, 4♀, WESTERN PROVINCE, *Colombo District*, Labugama Reservoir Jungle, as follows: 2♀, 18 Feb, 1 by P.J. Chandler, 1 by A.E. Stubbs, P.J. Chandler (London); 2♀, 400 ft (122 m), 2–3 Oct and 1 Dec 1976, G.F. Hevel, R.E. Dietz, IV, P.B. and S. Karunaratne, D.W. Balasooriya; 1♂, 13–14 Oct 1973, K.V. Krombein, P.B. Karunaratne, P. Fernando, J. Ferdinando. One male and two female paratypes have been placed in the National Museum, Colombo.

The male paratype is 4.8 mm long, has fore and mid tibiae entirely testaceous, and is otherwise very similar to the holotype. Female paratypes are 5.6–6.0 mm long and are similar to the allotype in color and sculpture except that the underside of the scape and that of the mid tibia may be entirely testaceous, and the fore tibia and all tarsi completely testaceous.

3. *Carinostigmus (Carinostigmus) costatus*, new species

FIGURES 5, 11, 21, 40, 46, 51

Females of *C. costatus* are similar to those of *C. congruus* (Walker) and *C. griphus*, new species, in having a narrower labrum and a narrower median clypeal lobe (Figures 9–11) than in females of *C. clypeolus*, new species, and *C. bucheilus*, new species (Figures 12, 13). They are also distinct in having a strong median carina on the face that

has a projection near the middle (Figure 18), whereas females of the latter two species have a weaker frontal carina that lacks the projection near the middle (Figure 19). Males of the latter two species are unknown, and I presume that they will differ from those of *C. costatus* and *C. congruus* in having a weaker frontal carina that lacks a projection near the middle, and possibly also in the conformation of the labrum and clypeus.

Both sexes of *C. costatus* differ from those of *C. congruus* in having the underside of the head with close longitudinal ridges and a small lineolate or irregularly rugulose median area (Figure 21) rather than a much larger punctate area and only a few rugae laterally. The former species also has a more coarsely sculptured propodeum (cf. Figures 38–42), and has the pronotal crest higher and emarginate in the middle rather than being uniformly lower. The males of *C. costatus* are most peculiar in having elongate, flattened maxillary palpi extending backward to apex of fore coxae and fringed on the inner edge by long curled setae, whereas those of *C. congruus* have short filiform maxillary palpi not extending beyond venter of head.

This uncommon species is known so far only from localities in the Wet Zone, from near sea level to about 640 m altitude, and with average annual rainfall ranging from 1950 to 3900 mm. The species occurs also at several localities in South India at altitudes of 380–1830 m.

The species most closely related to *C. costatus* are undescribed, one from Vizcaya and Mindanao in the Philippines (USNM), the other from Laos (Honolulu). The males have the maxillary palpi similarly developed, and the noticeable tuft of short erect setae on the edge of the seventh abdominal tergum. Both sexes of the Philippine species have numerous ridges on the head beneath as in *C. costatus* but these are weaker in the Philippine species, and the propodeal sculpture also is comparatively weaker than in the Ceylonese species. The Philippine female has a broader clypeal lobe with a subtruncate apex and narrow median emargination. Finally, the Philippine taxon differs from *C. costatus*, and all other

species of the genus, in having dark rather than white to ivory pronotal lobes. The species from Laos has close carinae rather than strong ridges on the underside of the head.

ETYMOLOGY.—The specific name is the Latin *costatus* (ribbed), in allusion to the closely costate venter of the head.

HOLOTYPE.—♀; Sri Lanka, Western Province, Colombo District, Gampaha Botanic Garden, 14 Jan 1977, K.V. Krombein, P. Fernando, D.W. Balasooriya, V. Gunawardane (USNM Type 101121).

FEMALE.—Length 5.5 mm. Black, integument shiny except vertical aspect of face, which is dull from delicate shagreening, the following are testaceous: palpi, mandible except extreme base, apical teeth and narrow ivory streak near base, underside of scape, underside of pedicel and first two flagellar segments, tegula, fore tibia, mid tibia except beneath and hind tarsi; pronotal lobe white. Wings clear, stigma black, veins dark brown.

Head in frontal view (Figure 5); viewed from above head moderately narrowed behind eyes, width at occiput 0.5 times greatest width; clypeus (Figure 11) with median lobe narrow, strongly produced, apex slightly emarginate, clypeal margin laterad of lobe gently incurved; labrum (paratype) narrow, pentagonal, sides near apex gently emarginate; frontal ridge strong, near middle with a narrow, erect T-shaped projection; ocular groove crenulate and moderately broad along vertical section of inner eye margin; vertical section of front delicately shagreened; upper horizontal part of front and vertex with sparse, tiny punctures, a weak groove before anterior ocellus; occipital groove narrow, weakly crenulate; underside of head (Figure 21) with strong longitudinal costae except a narrow median area with delicate longitudinal lineolations.

Anterior pronotal ridge strong, narrowly emarginate in middle, lateral angles spicate; notauli strongly impressed, crenulate, parapsidal lines weakly impressed; scutum with scattered punctures, a bit stronger and denser than on head, posterior area with several strong parallel ridges, longer in middle than laterally; scutellum

with strongly depressed crenulate groove anteriorly, discally with a few scattered punctures; metanotum delicately shagreened in middle, obliquely rugulose laterally; stigmal fovea small, circular; propodeal enclosure with radiating rugae on basal section, elsewhere rugosoreticulate (Figure 40); area adjacent to enclosure and posterior propodeal surface coarsely rugosoreticulate; lateral surface obliquely rugose.

Abdominal petiole slender (Figure 51), 5.0 times as long as median width, lateral surface with a few weak carinae; pygidium depressed, shiny, ellipsoidal, more elongate than in *C. congruus*.

ALLOTYPE.—♂, same label data as holotype (USNM).

MALE.—Length 5.2 mm. Color as in female except flagellum brown beneath.

Sculpture of head as noted for female except as follows: maxillary palpi very elongate, extending to apex of fore coxae, flattened and widened, inner margin with a fringe of long, close curled setae; apex of labrum broadly rounded; projection near middle of frontal ridge narrow, not T-shaped; first four flagellar segments subequal in length; occipital groove more strongly crenulate; and narrow median area of head beneath irregularly rugulose.

Thorax as in female except stigmal fovea small, oval, and lateral propodeal surface finely obliquely rugulose.

Petiole of abdomen six times as long as median width, lateral surface not carinate; edge of seventh tergum with narrow strip bearing a brush of many short erect setae.

PARATYPES (all USNM except when specified otherwise).—1♀, same data as holo- and allotype. 3♀, CENTRAL PROVINCE, *Kandy District*, Kandy, Udawattakele Sanctuary, as follows: 1♀, 26–30 Mar 1975, S. and P.B. Karunaratne; 1♀, 1700 ft (518 m), 29–30 May 1976, K.V. Krombein, P.B. and S. Karunaratne, D.W. Balasooriya; 1♀, 510–580 m, 8–10 Sep 1977, K.V. Krombein, P.B. Karunaratne, T. Wijesinhe, M. Jayaweera; 1♀, Kandy, Aug 1957, N.L.H. Krauss. 1♀, Peradeniya, Mahaweli River, 22–24 Feb 1974, A.E. Stubbs, P.J. Chandler (London). 1♀, WESTERN

PROVINCE, *Colombo District*, Labugama Reservoir Jungle, 13–14 Oct 1973, K.V. Krombein, P.B. Karunaratne, P. Fernando, J. Ferdinando. 4♀, 1♂, SABARAGAMUWA PROVINCE, *Ratnapura District*, 2 mi (3 km) S Weddagala, Sinharaja Jungle, 570 m, as follows: 3♀, 8–12 Feb 1977, 1 on foliage of *Macaranga digyna*, K.V. Krombein, P. Fernando, D.W. Balasooriya, V. Gunawardane; 1♀, 18–21 Jun 1976, K.V. Krombein, P.B. and S. Karunaratne; 1♂, 23 Sep 1977, on foliage of *Macaranga digyna*, K.V. Krombein. 1♀, Sinharaja Jungle, 9 Sep 1979, P.B. Karunaratne, T. Wijesinhe, L. Jayawickrema, R. Subasinhe. 1♀, Ceylon, Thwaites, Accession 1867-25 (London). 3♀, SOUTH INDIA, Nilgiri Hills, Cherangode, at 3500 ft (1067 m), Nov 1950, P.S. Nathan (D.G. Shapiro collection in USNM). 1♀, SOUTH INDIA, Nilgiri Hills, Naduvatam, 6000 ft (1829 m) May 1958, P.S. Nathan (Corvallis). 1♀, SOUTH INDIA, Nilgiri Hills, Kallar, 1250 ft (381 m), Nov 1954, P.S. Nathan (Corvallis). 5♀, SOUTH INDIA, South Coorg, Ammatti, 3100 ft (945 m), Feb (3♀) and Nov 1952 (2♀), P.S. Nathan (Corvallis). 2♀, 3♂, SOUTH INDIA, Anamalai Hills, Cinchona, 3500 ft (1067 m), Apr (♀) and May 1956 (♂), May 1959 (♀, 2♂), P.S. Nathan (Corvallis). The male and two female paratypes have been deposited in the National Museum, Colombo. A female from Ceylon, 1865, Sichel (London, ex Federated Malay States Museum; det. as *congruus* W. by Kohl) is excluded from the type series because the head is lacking.

Female paratypes are 5.1–5.8 mm long, and males are 4.8–5.7 mm. There is no appreciable variation in the Ceylonese population. The females from South India have darker legs, only the fore and mid tarsi being testaceous, and the other normally testaceous parts of the legs are brown.

4. *Carinostigmus (Carinostigmus) clypeolus*, new species

FIGURES 6, 12, 19, 22, 41, 47, 48

Stigmus niger Motschulsky.—Bingham, 1896:447 [Pundaloya (recte Pundaluoya), Ceylon; misidentification].—Bingham, 1897:267 [♀; Ceylon; misidentification].—

Green, 1903:69–70, figure 1 [nests in twigs or grass stems, provisions with aphids; misidentification].—Green, 1908:99 [nests in twigs of rubber plant, provisions with aphids; misidentification].

Stigmus (Carinostigmus) niger Motschulsky.—Tsuneki, 1954: 8–10 [republished Kohl's description of *S. congruus* Walker and Bingham's description of *S. niger* under the heading *S. niger*; misidentification].

The distinctively shaped female clypeus (Figure 12) agrees exactly with Bingham's description of what he considered to be *S. niger*. Bingham's specimen(s) came from Pundaluoya, a locality only seven miles (11 km) NW of Nuwara Eliya but at an altitude of about 1285 m, with surrounding hills to 1465 m. Green's biological note (1903) presumably was based on nests from this same area. There are no specimens from Pundaluoya in either the British Museum (Natural History), London, or the Zoological Museum, Berlin, East Germany, both of which house parts of Bingham's collection, nor in the National Museum, Colombo. However, as discussed under *C. congruus* (Walker), it is evident that *S. niger* is, indeed, a synonym of Walker's species, and that a new name must be proposed for the species misidentified by Bingham.

The male of *C. clypeolus* is unknown, but presumably it should differ from those of *C. congruus*, *C. griphus*, new species, and *C. costatus*, new species, in having a lateral tooth on the clypeal margin, in having a weaker median ridge on the front that lacks a projection near the middle, in having a more weakly crenulate groove along inner eye margin, in having weaker propodeal sculpture, and in having a shorter abdominal petiole with several lateral carinae. It should be similar to the male of *C. bucheilus* in the details mentioned above except for the clypeal and petiolar characters, but probably should differ in lacking white markings on the head and in having predominantly dark rather than mostly testaceous legs.

This rare species is known from a few localities in the Wet Zone and one in the Dry Zone, at altitudes of 300–1710 m with average annual rainfall of about 1700–3900 mm.

ETYMOLOGY.—The specific name is the Latin

clypeolus, a diminutive of *clypeus*, shield, in allusion to the distinctively shaped clypeal margin.

HOLOTYPE.—♀; Sri Lanka, Central Province, Kandy District, Adams Peak Trail, 4.5 mi (7.2 km) W Maskeliya, 1610–1690 m, 20–21 Oct 1977, K.V. Krombein, T. Wijesinhe, M. Jayaweera, P.A. Panawatta (USNM Type 101122).

FEMALE.—Length 5.0 mm. Black, integument predominantly shiny, pronotal tubercle white, the following medium to light red: palpi, apical half of mandible, and tegula; the following brown—scape, pedicel and first three flagellar segments beneath, trochanters, mid and hind tibiae beneath, and tarsi. Wings lightly infumated, stigma dark brown, veins lighter.

Head in frontal view (Figure 6); viewed from above head moderately narrowed behind eyes, width at occiput 0.6 times greatest width; clypeus (Figure 12) with median lobe narrow, moderately produced, slightly emarginate, apical margin with a deeper, broader emargination between lobe and large apically rounded tooth; labrum as broad as distance between two clypeal teeth, apex moderately convex; frontal ridge quite weak (Figure 19), without projection near middle; ocular groove narrow, weakly crenulate along inner eye margin; vertical aspect of front with close, weak vertical wrinkles on either side of median third; upper horizontal aspect of front and vertex with quite scattered small punctures, no groove before anterior ocellus; occipital groove narrow and delicately crenulate; underside of head (Figure 22) with scattered punctures and scarcely a trace of lateral carinae.

Anterior pronotal ridge weak, lateral angles weak and slightly produced laterally; notauli and parapsidal lines weakly impressed, not crenulate; scutum with scattered punctures, larger than on head, posteriorly neither crenulate nor ridged; scutellum with a narrow crenulate groove anteriorly, elsewhere with scattered small punctures; metanotum delicately transversely lineolate; mesopleuron finely longitudinally rugulose beneath wing base, smooth elsewhere, scrobal sulcus evanescent, omaulus and hyposternaulus more delicately crenulate than in *C. congruus*;

stigmatal fovea larger than in *C. congruus*, elliptical; propodeal enclosure (cf. Figure 41) with irregular, more or less radiating rugae, laterally with close oblique rugulae, declivity with a large smooth rounded area adjacent to median furrow, lateral surface with oblique rugulae.

Abdominal petiole (Figure 48) shorter and stouter than normal, 4.0 times as long as median width, dorsal surface somewhat flattened with a narrow lateral groove margined by a carina, lateral surface with two longitudinal carinae; pygidium small, oval, depressed, glossy.

MALE.—Unknown.

PARATYPES (all USNM except when specified otherwise).—2♀, same label data as holotype but 1690–1770 m. 1♀, CENTRAL PROVINCE, Nuwara Eliya District, Hakgala Natural Reserve, 6–7 Feb 1979, K.V. Krombein, P.B. Karunaratne, T. Wijesinhe, S. Siriwardane, T. Gunawardane. 1♀, Pedro Forest Reserve (or Mt. Pidurutalagala), 27 Feb 1974, P.J. Chandler (London). 1♀, UVA PROVINCE, Badulla District, Wellawaya, 8 Mar 1972, K.V. Krombein, P.B. Karunaratne. One paratype has been placed in the National Museum, Colombo. Paratypes are 5.2–5.4 mm long, and agree very well with the holotype in details of color and sculpture.

Carinostigmus (Perissostigmus), new subgenus

This new subgenus is proposed for the bizarre *C. bucheilus*, new species. The new group agrees with the diagnosis of *Carinostigmus Tsuneki* provided by Bohart and Menke (1976:189) except as follows: female mandible with two rather than three teeth (Figure 14); labrum with apical lobe as broad as least interocular distance instead of being considerably narrower; frontal ridge without projection near middle (cf. Figure 19); and subomalus and acetabular carina present on mesosternum rather than absent.

A female of an undescribed species from the Philippines also has bidentate mandibles. It has, however, a narrower pentagonal labrum similar in shape to that of *C. costatus*, new species, and lacks an acetabular carina and subomalus. I retain

the Philippine species provisionally in the subgenus *Carinostigmus* pending a revisionary study of the entire Oriental fauna.

TYPE-SPECIES—*Carinostigmus* (*Perissostigmus*) *bucheilus*, new species, by original designation and monotypy.

ETYMOLOGY.—The name is formed from the Greek *perissos* (odd or strange), in allusion to the mandibular teeth, plus *Stigmus*, the name of a related genus. The gender is masculine.

5. *Carinostigmus* (*Perissostigmus*) *bucheilus*, new species

FIGURES 7, 13, 14, 23, 42, 43, 52

The female of *C. bucheilus* is separated at once from the other four Ceylonese species of *Carinostigmus* by having two rather than three apical mandibular teeth (cf. Figures 8, 14); by having the labrum very broad and evenly rounded at apex (cf. Figures 9–13), and by having the palpi, apical margin of labrum, basal half of mandible and underside of scape white, in addition to the pronotal lobe (the only white area in the other four species). It differs also from those of *C. congruus* (Walker), *C. costatus*, new species, and *C. griphus*, new species, in having a weak frontal carina that is not armed with a projection near the middle, and in having a narrow groove along inner eye margin with evanescent crenulations (cf. Figures 3–7).

The male is unknown but presumably it will differ from those of *C. congruus*, *C. costatus*, and *C. griphus* in having a weaker median ridge on the front which lacks a projection near the middle. It is probable also that the male will have white markings on the head that should be lacking in males of the other three species.

So far as is known this is a montane species occurring at altitudes above 1610 m, and in areas characterized by relatively high rainfall averaging 2160–3900 mm annually.

ETYMOLOGY.—The specific name is formed from the Greek *bu-* (large) and *cheilus* (lip), in allusion to the very large labrum.

HOLOTYPE.—♀; Sri Lanka, Central Province, Nuwara Eliya District, Hakgala Natural Reserve, 6–7 Feb 1979, K.V. Krombein, P.B. Karunaratne, T. Wijesinhe, S. Siriwardane, T. Gunawardane (USNM Type 101123).

FEMALE.—Length 5.5 mm. Black, shiny, the following white: palpi, basal half of mandible, apex of labrum, scape beneath and pronotal tubercle; the following testaceous to light red: apical half of mandible except teeth, labrum except apex, underside of coxae, trochanters, undersides of fore and mid femora, fore and mid tibiae and tarsi; the following light to darker brown: tegula, fore and mid femora above, and underside of hind tibia. Wings clear, stigma black, veins dark brown.

Head in frontal view (Figure 7); viewed from above, head moderately narrowed, width at occiput 0.5 times greatest width; clypeus with median lobe moderately broad and produced, truncate at apex with a semicircular emargination in middle, an emargination of same size on either side between median lobe and a blunt tooth (Figure 13); frontal ridge very weak, without projection near middle (cf. Figure 19); ocular groove narrower than in *C. clypeolus*, crenulations evanescent; vertical aspect of front and vertex delicately shagreened; upper horizontal surface of front and vertex with tinier, more dispersed punctures than in *C. clypeolus*, no groove before anterior ocellus; occipital groove narrow and delicately crenulate; head beneath (Figure 23) with small scattered punctures and a few weak longitudinal rugulae laterally.

Anterior pronotal ridge weak, lateral angles acute but weak; notauli and parapsidal lines weakly impressed, the former crenulate; scutum with larger punctures than on head, closer than in *C. clypeolus*, many of those in middle separated by about the width of a puncture, anterolaterally with close transverse rugulae that curve toward middle and become longitudinal, posteriorly with short longitudinal gouges (Figure 42); scutellum with narrow, weakly crenulate groove anteriorly, elsewhere with somewhat smaller and more scattered punctures than on scutum; metanotum

with parallel ridges converging slightly toward middle; mesopleuron with fine punctures beneath wing base, smooth elsewhere except for short horizontal ridges posteriorly, scrobal sulcus, omaulus and hyposternaulus more weakly crenulate than in *C. congruus*; stigmal fovea elliptical, shorter and narrower than in *C. clypeolus*; propodeal enclosure (Figure 42) with irregular, more or less radiating rugulae anteriorly, posteriorly with transverse rugulae; dorsal area adjacent to enclosure with close oblique rugulae; small rounded smooth area on upper half of posterior surface adjacent to furrow and below that irregularly rugosoreticulate; lateral propodeal surface rugosoreticulate above and with close vertical rugulae below.

Abdominal petiole slender (Figure 52), elongate, 8.0 times as long as width at middle, dorsal surface rounded, carinae lacking dorsally and

laterally; pygidium small, oval, depressed, delicately shagreened.

MALE.—Unknown.

PARATYPES (all USNM except when specified otherwise).—4♀, same locality as holotype as follows: 1♀, 1650–1800 m, 23–25 Feb 1977, K.V. Krombein, P.B. Karunaratne, P. Fernando, D.W. Balasooriya; 3♀, 23–24 Apr 1981, 2 in Malaise trap, K.V. Krombein, T. Wijesinhe, L. Weeratunge. 1♀, Hakgala Forest Reserve, 28 Feb 1974, P.J. Chandler (London). 6♀, *Kandy District*, Adams Peak Trail, 4.5 mi (7.2 km) W Maskeliya, 1610–1710 m, 20–21 Oct 1977, K.V. Krombein, T. Wijesinhe, M. Jayaweera, P.A. Panawatta. Two paratypes have been placed in the National Museum, Colombo.

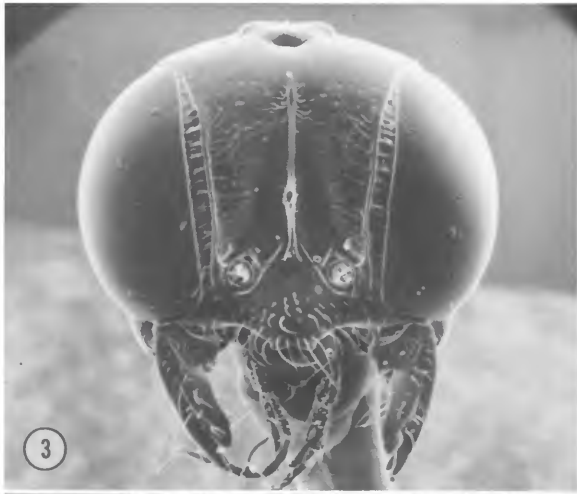
Paratypes are 5.0–5.9 mm long and show little variation from the holotype in color or sculpture.

Literature Cited

- Arnold, G.
1924. The Sphegidae of South Africa, Part V. *Annals of the Transvaal Museum*, 11(1):1-73, 42 figures.
- Bingham, C.T.
1896. A Contribution to the Knowledge of the Hymenopterous Fauna of Ceylon. *Proceedings of the Zoological Society of London*, 1896:401-459, plate 15.
1897. *The Fauna of British India Including Ceylon and Burma: Hymenoptera, 1 (Wasps and Bees)*. 579 pages, 189 figures, 4 plates. London.
- Bohart, R.M., and A.S. Menke
1976. *Sphécid Wasps of the World: A Generic Revision*. 695 pages, 190 figures, 2 plates.
- Dalla Torre, K.W., von
1897. Fossores (Sphegidae). In *Catalogus Hymenopterorum*, 8: 749 pages.
- Green, E.E.
1903. On the Nesting Habits of *Trypoxylon intrudens* and *Stigmus niger*. *Spolia Zeylanica*, 1:68-70, 2 figures.
1908. Animals Associated with the Hevea Rubber Plant in Ceylon. *Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon*, 4:91-102.
- Iwata, K.
1938. Habits of Some Japanese Pemphredonids and Crabronids (Hymenoptera). *Mushi*, 11:20-41, 7 figures, 1 plate.
1964. Bionomics of Nonsocial Wasps in Thailand. *Nature and Life in Southeast Asia*, 3:323-383, 68 figures.
- Kohl, F.F.
1890. Zur Kenntniss der Pemphredonen. *Annalen des Kaiserliche Königliche Naturhistorischen Hofmuseums Wien*, 5:49-65.
- Krombein, K.V.
1973. Notes on North American *Stigmus* Panzer (Hymenoptera: Sphecoidea). *Proceedings of the Biological Society of Washington*, 86:211-230, 16 figures.
- Maidl, F.
1925. Fauna Sumatrensis (Beitrag Nr. 11) (Sphegidae, Hym.). *Entomologische Mitteilungen*, 14:376-390, 26 figures.
- Motschulsky, V. de
1863. Essai d'un catalogue des insectes de l'île Ceylan, VI: Hyménoptères. *Bulletin de la Société Impériale des Naturalistes de Moscou*, 36:11-73, plate 2.
- Nietner, J.
1859. Un séjour sur l'île Ceylan. *Études Entomologiques*, 8:15-24.
- Tennent, J.E.
1861. *Sketches of the Natural History of Ceylon with Narratives and Anecdotes Illustrative of the Habits and Instincts of the Mammalia, Birds, Reptiles, Fishes, Insects, etc., Including a Monograph of the Elephant and a Description of the Modes of Capturing and Training It*. 500 pages, many unnumbered figures.
- Tsuneki, K.
1954. The Genus *Stigmus* Panzer of Europe and Asia with Descriptions of Eight New Species (Hymenoptera: Sphecoidea). *Memoirs of the Faculty of Liberal Arts, Fukui University*, series II (Natural Science), 3:1-38, 64 figures.
- Turner, R.E.
1917. On a Collection of Sphecoidea Sent by the Agricultural Institute, Pusa, Bihar. *Memoirs of the Department of Agriculture in India, Entomological Series*, 5:173-203.
- Walker, F.
1860. Characters of Some Apparently Undescribed Ceylon Insects. *Annals and Magazine of Natural History*, series 3, 5:304-311.

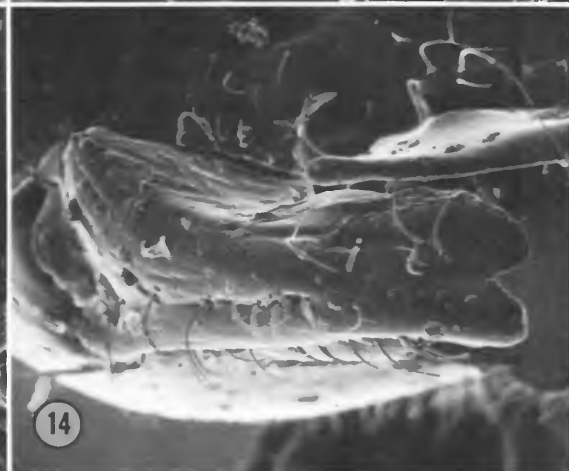
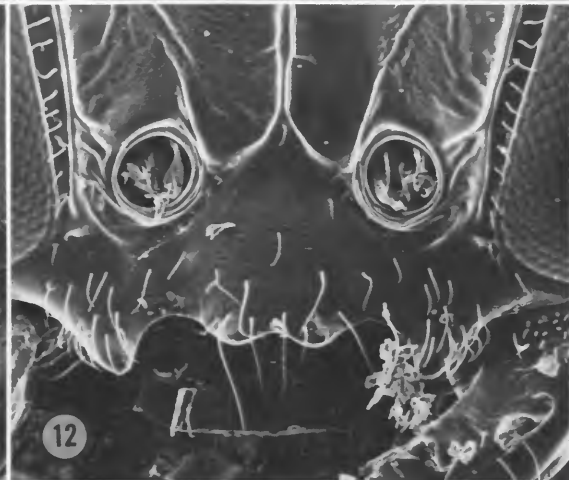
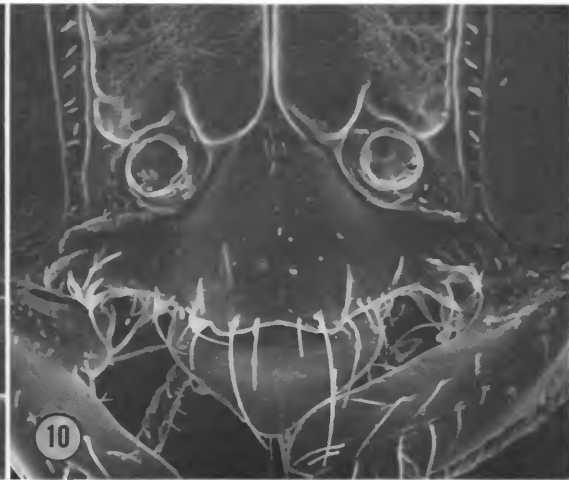
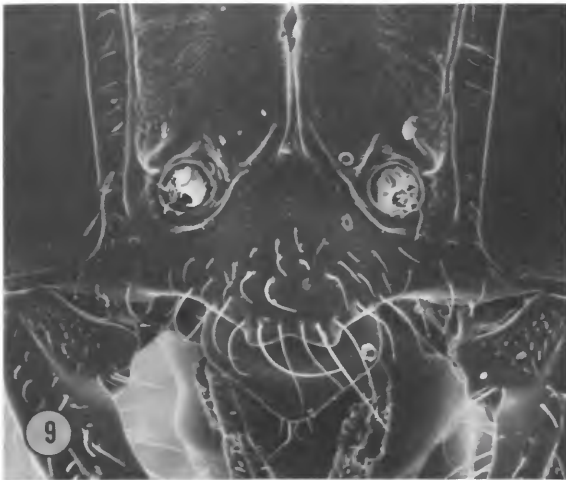
FIGURES 3-7.—Female *Carinostigmus*, frontal view of head: 3, *C. congruus* (Walker) ($\times 48$); 4, *C. griphus*, new species ($\times 49$); 5, *C. costatus*, new species ($\times 50$); 6, *C. clypeolus*, new species ($\times 54$); 7, *C. bucheilus*, new species ($\times 50$).

FIGURE 8.—Female mandible. *Carinostigmus congruus* (Walker) ($\times 104$).



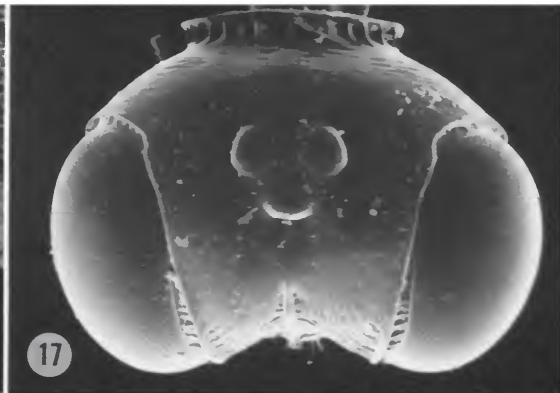
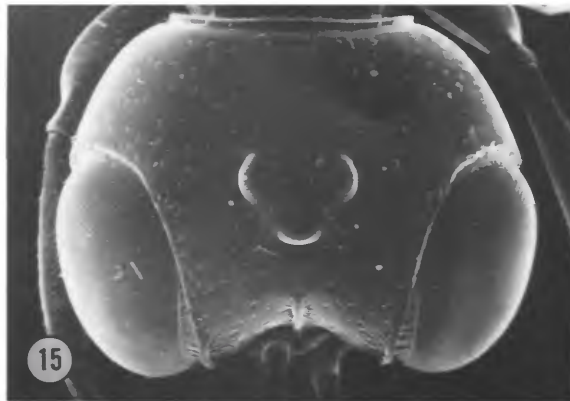
FIGURES 9–13.—Female *Carinostignus*, clypeus and labrum: 9, *C. congruus* (Walker) (× 110); 10, *C. griphus*, new species (× 112); 11, *C. costatus*, new species (× 137); 12, *C. clypeolus*, new species (× 138); 13, *C. bucheilus*, new species (× 140).

FIGURE 14.—Female mandible, *Carinostignus bucheilus*, new species (× 180).



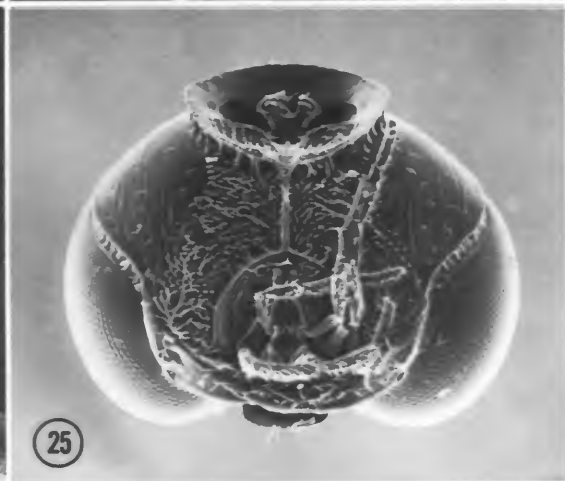
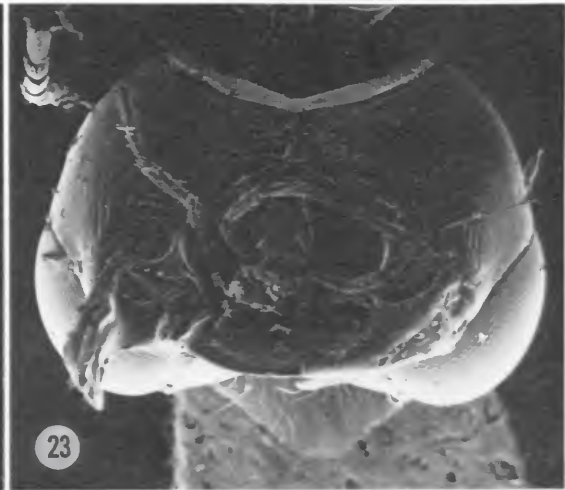
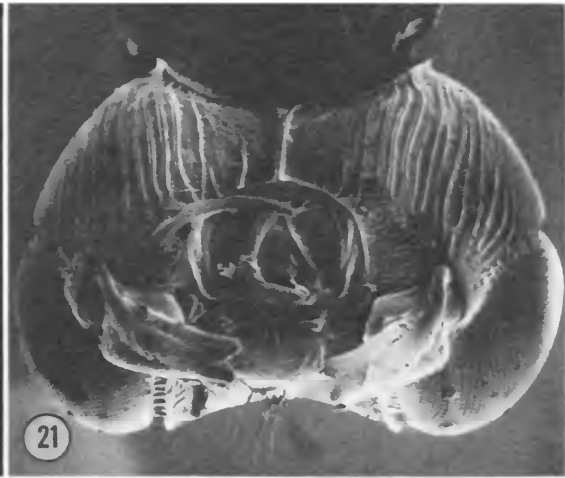
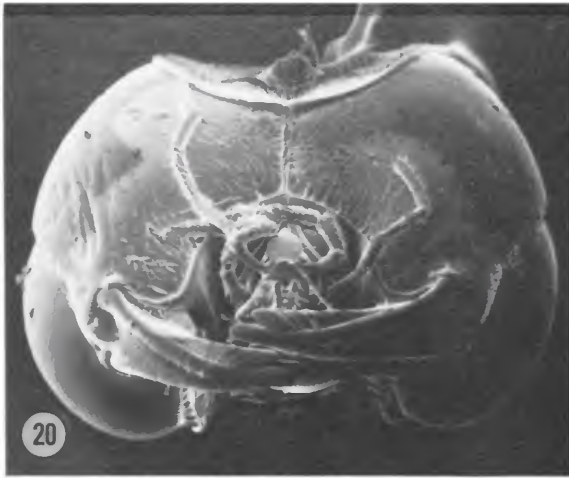
FIGURES 15–17.—*Carinostigmus*, dorsum of head: 15, female *C. congruus* (Walker) (× 58); 16, male *C. congruus* (Walker) (× 67); 17, male *C. griphus*, new species (× 65).

FIGURES 18–19.—Female *Carinostigmus*, oblique view of front to show median ridge: 18, *C. congruus* (Walker) (× 100); 19, *C. clypeolus*, new species (× 100).



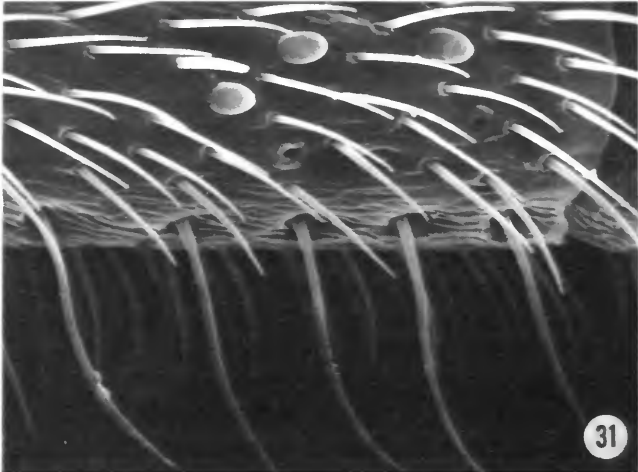
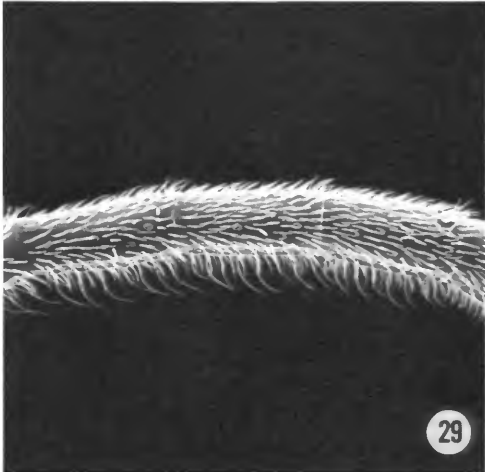
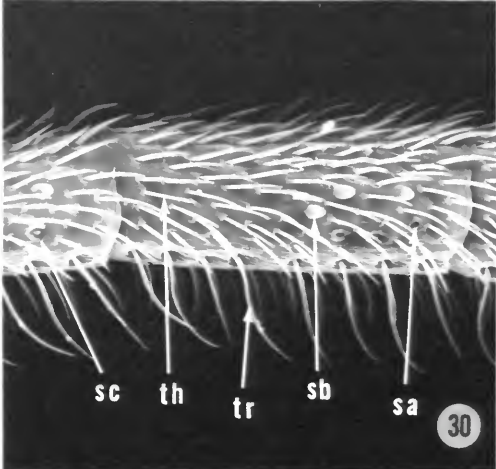
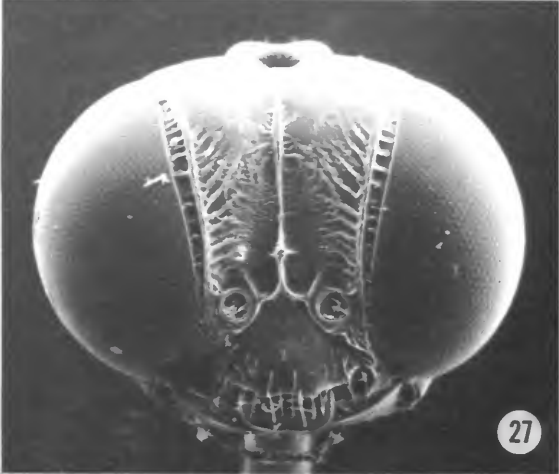
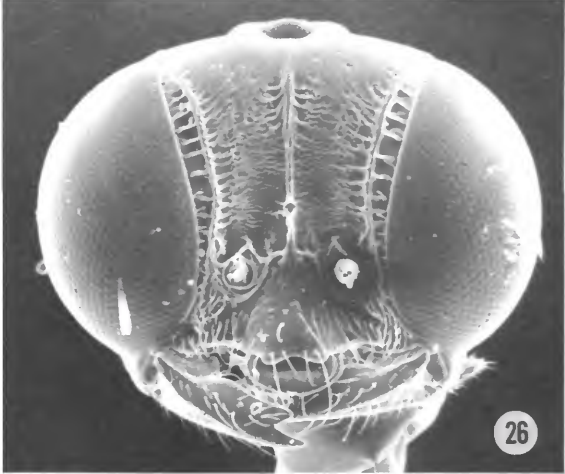
Figures 20–23.—Female *Carinostigmus*, venter of head: 20, *C. congruus* (Walker) (× 57); 21, *C. costatus*, new species (× 57); 22, *C. clypeolus*, new species (× 67); 23, *C. bucheilus*, new species (× 55).

FIGURES 24–25.—Male *Carinostigmus*, venter of head: 24, *C. congruus* (Walker) (× 75); 25, *C. gripus*, new species (× 60).



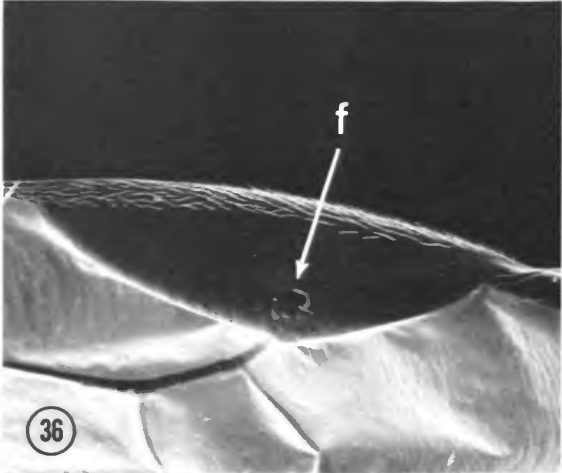
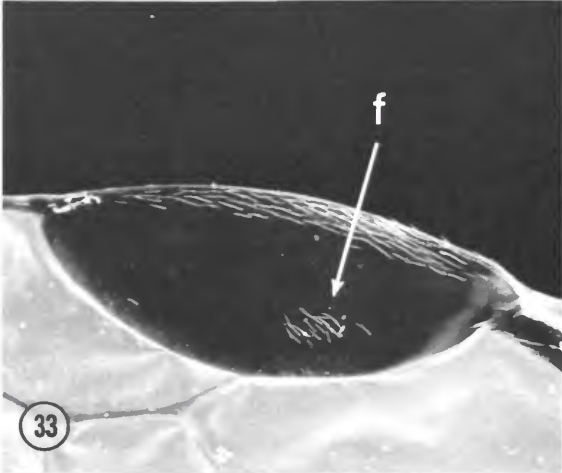
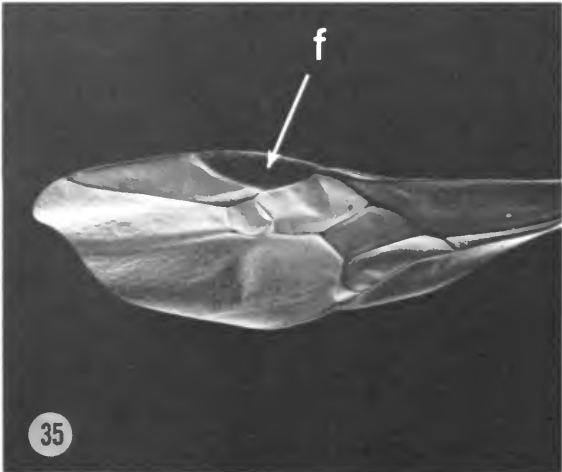
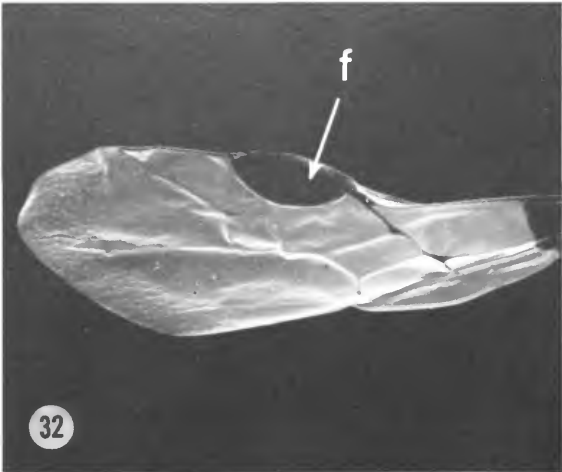
FIGURES 26–27.—Male *Carinostigmus*, frontal view of head: 26, *C. congruus* (Walker) (× 70); 27, *C. griphus*, new species (× 65).

FIGURES 28–31.—Male *Carinostigmus congruus* (Walker), antenna: 28, flagellar segments 2–11 (× 100); 29, flagellar segments 4–6 (× 200); 30, flagellar segment 4 (tr=trichobothrium [specialized tactile hair]; sb=sensillum basiconicum [olfactory]; th=tactile hair; sc=sensillum campaniformium [mechanosensitive]; sa=sensillum ampullaceum [?olfactory]) (× 350); 31, part of flagellar segment 4 (× 700).



FIGURES 32-34.—*Stignus americanus* Packard, forewing (f=fovea): 32, (× 40); 33, (× 145); 34, (× 1000).

FIGURES 35-37.—*Carinostignus congruus* (Walker), forewing (f=fovea): 35, (× 30); 36, (× 110); 37, (× 1500).



FIGURES 38–42.—Female *Carinostigmus*, dorsum of thorax: 38, *C. congruus* (Walker) (× 38); 39, *C. congruus* (Walker) (× 36); 40, *C. costatus*, new species (× 38); 41, *C. clypeolus*, new species (× 36); 42, *C. bucheilus*, new species (× 41).

FIGURES 43–46.—Female *Carinostigmus*, lateral aspect of thorax: *C. bucheilus*, new species (× 41); 44, *C. congruus* (Walker) (× 39); 45, *C. congruus* (Walker) (× 36); 46, *C. costatus*, new species (× 37).

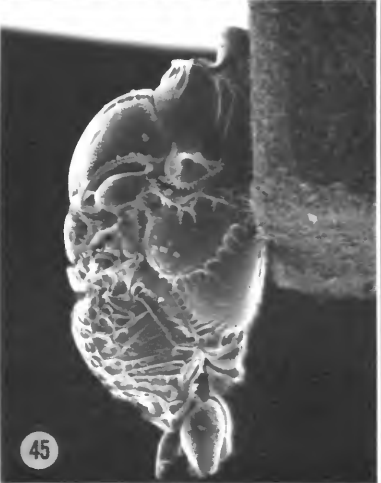
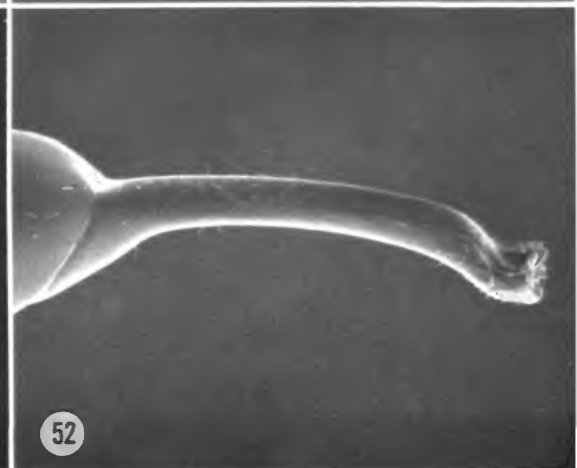
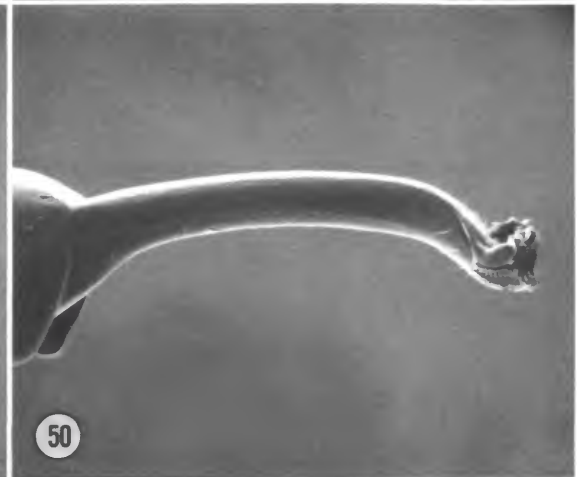
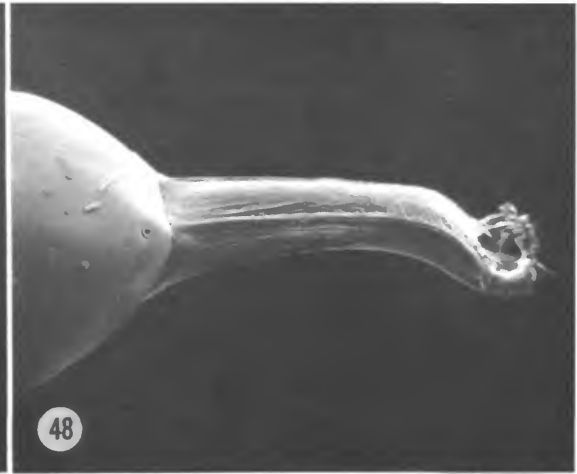
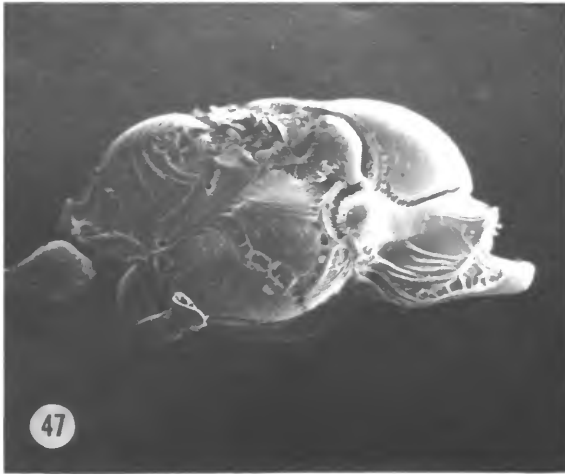


FIGURE 47.—Female *Carinostigmus clypeolus*, new species, lateral aspect of thorax ($\times 42$).

FIGURES 48–52.—Female *Carinostigmus*, abdominal petiole: 48, *C. clypeolus*, new species ($\times 81$); 49, *C. congruus* (Walker) ($\times 58$); 50, *C. congruus* (Walker) ($\times 81$); 51, *C. costatus*, new species ($\times 61$); 52, *C. bucheilus*, new species ($\times 72$).



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