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**A Revision of the Neotropical Fungus-growing
Ants of the Genus *Cyphomyrmex* Mayr.
Part II: Group of *rimosus* (Spinola)
(Hym. Formicidae)**

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**A Revision of the Neotropical Fungus-Growing Ants of the Genus
Cyphomyrmex Mayr. Part II: Group of rimosus (Spinola)
(Hym., Formicidae)**

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(With 50 figures and 1 table)

The present paper is a continuation of my revisionary studies on the New World fungus-growing ants of the attine genus *Cyphomyrmex*. The first part (Kempf, 1964: 1-44) contains the general introduction and a critical review of the *strigatus*-group, comprising about one half of the species described in the genus. The remaining half of the species constitutes the *rimosus*-group, a revision of which will be taken up in the present section. Only the study of *rimosus* itself, with its hitherto recognized subspecies, is not included here and will require still another installment of the series. As in Part I, the investigation is principally focussed upon the worker caste; the females are treated rather perfunctorily, and the males are completely left out. The reason for this restrictive procedure lies in the poor knowledge of the sexual castes.

The research for this paper was performed under a fellowship granted by the "Conselho Nacional de Pesquisas" of Brazil, whose generous help is gratefully acknowledged. Following are the abbreviations used for the collections in which the material under consideration is presently deposited:

- CTB — Borgmeier collection of ants (now in WWK)
- MCZ — Museum of Comparative Zoology at Harvard College
- NAW — Prof. Neal A. Weber's private collection
- NHMW — Naturhistorisches Museum, Wien (Mayr collection)
- WWK — This author's private collection

Group of *Cyphomyrmex rimosus*

The *rimosus*-group has previously (Kempf, 1962: 30; 1964: 4) been defined by the ensemble of the following characters in the worker (and female) caste: Mandibles with 5 teeth only; two or no midpronotal tubercles present; preocular carina either curving mesad above eyes (most species of the group) or fading out above eyes, yet with the postero-lateral border of the antennal scrobe more or less defined as in the *strigatus*-group (*longiscapus*, *wheeleri*, *costatus* and presumably also *flavidus*). Following is a list of the presently recognized forms, including the not yet analyzed infraspecific forms of *rimosus* and several new synonyms (W = worker; F = female; M = male):

- bicornis* Forel, 1895, W, eastern Brazil
championi Forel, 1899, M, Panama (= *salvini* Forel?)
costatus Mann, 1922, W, F, M, Honduras, Panama, Colombia
 = *colombianus* Weber, 1940 — NOV. SYN.
dentatus Forel, 1901, W, F, Mexico — NOV. STAT.
flavidus Pergande, 1895, W, Mexico
foxi Ern. André, 1892, W, F, Jamaica
hamulatus Weber, 1938, W, Bolivia, Panama — NOV. STAT.
kirbyi Mayr, 1887, W, F, Colombia, Ecuador
laevigatus Weber, 1938, W, Bolivia, Dutch Guiana
longiscapus Weber, 1940, W, F, Colombia, Panama
peltatus Kempf, n. sp., W, F — southern Brazil
rimosus (Spinola, 1851), W, Brazil: Pará
 = *difformis* (Fr. Smith, 1858)
 r. var. arnoldi Aguayo, 1932, W, Jamaica (= *foxi* Ern. André?)
 r. var. major Forel, 1912, W, Guatemala, Brazil: S. Paulo
 r. atratus Forel, 1912, W, F, M, Colombia
 r. breviscapus Weber, 1940, W, Panama
 r. cochunae Kusnezov, 1949, W, Argentina: Tucumán
 r. flavescens Weber, 1948, W, Haiti
 r. fuscus Emery, 1894, W, F, M, Cisandean South America
 = *fusculus* Emery, 1922
 = *curiapensis* Weber, 1938
 r. minutus Mayr, 1862, W, F, M, from U.S.A. to n. S. America
 = *deformis* Roger, 1863
 = *steinheili* Forel, 1884
 = var. *comalensis* Wheeler, 1907
 r. trinitatis Weber, 1938, W, F, Trinidad, Guianas, Panama
 r. venezuelensis Weber, 1938, W, Venezuela
salvini Forel, 1899, W, F, M, Panama, Costa Rica
 = *acutus* Weber, 1940 — NOV. SYN.
transversus Emery, 1894, W, F, M, Brazil, Argentina — NOV. STAT.
 = *olindanus* Forel, 1901
 = *pencosensis* Forel, 1914 — NOV. SYN.
vorticis Weber, 1940, W, Bolivia, Brazil: Rondônia
wheeleri Forel, 1900, W, F, M, U.S.A.: Tex., Cal.; Mexico

The *rimosus*-group is much more widely distributed than the *strigatus*-group, ranging from southern U.S.A. both over the Antilles and Central America south to central Argentina. Yet only *rimosus* with its puzzling "races" and morphs occupies the entire range of the territory (except for northeastern Brazil!), whereas the remaining species are seemingly rather restricted in their distribution. The group reaches its highest degree of diversity and endemism in northern South America and in Central America.

Most of the collected material, over 90% of the total, belongs to the ubiquitous *rimosus s. l.*, whose striking variability is still not understood and had to be left out for a future study. Yet a slight improvement is introduced here by raising *dentatus*, *hamulatus* and *transversus* to full specific rank.

In short, the presently proposed arrangement, while exhausting the best of my possibilities and efforts, is not to be considered as final. Only more copious material and a better knowledge of the variability, distribution and biology of all forms will permit to raise our knowledge of the *Cyphomyrmex* ants to a satisfactory level.

Bionomics. — With the exception of a few well studied species, such as *rimosus minutus* Mayr (Weber, 1955) and *costatus* Mann (Weber, 1957a), very little, if any, information is available for most forms. One fact, however, regarding the fungi cultivated by these ants, has become firmly established in the meantime. Whereas some species (*costatus* and *wheeleri*) grow a basidiomycete fungus of the family Agaricaceae, which under the care of the ants forms bromatia of loosely clustered hyphal swellings or gongylidia (fungus garden of the flocculent type), other species (*rimosus*, *dentatus*, *transversus*) cultivate bromatia consisting of polygonal solid masses of cells of a yeast-like fungus, which Wheeler (1907: 772) named *Tyridiomyces formicarum*, but so far has not been truly identified.

It is interesting to note that in the aforesaid species the difference in type of fungus and bromatia coincides with a morphological difference, shown by the development and direction of the preocular carina and the postero-lateral limit of the antennal scrobe; in *costatus* and *wheeleri* the preocular carina fades out above the eye, but the postero-lateral limit of the scrobe behind the eye is somehow indicated, whereas in *rimosus* and allies the preocular carina curves strongly mesad above the eye, and there is no proper postero-lateral limit to the scrobe. Only future research will show whether or not this relationship is constant and may be generalized.

Key to the species for workers

(*C. flavidus* is not included; *C. championi* is known only in the male caste).

1. Antennal scrobe reticulate and quite shining; preocular carina not curving mesad above eye, postero-lateral limit of antennal scrobe marked at least by difference of sculpture (Figs. 2, 19) 2
- Antennal scrobe densely but indistinctly granulate and opaque; preocular carina curving mesad above eye, the postero-lateral border of scrobe being formed by another carina (if present), which arises from the occipital corner and extends forward to the inferior or posterior border of eye, never joining the preocular carina (Figs. 3, 6, 11) 4
2. Antennal scape in repose surpassing the occipital lobe (Fig. 2); pronotal tubercles absent (Fig. 18); cheeks immarginate below
 1. *longiscapus* Weber

- Antennal scape not surpassing occipital corners when in repose; lateral pronotal tubercles developed; cheeks marginate below.... 3
- 3. Disc of tergum I of gaster with a pair of strong longitudinal carinae (Fig. 19); midpronotal tubercles absent; postero-dorsal margin of petiole not drawn out nor bidentate (Fig. 38) 4. *costatus* Mann
- Disc of tergum I of gaster lacking a pair of longitudinal carinae; midpronotal tubercles present (Fig. 25); postero-dorsal margin of petiole drawn out as a foliaceous bidentate lamina (Fig. 37) 2. *wheeleri* Forel
- 4. Antennal scapes not surpassing the strikingly auriculate occipital lobes (Figs. 4, 5); pronotum completely unarmed (Figs. 23, 26), its sides marginate only 5
- Antennal scapes usually surpassing the scarcely or gently drawn out occipital lobes; pronotum with the lateral tubercles always present.. 6
- 5. Anterior mesonotal tubercles conical, posterior ones low and tumuliform (Fig. 23); petiolar node much less than thrice as broad as long (Fig. 33) 5. *bicornis* Forel
- Thorax completely unarmed, its dorsum in profile evenly rounded (Fig. 26); petiolar node strikingly transverse, thrice as broad as long (Fig. 32) 6. *laevigatus* Weber
- 6. Paired midpronotal tubercles absent 7
- Paired midpronotal tubercles present 9
- 7. Hind femora not dilated nor ventrally carinate at basal third (Fig. 42); funicular segments II-VIII longer than broad 7. *kirbyi* Mayr
- Hind femora dilated and ventrally carinate at basal third (Figs. 46, 50); funicular segments II-VIII about as long as broad 8
- 8. Epinotum unarmed, rounded in both directions (Fig. 20); antennal scapes well projecting beyond occipital corners (Fig. 13) 8. *pellatus* n. sp.
- Epinotum dentate; basal face laterally marginate to carinate (Fig. 21); antennal scapes scarcely projecting beyond tip of occipital corners (Fig. 8) 9. *dentatus* Forel
- 9. Maximum expansion of frontal carinae less than interocular width (Fig. 6); thorax finely but distinctly rugose; lateral, pronotal and anterior mesonotal projections long and spine-like (Fig. 14) 10. *foxi* Forel
- Maximum expansion of frontal carinae exceeding interocular width; thorax lacking distinct rugulae; lateral pronotal and anterior mesonotal projections short, tubercular or at best conical 10
- 10. Apex of occipital lobes drawn out into a spine (Figs. 1, 3); anterior mesonotal tubercles high and conical (Figs. 15, 16) 11
- Apex of occipital lobes not drawn out into a spine; anterior mesonotal tubercle low and usually tumuliform 12
- 11. Body without appressed scale-like hairs; basal face of epinotum sharply carinate in its entire length; posterior mesonotal tubercles low, not tooth-like (Fig. 15) 11. *vorticis* Weber
- Body hairs scale-like; basal face of epinotum bluntly carinate on anterior half; posterior mesonotal projections conical (Fig. 16) 12. *salvini* Forel
- 12. Petiole strikingly transverse, thrice as broad as long (Fig. 30); postpetiole discally deeply and broadly impressed; body hairs thickly squamous 14. *transversus* Emery
- Petiole narrower, not thrice as broad as long (Fig. 39); postpetiole with a shallower middorsal impression; body hairs finer 13

13. Hairs on head and gaster recurved or hook-like, not appressed nor strictly scale-like; thoracic tubercles sharply pointed (Fig. 22)..
 15. *hamulatus* Weber
 — Hairs on head and gaster appressed and scale-like; thoracic tubercles low and tumuliform, never pointed 16. *rimosus* (Spinola)

Table I

Comparison between critical measurements of workers

Species	Total L	Head L	Head W	Thorax L	H Femur L
<i>foxi</i>	3.8-4.0	0.95-0.97	0.80-0.87	1.28-1.33	1.17-1.23
<i>vorticis</i>	3.6-3.9	0.83-0.88	0.78-0.83	1.20-1.31	1.14-1.28
<i>salvini</i>	3.3-3.8	0.80-0.93	0.69-0.83	1.07-1.28	1.01-1.17
<i>kirbyi</i>	3.5-3.7	0.80-0.85	0.72-0.80	1.14-1.25	0.99-1.09
<i>longiscapus</i>	3.0-3.7	0.72-0.91	0.56-0.67	1.01-1.23	0.82-1.17
<i>laevigatus</i>	3.3-3.7	0.85-0.96	0.85-0.96	1.07-1.23	0.85-0.94
<i>bicornis</i>	3.2	0.83	0.76	1.04	0.83
<i>wheeleri</i>	2.8-3.4	0.71-0.85	0.62-0.72	0.83-1.06	0.64-0.78
<i>dentatus</i>	2.9-3.2	0.72-0.73	0.67-0.69	0.93-1.04	0.72-0.77
<i>transversus</i>	2.7-3.4	0.67-0.83	0.64-0.80	0.88-1.09	0.69-0.83
<i>peltatus</i>	2.8-3.1	0.66-0.72	0.63-0.69	0.93-1.04	0.75-0.85
<i>hamulatus</i>	2.7	0.66	0.63-0.66	0.88-0.91	0.72-0.75
<i>costatus</i>	2.1-2.4	0.56-0.61	0.51-0.56	0.67-0.75	0.48-0.56

1. *Cyphomyrmex longiscapus* Weber

(Figs. 2, 18, 29, 45)

Cyphomyrmex longiscapus Weber, 1940: 410 (Worker; Colombia: Rio Porco). — Kempf, 1964: 4.

Types. — Several workers, collected at an altitude of 1020 m (3400') by Prof. N. A. Weber; 3 specimens seen.

Worker (lectotype). — Total length 3.7 mm; head length 0.91 mm; head width 0.67 mm; thorax length 1.23 mm; hind femur length 1.17 mm. Fuscous brown; appendages lighter. Integument of body and appendages densely and sharply reticulate-punctate; body with densely distributed foveolae, which are rather difficult to see on account of the microsculpture, extending equally over both pits and intervals.

Head as shown in Fig. 2. Mandibles longitudinally striolate, strikingly elongate. Clypeus with prominent and strongly convex, mesially vestigially notched, anterior apron; postero-mesially, in front of each anterior corner of frontal lobes, a vestigial tooth. Frontal lobes very little expanded laterad, continued posteriorly by the nearly straight, subparallel, strongly carinate, frontal

carinae, which attain the triangular occipital lobes. Vertex with a pair of strong carinae. Preocular carinae fading out at level of eyes, not curving mesad nor prolonged caudad. Antennal scrobe neatly differentiated in its posterior half from the cheeks by the absence of coarse pits. No supraocular tumulus. Eyes strongly convex with about 7-8 facets across their greatest diameter. Cheeks immarginate below. Occiput prolonged into a low, collar-like prominence around foramen. Scapes elongate-clavate, projecting beyond the occipital lobes by a distance exceeding twice their maximum width. Funicular segment I very long, subequal to II-IV combined; segments II-IX distinctly elongate.

Thorax as shown in Fig. 18. Pronotum completely unarmed, lacking also lateral carinae on disc; antero-inferior corner obtusely dentate. Mesonotum with two pairs of rather strong tubercles. Mesoepinotal constriction present. Epinotum completely unarmed; spiracle on a slight prominence. Legs rather long and thin; hind femora (Fig. 45) not dilated ventrally on basal third; postero-ventral border vestigially carinulate.

Pedicle as shown in Figs. 18 and 29. Petiolar node, as seen from above, one and a half times as broad as long, its anterior corners broadly rounded; lacking dorsal carinae and tumuli. Postpetiole with an oblique anterior face nearly at right angle to the dorsal face; the latter with a pair of approximated small tubercles on anterior corners, another pair, blunter, stronger and more widely separated, on posterior corners; posterior border between tubercles slightly excised. Anterior border of first gastric tergum and sternum marginate; sides of tergum I practically immarginate.

Pilosity inconspicuous, consisting solely of fine, thin, silvery, decumbent hairs.

Female (cf. below) and male unknown.

Specimens examined: 3 workers taken by N. A. Weber at Rio Porce, Cordillera Central, Colombia, 3400 feet, Nov. 1938 (NAW n. 1088), lectotype (NAW) and paratypes (MCZ, WWK).

Discussion. — The present species, still known only from the type series, is highly distinctive both in general aspect (elongate head, mandibles and scape) and in several features not shared by any other known species of the group: the long mandibles, the scarcely expanded frontal lobes, the neck-like collar on occiput, and above all the configuration of the antennal scrobe which, although lacking the postero-lateral limit of a postocular carina, is nevertheless similar to that of the *strigatus*-group. Fore the preocular carina does not curve mesad above eyes, and the postero-lateral limit of the scrobe is indicated by a

difference in sculpture. The dentition of the mandibles, however, is of the *rimosus*-group, i. e. consisting of only five teeth.

There is no close relative for this species, even though *wheeleri* and *costatus* have the same reticulate-punctate sculpture of the antennal scrobe, and their preocular carina likewise does not curve mesad above eyes; *wheeleri*, in addition, even possesses the reticulate-punctate sculpture of the integument of body and appendages.

Note. — Although basically resembling, I hesitate in definitely ascribing to the present species a lone worker and female, taken by W. L. Brown, Jr. and E. S. McCluskey on Barro Colorado Island, Panama Canal Zone, in January 1960 (n. B-55), on account of the following aberrant features:

Worker. — Decidedly smaller than type: total length 3.0 mm; head length 0.72 mm; head width 0.56 mm; thorax length 1.01 mm; hind femur length 0.82 mm. Reticulate-punctate body sculpture more superficial, hence the integument is shinier. Mesonotum having only the anterior pair of tubercles developed, the rest being flat. Mesoepinotal impression obsolete. Hind femora ventrally lobate and carinate on basal third. Petiole and postpetiole slightly broader (6:9 and 11:10), the latter with a deeper middorsal impression, stronger posterior paired tubercles, which project beyond the mesially deeply excised posterior border.

Female. — Total length 3.8 mm; head length 0.88 mm; head width 0.69 mm; thorax length 1.22 mm; hind femur length 0.98 mm. Similar to the worker. Pronotum unarmed, with humeral angles only feebly marked. Mesonotum: scutum flat, notauli present, no Mayrian furrows. Scutellum posteriorly weakly excised. Epinotum practically lacking a basal face, completely unarmed. Petiole and postpetiole similar to those of worker.

We need more material to decide whether these specimens represent a discrete form or just an extreme variant of *longiscapus*.

2. *Cyphomyrmex wheeleri* Forel

(Figs. 7, 25, 37, 49)

Cyphomyrmex wheeleri Forel, 1900: 282-4 (Worker, female; U.S.A., Texas: Austin). — Wheeler, 1907: 725-6, 765-8, fig. 30, pl. 49 fig. 2 (Worker, female, male; U.S.A., Texas: Austin, Belton, Langtry, Fort Davis, California; Three Rivers: Bion.). — Weber, 1940: 409 (Worker; key). — Creighton, 1950: 315-7, pl. 40, figs. 1-4 (Worker, female, male; distrib., key). — M. R. Smith in Muesebeck *et al.*, 1951: 830 (U.S.A.: Texas, California; Mexico).

Types. — Workers and a female collected by W. M. Wheeler in the environs of Austin, Texas, U.S.A.; three syntype or nidotype workers, received on exchange from the Museum of Comparative Zoology at Harvard College for my collection (WWK), were examined.

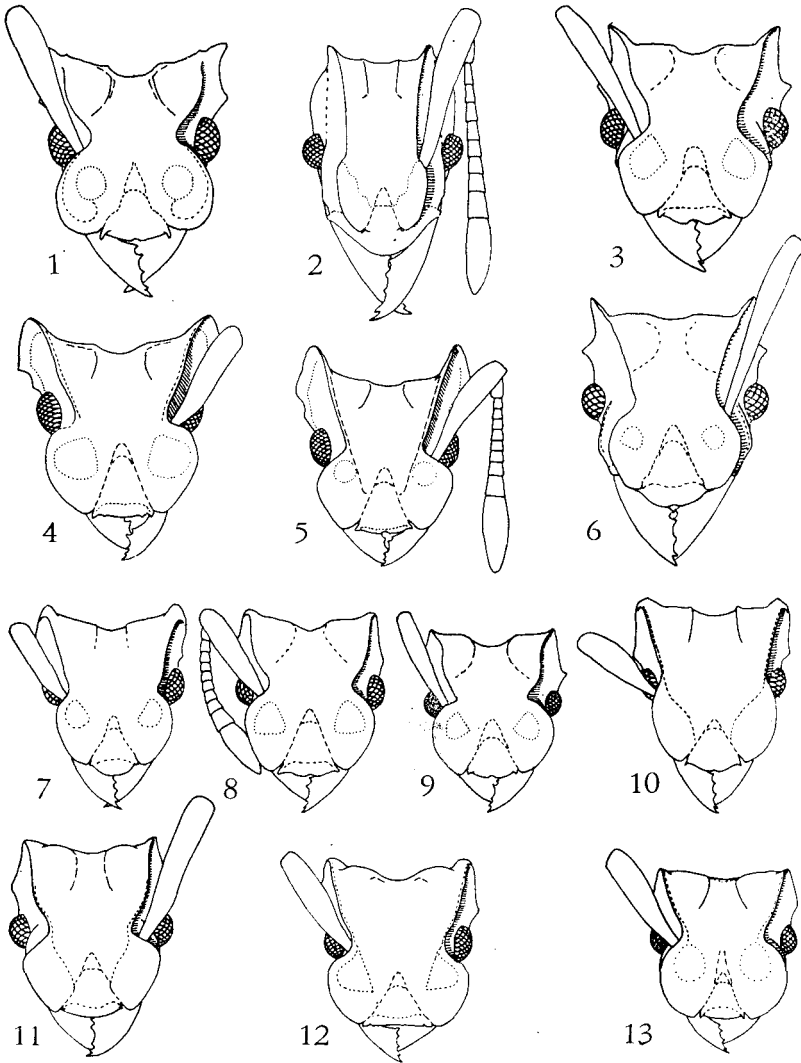
Worker. — Total length 2.8-3.4 mm; head length 0.71-0.85 mm; head width 0.62-0.72 mm; thorax length 0.83-1.06 mm; hind femur length 0.64-0.78 mm. Light yellowish-brown; older specimens also darker. Integument very sharply reticulate-punctate, opaque. Mandibles and funiculi more superficially sculptured and somewhat shining.

Head as shown in Fig. 7. Anterior apron of clypeus flattened, only vestigially notched on convex anterior border; lateral teeth,

next to origin of frontal lobes, small and almost hidden by the latter. Frontal lobes elongate-rounded and flat, covering cheeks in full-face view. Frontal carinae moderately diverging caudad, straight. Occipital corners lobate, prominent, longitudinally carinate. Paired carinae on vertex feeble, short, scarcely diverging cephalad. Preocular carina fading out above eyes, not curving mesad. Postocular carina extending forward from lateral face of occipital lobe, becoming obsolete just in front of posterior orbit of eyes, closing completely the antennal scrobe. Supraocular tumulus dentiform, situated below the postocular carina. Inferior border of sides of head carinate on posterior half. Eyes with 8-10 facets across greatest diameter. Scape strikingly attenuate at base, strongly incrassate apicad, not projecting beyond antennal scrobe. Funicular segments III-IX about as broad as long, I and X longer than broad.

Thorax as shown in Fig. 25. Pronotum with a pair of small denticles on disc, the latter laterally marginate between the marked humeral angle and the strong lateral pronotal tooth; antero-inferior corner acutely dentate. Mesonotum forming a shallowly impressed oval disc, the borders of which are flanked by the pair of anterior and posterior carinate welts; the anterior pair separated from the posterior pair by a small impression. Mesoepinotal suture distinct on bottom of broadly and deeply impressed mesoepinotal groove. Basal face of epinotum transversely shallowly concave, sides somewhat diverging caudad, bordered by carinae, which become foliaceous in front of the compressed, lamellate, acute, epinotal tooth; infradental lamellae low, bordering the upper half of the declivous face. Epinotal spiracle small, situated on the vestigial oblique carinule. Femora, especially hind femora, postero-ventrally crested and bearing on basal first a broader foliaceous lobe (Fig. 49). Tibiae sub-prismatic.

Pedicle as shown in Figs. 25 and 37. Petiolar node trapezoidal in dorsal view, broadest just behind the obliquely truncate anterior corners, its dorsum flattened, oblique; posterior corners with a raised, strong tooth; posterior border likewise raised and lamelliform, connecting the teeth from base to tip. Postpetiole decidedly broader than long, its dorsum with a shallow median impression between a pair of low, longitudinal welts, the extremities of which are tumuliform. Posterior border moderately and evenly rounded. Gaster anteriorly truncate; tergum I with a short antero-median impression, its sides submarginate.



Cyphomyrmex Mayr

Head of worker in full-face view. Fig. 1. *vorticis* Weber (lectotype). — Fig. 2. *longiscapus* Weber (paratype). — Fig. 3. *salvini* Forel. — Fig. 4. *laevigatus* Weber (lectotype). — Fig. 5. *hicornis* Forel. — Fig. 6. *foxi* Ern. André. — Fig. 7. *wheeleri* Forel (syntype). — Fig. 8. *dentatus* Forel (syntype). — Fig. 9. *hamulatus* Weber (syntype). — Fig. 10. *costatus* Mann. — Fig. 11. *kirbyi* Mayr (paratype). — Fig. 12. *transversus* Emery. — Fig. 13. — *peltatus* n. sp. (paratype). — Kempf del. (all figures drawn to the same scale except for fig. 10, which is one and a half times enlarged).

Pilosity scarce, inconspicuous, decumbent throughout; dorsum of head and gaster with small, whitish, scale-like hairs.

Female. — Described both by Forel (1900) and Wheeler (1907) and pictured by Creighton (1950). Differs from *costatus* in larger size, reticulate-punctate body sculpture, presence of paired erect teeth on petiole and absence of two pairs of longitudinal carinae on tergum I of gaster.

Male. — Described by Wheeler (1907) and pictured by Creighton (1950). No specimen seen.

Distribution. — The entire range of *wheeleri* seems to lie outside of the Neotropical region. So far, it has been reported from central and southwestern Texas and southern California in the U.S.A., and from Mexico (Smith, 1951).

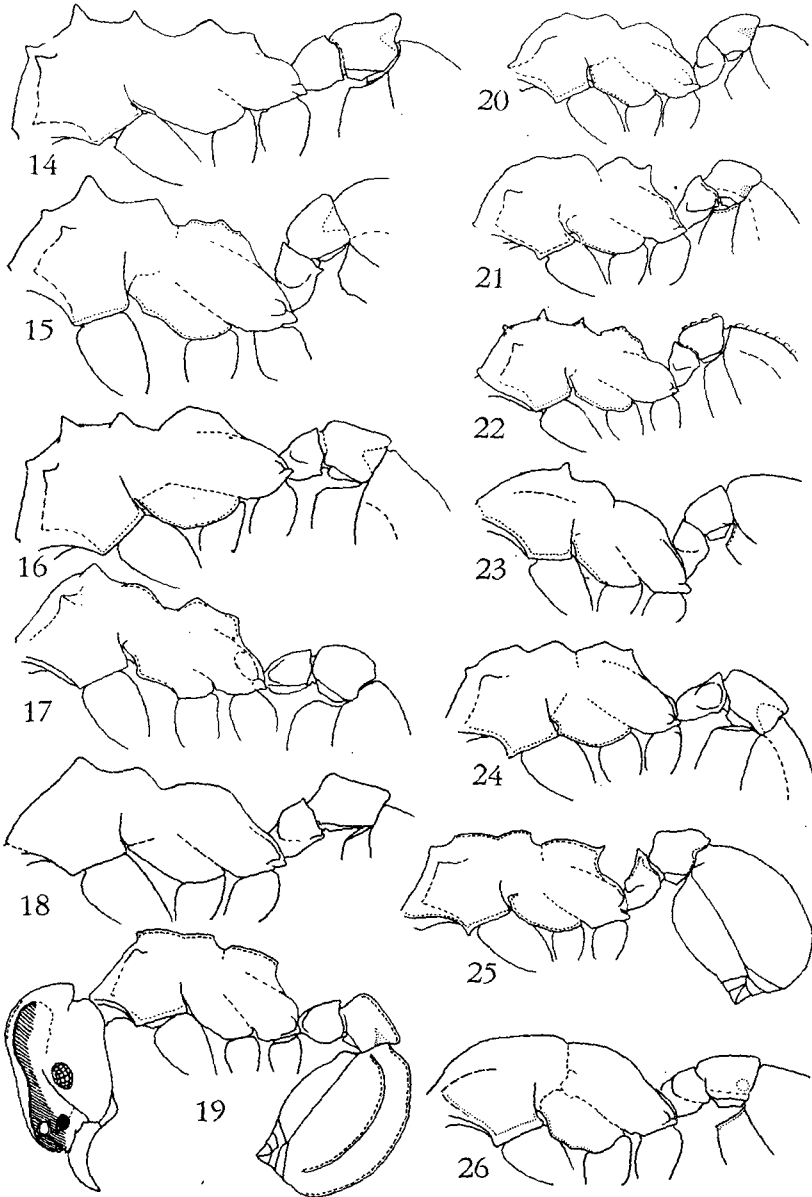
Specimens examined: 6 workers, as follows: U.S.A., State of Texas: Austin, W. M. Wheeler leg. 3 workers (syntypes); Fisher Hill, Davis Mts., July 26, 1955, A. C. Cole leg. 3 workers (WWK).

Discussion. — The variability of *wheeleri*, according to the limited material available for this study, seems to be very little and finds its expression chiefly in size and color. The syntype specimens from Austin belong to the lower range of the measurements, whereas the three workers from the Davis Mts. are considerably larger and partly darker in color.

C. wheeleri is closest to *costatus*. Following are the main differences for the worker caste: Larger size (cf. measurements); body very sharply reticulate-punctate throughout; anterior clypeal border scarcely notched; carinae on vertex weak; postocular carina sharp, the supraocular tubercle lying below the carina; eyes larger with more facets; midpronotal denticles present; antero-inferior pronotal and epinotal teeth acute; petiole with a pair of postero-dorsal teeth; tergum I of gaster without four strongly raised longitudinal costae.

Bionomics. — *C. wheeleri* is more xerophilous than most species of the genus. According to Wheeler (1907: 765-8), whose field studies were made in the vicinity of Austin, it occurs only in arid regions. Nests were found principally on the higher and drier terraces of limestone hills, although a few nests were also discovered in the hard, pebbly soil of open wood at lower altitudes.

The hillside nests are invariably under large stones, which cover both horizontal and vertical galleries (the latter descending into the ground to a depth of 10-15 cm). One of the horizontal galleries communicates with the exterior at the edge of the stone. The entrance is sometimes marked by a small crater. The sessile fungus garden, having the size of pecan nut, is found at a particular widened portion of either the horizontal or the vertical galleries. The garden presents a flocculent appearance, and consists of small slivers of vegetable debris (probably entire sections of stems of herbaceous plants) bound together by the snow white mycelium. Skeletal parts of dead insects, principally fragments of coleopterous elytra, have been found inside the garden; they were probably added to the structure in order to give it consistency. The ants attach the refuse as a flat mass to the undersurface of the stone, or more rarely dump it outside the entrance.



Cyphomyrmex Mayr
 Thorax and pedicel of worker in profile. Fig. 14. *foxi* Ern. André. — Fig. 15. *vorticis* Weber (lectotype). — Fig. 16. *salvini* Forel. — Fig. 17. *kirbyi* Mayr (paratype). — Fig. 18. *longiscapus* Weber (paratype). — Fig. 19. *costatus* Mann. — Fig. 20. *peltatus* n. sp. (paratype). — Fig. 21. *dentatus* Forel (syntype). — Fig. 22. *hamulatus* Weber (syntype). — Fig. 23. *bicornis* Forel. — Fig. 24. *transversus* Emery. — Fig. 25. *wheeleri* Forel (syntype). — Fig. 26. *laevigatus* Weber (lectotype). — Kempf del. (Fig. 19 one and a half times more enlarged than the remaining figures).

The woodland nests were marked by craters of earth crumbs, around a small, circular opening of a vertical gallery, descending to appreciable depth into the soil. Wheeler was unable to unearth the fungus garden.

The colonies usually do not comprise more than a few dozen workers with a single queen. Their activity seems to be mainly nocturnal. Sexual forms appear in the nests ready for nuptial flight from early to late in June. As all other species of the present genus, the worker move slowly and "feign death" at the least disturbance.

3. *Cyphomyrmex flavidus* Pergande

Cyphomyrmex flavidus Pergande, 1895, Proc. Calif. Acad. Sc. (2) 5: 895 (Worker; Mexico, Nayarit: Tepic, Santiago Ixcuintla). — Wheeler, 1907: 726-7 (Worker). — Weber, 1940: 409 (Worker; key).

Types. — Workers collected by Eisen and Vaslit at Tepic and Santiago Ixcuintla in Nayarit State, Mexico; presumably deposited in the U. S. National Museum. No specimens seen. Wheeler (1907) redescribed the species upon a syntype worker. From this description the ensuing information may be gleaned:

Worker. — Rather close to *wheeleri*, with the same reticulate-punctate integument. The differences from *wheeleri* are as follows: petiole and postpetiole strikingly transverse, the former lacking the postero-dorsal pair of teeth; occipital corners broadly truncate, with the apex of the antennal scrobe rectangular, not rounded; antennal scapes a little projecting beyond scrobe; thoracic ridges and projections much blunter; frontal lobes, posteriorly, with a triangular depression in its surface. Size and color as in *wheeleri*. Inasmuch as Wheeler does not mention them, the midpronotal tubercles seem to be lacking also.

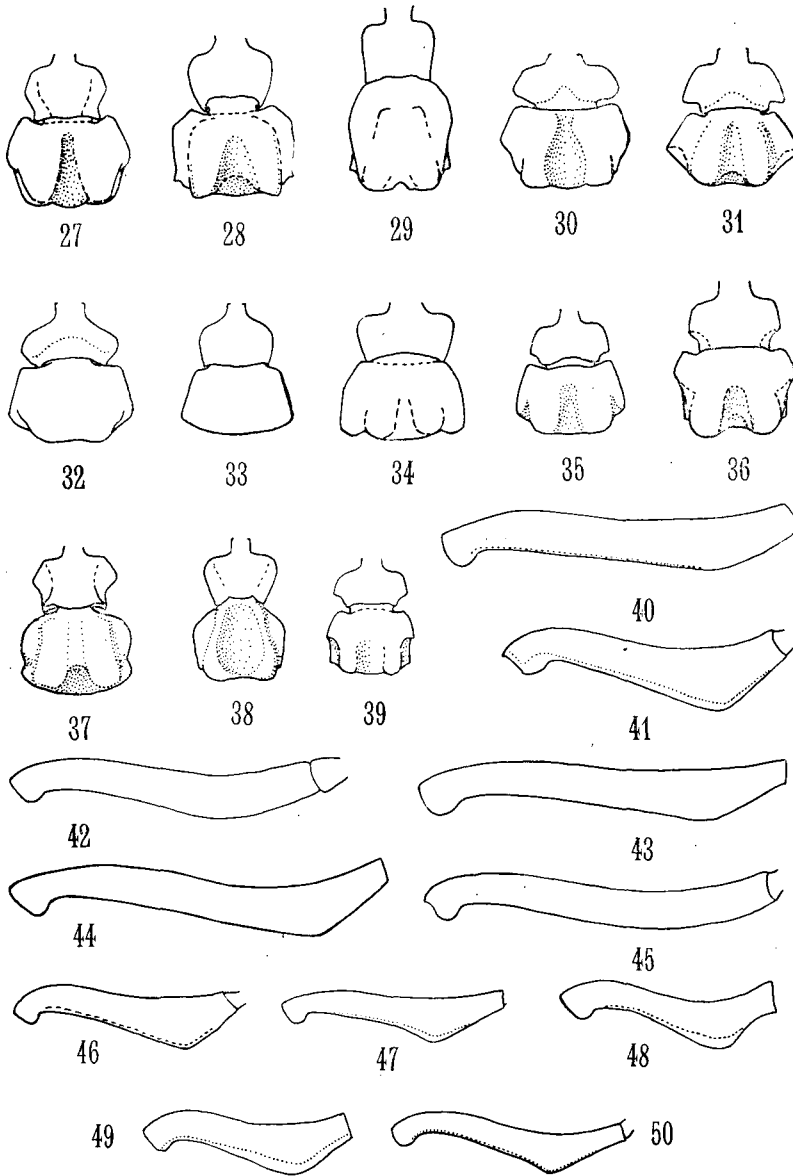
The present species is not included in the key.

4. *Cyphomyrmex costatus* Mann

(Figs. 10, 19, 38, 48)

Cyphomyrmex costatus Mann, 1922: 44-5 (Worker; Honduras: Lombardia). — Weber, 1940: 408, figs. 1-2 (Worker; key). — Weber, 1941: 104-6, pl. 2 (Panama Canal Zone: Barro Colorado Island; Bion.). — Weber, 1956 (1958): 723 (Bion.). — Weber, 1957a: 480-94, figs. 1-5 (Panama Canal Zone: Barro Colorado Island; Panama; Cerro Campana; Bion.). — Weber, 1957b: 638 (Bion.).
Cyphomyrmex colombianus Weber, 1940: 408, 413-4 (Worker; Colombia: Rio Porce, El Hormiguero Mine). — NOV. SYN.
Cyphomyrmex strigatus: G. C. Wheeler, 1948 (*nec* Mayr, 1887): 669-70, pl. 2, figs. 7-8 (Larvae; Panama Canal Zone).

Types. — 3 workers collected by W. M. Mann in rotten wood, presumably deposited in the U. S. National Museum; not seen. Holotype worker (unique) of *colombianus* in the N. A. Weber collection; not seen. One of the three isolated females of *colombianus*, not described but mentioned by Weber (1940: 414), taken at the same locality as holotype, was examined (NAW).



Cyphomyrmex Mayr

Figs. 27-39. Pedicel of worker in dorsal view. 27. *kirbyi* Mayr. — 28. *foxi* Ern. André. — 29. *longiscapus* Weber. — 30. *transversus* Emery. — 31. *dentatus* Forel. — 32. *laevigatus* Weber. — 33. *bicornis* Forel. — 34. *vorticis* Weber. — 35. *peltatus* n. sp. — 36. *salvini* Forel. — 37. *wheeleri* Forel. — 38. *costatus* Mann. — 39. *hamulatus* Weber. — Figs. 40-50. Hind femur of worker. 40. *salvini* Forel. — 41. *laevigatus* Weber. — 42. *kirbyi* Mayr. — 43. *foxi* Ern. André. — 44. *vorticis* Weber. — 45. *costatus* Mann. — 49. *wheeleri* Forel. — 50. *peltatus* n. sp. — Kempf del. (Figs. 38 and 48 one and a half times more enlarged than the remaining figures).

Worker. — Total length 2.1-2.4 mm; head length 0.56-0.61 mm; head width 0.51-0.56 mm; thorax length 0.67-0.75 mm; hind femur length 0.48-0.56 mm. Light brown; dorsum of head and gaster fuscous reddish brown. Integument densely granulose, opaque, with larger, shallow, scattered pits, visible on head and gaster. Antennal scrobe superficially reticulate-punctate and somewhat shining.

Head as shown in Figs. 10 and 19. Anterior apron of clypeus flattened, gently convex, mesially notched, laterally acutely dentate. Frontal lobes semicircular, greatly expanded, covering cheeks in full-face view. Frontal carinae moderately diverging caudad. Occipital corners lobate, not foliaceous, somewhat projecting. Vertex with a pair of carinae that diverge cephalad. Preocular carina fading out above eyes. Postero-inferior border of antennal scrobe bluntly marginate between upper orbit of eye and occipital lobe. Lower border of cheeks bluntly marginate. Eyes with 5-6 facets across greatest diameter. Supraocular tumulus either vestigial or distinct. Scape greatly attenuated at base, strongly incrassate apicad, not projecting beyond scrobe when in repose. Funicular segments II-VIII rather broader than long, IX about as long as broad.

Thorax as shown in Fig. 19. Pronotum lacking mesial tubercles on disc, a small tubercle postero-laterally on each side, just behind the vestigially marginate lateral border of disc; antero-inferior corner of pronotum rectangular. Mesonotum dorsally with a shallow longitudinal impression, flanked on each side by a prominent, bluntly edged carina, which is slightly sigmoidal in dorsal view. In side-view, the carina is feebly impressed just behind the half. Mesoepinotal groove broadly and rather deeply impressed. Basal face of epinotum with a similar longitudinal impression, flanked on each side by a blunt ridge, which slightly diverges caudad; its posterior corner forming a rectangular tooth in side-view. Declivous face laterally unarmed. Epinotal spiracle situated on a vestigial oblique carina. Femora, especially hind femora, postero-ventrally crested, bearing at basal third a broader foliaceous lobe (Fig. 48). Tibiae subprismatic.

Pedicel as shown in Figs. 19 and 38. Petiolar node trapezoidal in dorsal view, broadest in front with rounded corners, its dorsum flattened, with a short, prominent median laminule on posterior border. Postpetiole also slightly broader than long, with a distinct anterior face at right angle to dorsal face, having a median oval depression flanked by blunt, divergent ridges,

bearing a vestigial tumulus on anterior, a more distinct and flat one, on posterior end. Tergum I of gaster with four longitudinal, coarse and blunt carinae; both lateral and median carinae becoming obsolete somewhat in front of posterior border.

Pilosity scarce, consisting of minute, decumbent, silvery hairs on body and appendages:

F e m a l e (undescribed). — Total length 2.8-3.0 mm; head length 0.64-0.72 mm; head width 0.59-0.64 mm; thorax length 0.83-0.88 mm; hind femur length 0.62-0.64 mm. Quite similar to the worker, with the following differences of the caste: Compound eyes with about 10 facets across greatest diameter. Ocelli small, anterior ocellus between anterior end of carinae on vertex, lateral ones on the outer face of the same carinae. Lateral pronotal tubercles well developed. Mesothoracic scutum with a pair of short antero-mesial ridges, starting at anterior border and fading out at the half of the length of scutum. Postero-laterally, a pair of ridges that start at the transcutal suture going forwards to the antero-lateral border, lateral border slightly upturned. Scutellum not separated by sutures from the tubercular and slightly prominent paraptera; posteriorly, the scutellum is bilobate. Epinotal spines prominent, in side-view as long as deep at base, compressed, bluntly tipped. Postpetiole more transverse than in worker. Wings somewhat infuscated, with the usual venation.

M a l e still undescribed. I leave the diagnosis of this caste for another occasion, when it will be possible to treat it comparatively.

D i s t r i b u t i o n. — The territory inhabited by *costatus*, as presently known, extends from Honduras in Central America to the Cordillera Central in northern Colombia.

S p e c i m e n s e x a m i n e d: 9 worker, 5 females and 7 males, as follows: Panama Canal Zone: Barro Colorado Island, June 1955, N. A. Weber leg. 4 workers, 1 female (NAW n. 3483, 3488); same locality, June-October 1943, Zetek leg. 3 workers (MCZ); same locality, January 1960, W. L. Brown, Jr. & E. S. McCluskey leg. 2 workers, 3 females, 7 males (the latter taken in nuptial flight) (MCZ, WWK). — Colombia, Cordillera Central, Rio Porce, 1020 m, 1938, N. A. Weber leg. 1 female (paratype of *colombianus*) (NAW n. 981).

D i s c u s s i o n. — This is the smallest species of the genus, easily recognized, being the only form in the *rimosus*-group having four longitudinal carinae on tergum I of gaster. The closest relative is *wheeleri*, from which it was already distinguished on a foregoing page.

Synonymy. — Prof. Weber based his *colombianus* on a lone worker found at El Hormiguero Mine, on the slope of the Cordillera Central bordering the Rio Porce, Colombia. A little later, he also discovered three dealate females, not yet described, apparently belonging to the same species. The *colombianus* worker is said to differ from *costatus* in somewhat larger size, darker color and shallower mesoepinotal groove. One of the females, received on loan, proved quite similar to the known *costatus* females, except for larger size: total length 3.2 mm; head length 0.78 mm; head width 0.67 mm; thorax length 0.88 mm; hind femur length 0.69 mm. Inasmuch as size alone seems so far to be the only palpable difference between both forms, and as such not very impressive, I propose to place *colombianus* into synonymy of *costatus*.

Bionomics. — The types of the species were found by Mann in rotten wood. No further detail is given.

The bulk of our information has been gathered by Weber, who, in successive studies (1941-57), was able to elucidate many aspects of its biology, so that in this regard *costatus* is one of the best known species of the genus.

Weber's observations were made in Panama, principally on Barro Colorado Island. There, the ants are not uncommon, although seasonal scarcity, due to dry seasons and different stages of the wet season, has been observed. The nests are found in the soil, under stones or rotten wood. The cells, elliptical in shape, are of variable size, according to colony development. 8×5 , 15×10 , 32×13 and 30×20 mm with a maximum height of 10 mm are the dimensions obtained by actual measurements in the field.

The fungus garden is bluish gray in color, friable, and crumbles easily. In nature, the garden, though sessile, is in part supported by rootlets. The substrate, consisting of vegetable debris, is strengthened by quartz sand grains, parts of insect skeletons, notably of ants (Weber gives a list of parts from a variety of species), forming the frame work of the fungus-garden.

In artificial cultures, the ants accepted as substrate dried fecal pellets of caterpillars, rose stamens, and cassava granules dusted with yeast extract. The material collected in Panama, in June 1955, was taken to the U. S. by Prof. Weber, who studied the factors responsible for the production and maintenance of thriving cultures of fungi in ant gardens, despite continual possibilities for contamination. The most striking result of this important research consisted in the development, from artificial cultures, of the sporophore or fruiting stage of the fungus cultivated by *costatus*. This was identified by two specialists as a new species belonging to the agaric genus *Lepiota*.

Individual colonies, always monogynous, may contain from 20 up to nearly 100 workers. Individual behavior, like "jigging" and grooming was likewise observed (cf. Weber, 1957: 484).

Finally, the ant *Megalomyrmex wheeleri* Weber was found living in symbiotic relationship with *Cyphomyrmex costatus*. The former, apparently feeding on the fungus, occurred in 4 nests of the latter. In two nests, there was only a queen of *Megalomyrmex*, in the remaining nests a queen with numerous workers of her own species. In all cases, the guests lived in a separate cell which, however, communicated with the cell containing the fungus garden. The host species did not disturb the guest. Due to adverse conditions, the study of this relationship could not be carried to completion.

Notes. — The larvae described under the name of *C. strigatus* by G. C. Wheeler (1948: 669-670) certainly belong to the present species. Both *strigatus* and *costatus* have four longitudinal costae on gaster, but the former does not occur in Panama.

The figures for this species have been drawn to a larger scale, as compared with the rest of the drawings. So the striking difference in size is not readily apparent.

5. *Cyphomyrmex bicornis* Forel

(Figs. 5, 23, 33)

Cyphomyrmex bicornis Forel, 1895: 179 (Worker; Brasil, Rio de Janeiro: Colônia Alpina nr. Teresópolis). — Weber, 1940: 409 (Worker; key). — Kempf, 1962: 30.

Types. — Worker(s) collected by E. A. Goeldi, presumably deposited in the Forel collection; not seen.

Worker. — Total length 3.2 mm; head length 0.83 mm; head width 0.76 mm; thorax length 1.04 mm; hind femur length 0.83 mm. Brown; head and gaster somewhat darker. Integument densely granular, opaque, including the antennal scrobe.

Head as shown in Fig. 5. Clypeus: anterior border feebly convex with a faint mesial notch, flanked on each side by a small tooth next to origin of frontal lobes. A median tumulus behind frontal area, flanked by a broad circular depression in the frontal lobes, above the antennal sockets. Carinae on vertex short but strong, diverging cephalad. Eyes with about 8 facets across greatest diameter. Preocular carinae curving mesad in front of eyes. Postocular carinae forming the strongly lamellate border the huge, auriculate, occipital lobes, continuing forward and obliquely downward beneath the eyes, fading out just in front of the anterior orbit of eyes. Lower border of sides of head strongly but irregularly carinate. Scape rather thin at base, gradually thickening in a club-like fashion toward apex; its upper and lower border of leading face finely carinate. Funicular segments II-VIII scarcely longer than broad.

Thorax as shown in Fig. 23. Pronotum without dorsal projections, dorso-laterally marginate by a blunt and feeble longitudinal welt; antero-inferior corner subdentate and rectangular. Mesonotum: a pair of anterior, conical, bluntly tipped spines; a posterior pair of more approximate longitudinal welts, which are obtusely carinate, anteriorly diverging and rounded in profile. Mesoepinotal constriction strong. Epinotum completely unarmed and convex in both directions. Legs somewhat compressed, femora ventrally with a lamellate carinule. Hind femora ventrally dilated at basal third into an obtuse triangular lobe (cf. Fig. 41).

Pedicle as shown in Figs. 23 and 33. Petiolar node broader than long, its anterior corners rounded in dorsal view, its dorsum without ridges, its postero-superior border without a projecting laminule. Postpetiole still broader than petiole, strikingly transverse, lacking conspicuous dorsal and lateral impressions and tumuli. Anterior border of tergum I of gaster carinulate above the postpetiolar insertion; laterally immarginate.

Hairs decumbent or appressed on body and appendages, rather fine and not scale-like, somewhat glistening, more conspicuous on scapes and legs.

Female and male unknown.

Specimen examined: 1 worker, collected in July 1956 in leaf mold, in the Itatiaia National Park, Rio de Janeiro State, Brazil, by T. Borgmeier (CTB).

Discussion. — This rare and cryptic species, which so far has been collected only twice, is apparently confined to the woodlands in the Mantiqueira Mountains in Rio de Janeiro State. The specimen described above agrees well with the description of the type. Only the epinotum and postpetiolar dorsum are even smoother than in the type, lacking the vestigial tumuli mentioned by Forel. According to the original description, the mandibles are 5-6 toothed. My specimen has the tips of the mandibles broken off, but it seems that the basic dental number is five, there being a minute intercalary tooth in the diastema between the 2nd and 3rd tooth.

The present species is quite distinct, chiefly in the peculiarly auriculate occipital lobes of head, which occur only in *laevigatus*. The latter, however, differs conspicuously from *bicornis*, from which it will be differentiated on a following page.

6. *Cyphomyrmex laevigatus* Weber

(Figs. 4, 26, 32, 41)

Cyphomyrmex (*Cyphomannia*) *laevigatus* Weber, 1938: 184-5, figs. 20-1 (Worker; Bolivia: lower Rio Madidi). — Weber, 1940: 408 (Worker; key).
Cyphomyrmex laevigatus? Kempf, 1961: 518 (Worker; Surinam: Dirkshoop).
Cyphomyrmex laevigatus: Kempf, 1962: 29-30. — Kempf, 1964: 4.

Types. — 12 workers from a single nest series; 4 workers (lectotype and paratypes) examined (NAW, MCZ).

Worker (lectotype). — Total length 3.5 (3.3-3.7) mm; head length 0.91 (0.85-0.96) mm; head width 0.88 (0.85-0.96) mm; thorax length 1.20 (1.07-1.23) mm; hind femur length 0.91 (0.85-0.94) mm. Rather close to *bicornis* with the following differential characters:

Head (Fig. 4) dorsally with vestigial longitudinal rugae. Clypeus with a small to vestigial accessory tooth mesad of antero-lateral one. Auriculate occipital lobes slightly less projecting caudad. Antennal scape rather abruptly thickened after basal third. Eyes with about 9 facets across greatest diameter.

Thorax (Fig. 26) completely unarmed on dorsum. Pronotal disc laterally rather sharply carinate. Mesoepinotal junction not deeply impressed, but with a distinct mesoepinotal suture. Fore femora dorso-apically with a short longitudinal, lamellate carinule. Hind femora (Fig. 41) as in *bicornis*, not longer than maximum head width.

Pedicle shown in Figs. 26 and 32. Petiole much shorter and broader, likewise without dorsal ridges. Postpetiole with a weak impression laterally, discad of posterior border; the latter vestigially notched in the middle.

Hairs minute, fine, strictly appressed, less conspicuous than in *bicornis*.

Female and male unknown.

Specimens examined: 11 workers, as follows: Bolivia: lower Madidi River, January 1922, W. M. Mann leg. 4 workers (lectotype: NAW; paratypes: MCZ). — Surinam: Dirkshoop, May 1959, primary forest on sand, J. van der Drift leg. 7 workers (WWK and van der Drift collections).

Discussion. — The Surinam specimens fully agree with the types from northwestern Bolivia. The variation in measurements was already given above in the differential diagnosis. *C. laevigatus* seems to be a denizen of the soil in woodland. The Surinam catches came from primary forest and were secured from pitfall traps and desiccated soil samples.

As shown in previous publications (Kempf, 1962, 1964), *laevigatus* is not sufficiently distinct to be placed into a separate subgenus, as proposed by its author (Weber, 1938). It is rather similar to *bicornis* and doubtless still an orthodox member of the *rimosus*-group.

7. *Cyphomyrmex kirbyi* Mayr

(Figs. 11, 17, 27, 42)

Cyphomyrmex kirbyi Mayr, 1887: 557 (Worker; Colombia). — Santschi, 1921: 97-98 (Female; Ecuador: Guayaquil). — Weber, 1940: 408. (Worker; key).
Cyphomyrmex difformis Mayr, 1870 (nec Fr. Smith, 1858): 372 (Colombia).
Cyphomyrmex deformis Forel, 1884 (nec Roger, 1863): 368.

Types. — 11 workers — lectotype and paratypes — from N. Grenada (= Colombia), received on loan from the Mayr collection (NHMW). Mayr, foregoing a detailed description, has proposed this species by merely presenting a few differential characters. Hence I give the following diagnosis, based on the type series.

Worker (lectotype). — Total length 3.6 (3.5-3.7) mm; head length 0.84 (0.80-0.85) mm; head width 0.77 (0.72-0.80) mm; thorax length 1.25 (1.14-1.25) mm; hind femur length 1.07

(0.99-1.09) mm. Dark reddish brown; mandibles, funiculus and legs a bit lighter, without reddish hues. Integument opaque throughout, finely, densely and indistinctly punctate-granulate. Scape reticulate-rugose. Front with a few fine, longitudinal rugulae.

Head as shown in Fig. 11. Mandibles finely striolate-punctate, subopaque; chewing border with 5 teeth, a larger diastema between 2nd and 3rd basal tooth, as in *rimosus* and allies. Anterior border of clypeus not excised in the middle; tooth near origin of frontal lobes obsolescent. Frontal area impressed, hairless. Frontal lobes not semicircular, but somewhat angular, with an acutely rounded corner projecting in front and a more bluntly rounded corner projecting laterad. Posterior prolongation of frontal carinae sigmoidal. Carinae of vertex present, subparallel. Preocular carina curving mesad above eye. There is no postocular carina between posterior border of eye and occipital corner. Supraocular tubercle obtuse and low. Dentate occipital corner little projecting. Occipital border gently excised, a bit more deeply concave between carinae of vertex. Inferior border of cheeks marginate in its entire length. Scape in repose exceeding the occipital corner by nearly twice its maximum thickness. Funicular segments II-IV distinctly longer than broad.

Thorax as shown in Fig. 17. Midpronotal tubercles absent, lateral ones well developed, each sending out forward an ill-defined carinule separating the dorsal face from the lateral face of pronotum. Inferior pronotal corner rather obtuse and not dentate. Mesonotum with two pairs of parallel and subcontinuous longitudinal ridges, the anterior pair in profile dentiform, the posterior pair blunter. Mesoepinotal constriction deep and broad. Basal face of epinotum with a pair of sharp longitudinal ridges, their anterior and posterior ends subdentate in profile; laterally, on sides of thorax, another weaker and lower carina, which bears the epinotal spiracle. Hind femora (Fig. 42) not conspicuously broadened nor angulate beneath.

Pedicel as shown in Figs. 17 and 27. Petiole depressed; node not strikingly transverse but only little broader than long. Postpetiole with a deep postero-median impression, its lateral border practically immarginate.

Pilosity decumbent to appressed, not scale-like yet glistening, golden; rather long and conspicuous on gaster. Tip of tibiae and gaster with a few standing hairs.

F e m a l e. — This caste was made known by Santschi (1921) who gave it the following description:

“Long. 2,7 mm. Diffère de *rimosus* Mayr (sic!), par sa tête un peu plus longue, le bord postoculaire non denté. L'angle de l'épistome forme un petit lobe arrondi (lobe anguleux chez *rimosus*). Le bord antérieur plus arqué, les arêtes frontales moins relevées; sur un plan plus égal à celui du front. Le sillon médian du mésonotum beaucoup moins profond. Les dents de l'épinotum plus longues. Ailes un peu plus claires. Pilosité squameuse, surtout sur le gastre, qui est en outre pruineux. — Équateur: Guayaquil (Rosenberg, 1904) ouvrière et femelle. Muséum de Paris. — Ces exemplaires avaient été déterminés sous le nom de *C. rimosus* Mayr, par E. André, mais ils se rapportent bien mieux à la description de *C. kirbyi*, que je ne connais pas en nature”.

I am afraid that this description is not very helpful for the recognition of isolated females. It is even doubtful whether Santschi's specimens really belong to the present species.

M a l e unknown.

Discussion. — So far, except for the aforementioned Ecuador specimens, *kirbyi* is still known only from the types, hailing from an unknown locality in Colombia.

The paratype workers fully agree with the foregoing description. Their variation as regards the critical measurements was already given above in parentheses.

C. kirbyi doubtless belongs to the *rimosus*-group, and differs from *rimosus* in the shape of the frontal lobes (Fig. 11), absence of conspicuous parafrontal teeth on clypeus, elongate funicular segments II-IV, rather obtusely angulate infrapronotal corner, lack of midpronotal tubercles, sharper and lower meso- and epinotal ridges which never form distinctly conical tubercles, shape of hind femora which are not angulate beneath, significantly less transverse petiole, body hairs which are not squamate but simple, longer and more conspicuous.

The very long scapes and the thoracic profile reminds of *vorticis* and *salvini*, but *kirbyi* lacks the midpronotal tubercles, the prominent spine-like occipital lobes, the ventral lobe or angle on basal third of hind femora.

The Mexican *dentatus* and Brazilian *peltatus* agree with *kirbyi* in the absence of midpronotal tubercles, but differ in smaller size, more thick-set body, different shape of head, thorax, pedicel and hind femora, as can be readily seen by a comparison of the respective figures.

8. *Cyphomyrmex peltatus* n. sp.

(Figs. 13, 20, 35, 50)

W o r k e r (holotype). — Total length 3.1 mm; head length 0.72 mm; head width 0.69 mm; thorax length 1.04 mm; hind femur length 0.85 mm. Ferruginous; dorsum of head, scapes

and tibiae strongly, promesonotum and gaster more lightly intuscatate. Integument densely and finely granulate-punctate.

Head as shown in Fig. 13. Mandibles finely striolate-punctate, somewhat shining. Anterior border of clypeus very gently convex, almost straight; lateral teeth triangular, not projecting. Frontal area impressed. Frontal lobes semicircular. Frontal carinae almost straight, diverging caudad, attaining tip of occipital corner. The latter scarcely salient. Front with a weak and low tumulus just behind frontal area, followed by a shallow transverse depression between greatest constriction of frontal carinae. Carinae of vertex strong, subsemicircular, diverging both cephalad and caudad, the posterior end does not attain the occipital corner. Occiput perpendicular to vertex, distinctly excavate. Preocular carina curving mesad above eye; postocular carina extending from occipital corner to the inferior border of eye, containing the supraocular tooth, which in full-face view appears just as a blunt angle of postero-lateral border of head. Eyes with 7 facets across greatest diameter. Inferior border of cheeks sharply marginate. Antennal scape gradually but strongly incrassate toward apex; surpassing in repose the occipital corner by a distance which distinctly exceeds its maximum width. Funicular segments II-IX not longer than broad, segment I as long as II and III combined.

Thorax as shown in Fig. 20. Midpronotal tubercles absent. Lateral pronotal tooth tubercular and obtuse, sending forward a weak carinule which separates the pronotal dorsum from its sides; antero-inferior corner rectangular. Humeral angle not expressed. Mesonotum with a shallow pentagonal impression margined by blunt carinae formed by the very low and welt-like anterior and posterior pair of tubercles; the latter form at the antero-lateral corner a bluntly projecting tumulus. Mesoepinotal constriction rather strong. Basal face of epinotum laterally immarginate with two indistinct tubercles antero-laterally, blending posteriorly into the declivous face, which is laterally immarginate. Oblique welt on sides of epinotum indistinct. Hind femora (Fig. 50) ventrally angulate at basal third, postero-ventral border narrowly crested.

Pedicle as shown in Figs. 20 and 35. Petiolar node nearly twice as broad as long, the anterior corners rounded, posteriorly strongly constricted in front of postpetiolar insertion; no dorsal ridges nor posterior salient laminule present. Postpetiole without a distinct anterior face, its dorsal face with a sagittal impression

and postero-lateral impressions flanking a pair of blunt and low tubercles, which do not project beyond the entire posterior border. Tergum I of gaster with a feeble antero-median groove; lateral marginations at best vestigial.

Hairs minute, short, shiny and recurved, not scale-like, never completely appressed.

F e m a l e (paratypes). — Total length 3.6-3.7 mm; head length 0.77-0.80 mm; head width 0.75-0.77 mm; thorax length 1.15-1.20 mm; hind femur length 0.88-0.91 mm. Resembling the worker, with the differences peculiar to the caste. — Ocelli very small. Eyes with about 12 facets across the greatest diameter. Lateral pronotal tooth low, blunt, tumuliform. Mesonotum: Scutum with an antero-median, laterally marginate elevation between the anterior arms of the shallowly impressed Mayrian furrows; notauli indistinct. Paraptera flat with rounded border. Scutellum posteriorly bidentate, with a semicircular excision between the teeth. Epinotum continuously declivous, without a differentiated basal face; its upper portion laterally sharply carinate. Middorsal impression of postpetiole deeper. Wings unknown.

M a l e unknown.

S p e c i m e n s e x a m i n e d: 28 workers and 3 females, as follows: Brazil, Santa Catarina; Ibicaré, September 1960, F. Plaumann leg. 6 workers, 1 female (holotype and paratypes); Chapecó, V-1957, F. Plaumann leg. 1 worker; Nova Teutônia, strays from 8 different collections made between October 1953 and February 1963 by F. Plaumann, 17 workers; Rio Grande do Sul: Barão de Cotegipe, July 1960, F. Plaumann leg. 2 workers, 2 females; Boqueirão, September 1960, F. Plaumann leg. 2 workers. (All paratypes and deposited in WWK).

D i s c u s s i o n. — The holotype worker is the tallest of the series; the smallest worker examined measures as follows: total length 2.8 mm; head length 0.66 mm; head width 0.63 mm; thorax length 0.93 mm; hind femur length 0.75 mm. Otherwise the paratypes agree completely with the holotype in all essential features and details.

The present species is very close to *rimosus* but a few constant characters help to differentiate both forms. The worker of *pellatus* differs from sympatric morphs of *rimosus* in the following characters: Lack of midpronotal tubercles; pentagonal impression on mesonotum, margined by the 4 low welts, the anterior pair forming a tubercle at the antero-lateral corner of the pentagon; epinotum completely unarmed, the anterior pair of tubercles bluntly rounded and only vestigial; middorsal post-petiolar impression always deeper; hairs as a rule thin, recurved, not scale-like. The female is at once recognized by the lack of epinotal spines.

The typical *peltatus* is known from southeastern Brazil in the States of Santa Catarina and Rio Grande do Sul. I provisionally associate with the same species stray specimens from northern Brazil (Amazonas: Benjamim Constant, Manaus; Pará: Belém; Mato Grosso: Utiariti) and Surinam (La Poulle, Vank; erroneously identified as *kirbyi* in my paper of 1961: 518), although they are smaller in size, of lighter color, having shorter scapes and rather scale-like hairs.

Another species from Mexico, *dentatus* Forel, is doubtless a close relative of *peltatus*; it will be differentiated in the ensuing description.

9. *Cyphomyrmex dentatus* Forel, n. stat.

(Figs. 8, 21, 31, 46)

Cyphomyrmex rimosus dentatus Forel, 1901a: 124-5 (Worker; Mexico, Morelos: Cuernavaca). — Wheeler, 1901: 200-1 (Bion.). — Wheeler, 1907: 722-3 (Worker, female; Mexico, Morelos: Cuernavaca). — Skwarra, 1934: 131 (Bion.). — Weber, 1940: 412 (Worker, female; key).

Type s. — Workers collected by W. M. Wheeler; deposited in the Forel collection; 5 syntypes from the Wheeler collection (MCZ) examined.

Worker. — Total length 2.9-3.2 mm; head length 0.72-0.73 mm; head width 0.67-0.69 mm; thorax length 0.93-1.04 mm; hind femur length 0.72-0.77 mm. Rather close to the preceding *peltatus*, presenting the ensuing differences:

Pale ferruginous yellow, with the front medium brown in color (some specimens, not the types, are a trifle darker). Body hairs minute, appressed, inconspicuous, absolutely not scale-like. Frontal carinae more sinuous. Carinae of vertex rather feeble and blunt. Eyes larger, with about 9 facets across greatest diameter. Scape shorter, not surpassing the somewhat projecting occipital corner by a distance equalling its maximum width (Fig. 8). Pronotum conspicuously but bluntly dentate at antero-inferior corner (Fig. 21). Mesonotal disc rather elongate elliptical than pentagonal. Mesoepinotal constriction deep. Basal face of epinotum anteriorly with a pair of low tubercles, posteriorly with a pair of triangular prominent teeth. Femora, especially hind femora, deeper (Fig. 46). Petiolar node (Fig. 31) still broader, its sides diverging caudad, its posterior corners bluntly dentate in front of the strongly constricted postpetiolar insertion. Postpetiole relatively shorter and broader. Tergum I of gaster with the antero-median groove nearly as long as postpetiole; lateral marginations of tergum rather distinct.

Female. — There is a short description by Wheeler (1907: 723) which reads as follows:

"Two dealated females of *dentatus* in my collection measure 2.4 mm. (a single spread measurement; hence much too low! W.W.K.) in length, and have prominent but blunt and upturned prothoracic spines and strong laterally compressed epinotal teeth; the epinotal declivity is very concave, the postero-lateral cones of the postpetiole are more prominent and the median dorsal region of the same segment is more concave than in the worker. The head and thorax are much rougher than in the females of the typical *rimosus* and the gaster is more strongly tubercular, with a short but deep median depression at the base of the first segment. The body is dark brown, the upper surface of the head and thorax blackish and covered with a bluish bloom".

Male unknown.

Distribution. — So far, this species is only known from the type locality, where it has been repeatedly collected over the years.

Specimens examined: 10 workers as follows: Mexico, Morelos: Cuernavaca, no date, W. M. Wheeler leg. 5 workers (syntypes) and 2 additional workers with the same data but lacking a type label; same locality, June 26, 1928, E. Skwarra leg. 3 workers (MCZ, WWK).

Discussion. — The differences from *peltatus* were already given above in the differential diagnosis. The *dentatus* worker differs from *rimosus* in the following features: Color lighter and body hairs minute and simple. Scapes of antennae short and barely surpassing the occipital angle. Lack of pronotal tubercles. Mesonotum with a shallowly impressed marginate disc, lacking pronounced and prominent tubercles. Antero-inferior pronotal corner dentate. Petiole transverse, with diverging sides, postero-laterally prominent and cone-shaped corners, followed by a pronounced constriction. Postpetiole relatively short and broad with a deep middorsal impression. Epinotum with salient triangular teeth (this latter feature occurs occasionally in some morphs of *rimosus*, but in this case the remaining features help to separate both species).

The differences for the females are more problematical, since I have not seen any specimens, and Wheeler's description is not sufficient for the diagnosis of isolated females.

At any rate, *dentatus* seems to me sufficiently distinct from *rimosus* to be accorded full specific rank.

Bionomics. — According to Wheeler (1901: 200-1), who first collected this species on December 26 (year not given), the species is "not uncommon along the barrancas where it nests under stones, forming irregular chambers about the roots of the grasses. There are sometimes two queens in a nest. The older and darker queens and workers have the head and thorax covered with a bluish bloom. *C. rimosus* (Wheeler obviously refers to the present form which he considered as a mere race of *rimosus*! W.W.K.) is said not to cultivate mushroom gardens, but this is scarcely correct. They certainly collect caterpillar excrement and on this they grow a peculiar fungus which is not in

the form of a white mycelium, like that cultivated by some other species of *Cyphomyrmex* (*C. wheeleri* Forel, for example) but consisting of clusters of small orange yellow, spherical or pyriform nodules about 5 mill. (= 0.5 mm?) in diameter. The exhausted masses of caterpillar excreta are piled on the refuse heap in a distant corner of the nest. The eggs of *C. rimosus* (again the present form is meant! W.W.K.) are very broad and short, almost spherical".

Dr. Skwarra (1934: 131) rediscovered the same species at Cuernavaca, finding two earth nests, one of them in the loosely heaped up refuse of *Atta* nests. She surmises that *dentatus* possibly uses this material as substrate for its own fungus.

10. *Cyphomyrmex foxi* Ern. André

(Figs. 6, 14, 28, 43)

Cyphomyrmex foxi Ern. André, 1892: 55-6 (Worker; Jamaica). — Wheeler, 1917: 461-2 (Female; Jamaica; Newton). — Weber, 1940: 408-9, 412 (Worker; key).

Types. — Workers collected by J. W. Fox at an unknown locality in Jamaica. Place of present deposition of types unknown to me.

Worker. — Total length 3.8-4.0 mm; head length 0.95-0.97 mm; head width 0.80-0.87 mm; thorax length 1.28-1.33 mm; hind femur length 1.17-1.23 mm. Dark reddish brown; mandibles, funiculi and tarsi yellowish brown. Integument opaque, finely and densely granulate-punctate; head, thorax and pedicel covered with dense rugae, which are predominantly longitudinal on head, sides of thorax and pedicel, but transversely arched between promesonotal armature and postpetiolar tubercles.

Head as shown in Fig. 6. Mandibles densely punctate-striolate. Anterior apron of clypeus flat, prominent, anterior border strongly convex and feebly notched in the middle. Lateral teeth of clypeus acute but hidden in full-face view under tip of frontal lobes. The latter moderately expanded laterad, their maximum width scarcely matching the interocular width, exposing part of the cheeks in full-face view. Frontal carinae nearly straight and diverging caudad, reaching tip of prominent occipital spines. Front with a broad but shallow transverse impression between laterally carinate frontal area and semicircular carinae on vertex. Preocular carina gently curving mesad above eyes, visible in full-face view. Postocular carina feebler, reaching from postero-inferior orbit of eye to tip of occipital spine, bisected by the prominent supraocular tooth. Eyes with approximately 10 facets across greatest diameter. Inferior border of cheeks sharply marginate. Scape in repose surpassing apex of occipital spine by a distance equalling twice its maximum diameter. All funicular

segments longer than broad, segment I shorter than II and III combined.

Thorax as shown in Fig. 14. Midpronotal teeth short but acute; lateral ones long and spine-like, projecting obliquely laterad and upward, longer than the pair of stout, conical, anterior mesonotal spines. Lateral border of pronotal disc vestigially carinate. Antero-inferior pronotal corner subrectangular. Posterior pair of mesonotal spines subequal to midpronotal ones. Mesopinotal constriction broad but rather shallow. Basal face of epinotum with a pair of longitudinal sharp carinae, which in profile form two succeeding obtuse teeth; infradental lamella of posterior tooth descending halfway down the declivous face. Oblique welt on sides of epinotum rather prominent. Hind femora (Fig. 43) moderately angulate in front of basal third; postero-ventral border vestigially carinate.

Pedicel as shown in Figs. 14 and 28. Petiolar node with convex sides, lacking a postero-dorsal salient laminule. Postpetiole much broader, bearing postero-dorsally a prominent, stout and bluntly tipped pair of tubercles. Tergum I of gaster with a very short and feeble antero-median groove, the lateral margination at best vestigial.

Pilosity simple, not scale-like, hairs recurved to appressed.

F e m a l e . — This caste was described by Wheeler (1917: 461-2) as follows:

“The female, hitherto undescribed, is represented by a single, dealated individual. It measures 3.4 mm. and closely resembles the worker in color, sculpture, and pilosity and in the structure of the head. The spines on the humeri of the pronotum are long and stout. The mesonotum is flattened above, as broad as long, with a pair of low longitudinal welts anteriorly and expanded postero-lateral borders, bluntly dentate anteriorly and posteriorly. The scutellum is bluntly bidentate and projecting. The epinotum is abruptly declivous, without distinct base and declivity, and with a pair of longitudinal ridges terminating behind in large, blunt, compressed teeth. Between these ridges the surface is transversely rugose. The petiole is small and similar to that of the worker, the postpetiole very large, broader than long, subrectangular when seen from above, with two short, blunt, longitudinal ridges, terminating in large blunt projections behind and separated by a deep concavity. The gaster is broadly oval, hardly longer than broad, rounded above, on the sides and

behind, without longitudinal ridges and with a distinct median longitudinal groove at the base".

Male unknown.

Specimens examined: 6 workers, taken at Newton, Jamaica, at an altitude of 3000 ft., C.T. Brues leg., January 1912 (WWK).

Discussion. — This striking species, which is restricted to the Island of Jamaica in the Caribbean Sea, on account of the larger size and the salient spinulation of occiput and thorax, resembles the continental species *vorticis* and *salvini*. The moderately expanded frontal carinae, the prominent clypeal lobe, the very long lateral pronotal spines, the raised paired tubercles on postpetiole, the densely rugose integument of head, thorax and pedicel set *foxi* at once apart from its closest relatives.

Note. — In a footnote to his key to the species of *Cyphomyrmex*, Weber (1940: 412) states his well founded suspicion that *rimosus* var. *arnoldi* Aguayo might be identical with the present species.

11. *Cyphomyrmex vorticis* Weber

(Figs. 1, 15, 34, 44)

Cyphomyrmex vorticis Weber, 1940: 409-10 (Worker; Bolivia: Santa Helena).

Types. — Workers taken by W. M. Mann at Santa Helena, Bolivia, in August 1921. A single specimen (lectotype NAW) seen.

Worker (lectotype). — Total length 3.8 mm; head length 0.88 mm; head width 0.85 mm; thorax length 1.28 mm; hind femur length 1.28 mm. Medium brown; dorsum of head, scapes, tibiae and gaster darker with ferruginous hues. Integument opaque; densely and minutely punctate-granulate.

Head as shown in Fig. 1. Mandibles finely reticulate-rugulose, somewhat shining; chewing border with a broader diastema between 2nd and 3rd basal tooth. Clypeus with flattened anterior apron, the border of which is gently convex and notched in the middle; on each side it bears a prominent tooth. Frontal lobes very broadly expanded, the anterior curvature stronger than the posterior one; upper surface with a depressed circular area above the antennal socket. Frontal carinae sigmoidal, not quite reaching occipital corner, their border somewhat elevated at place of greatest constriction. Front with a feeble tumulus at frontal area, followed by a transverse shallow depression. Carinae of vertex semicircular, having as center a prominent tubercle; from there they diverge both cephalad and caudad. Occipital corners strongly dentate, tooth curving slightly upward and outward. Occiput oblique, not perpendicular. Preocular carina

curving mesad above eyes. Postocular carina beginning below eye and extending backwards to the prominent supraocular tooth. Eyes with about 11-12 facets across greatest diameter. Inferior border of cheeks strongly and irregularly crested. Scapes gradually incrassate toward apex, surpassing the occipital corner by more than their maximum width. All funicular segments longer than broad, segment I as long as II and III combined.

Thorax as shown in Fig. 15. Pronotum with small median, stronger lateral teeth; the latter connected with the feebly marked humeral angle by a blunt carina; antero-inferior tooth rectangular. Mesonotum with strong paired conical anterior teeth, followed by another pair of low elongate and blunt tubercles. Mesoepinotal constriction deep. Basal face of epinotum flanked by sharply carinate ridges in its entire length; space between ridges shallowly excavate. Declivous face laterally immarginate. Lateral blunt and oblique welt well developed, bearing the spiracle. Hind femora (Fig. 44) angular beneath in front of basal third, then gradually tapering toward apex; the postero-ventral border very slightly carinate.

Petiole and postpetiole as shown in Figs. 15 and 34. Petiolar node strikingly transverse without ridges or prominent postero-dorsal laminule. Postpetiole even broader, with a pair of low diverging tubercles near entire posterior border, separated by a shallow median depression. Gaster anteriorly sharply marginate; tergum I without an antero-median impression and a distinct lateral margination.

Pilosity inconspicuous, minute and appressed, not scale-like; more visible on appendages and sharp ridges of body where they become decumbent.

Female and male unknown.

Distribution. — Although collected only twice, it is quite possible that *vorticis* is confined to the upper Amazon basin, in northwestern Brazil and northern Bolivia.

Specimens examined: 3 workers; besides the lone lectotype (NAW) already mentioned above, two more workers from Brazil, Rondônia territory, São Pedro, Rio Jamarí, O.P. Forattini leg. on July 11, 1960 (WWK).

Discussion. — The Brazilian workers agree completely with the Bolivian type. Their measurements are the following: total length 3.6-3.9 mm; head length 0.83-0.88 mm; head width 0.78-0.83 mm; thorax length 1.20-1.31 mm; hind femur length 1.14-1.28 mm.

The closest ally of *vorticis* is *salvini*, differing the former from the latter in the following features: Body hairs simple, never scale-like; frontal lobes strikingly different in shape, broadly rounded cephalad, the curvature gradually decreasing caudad (cf. Figs. 1 and 3); the sigmoidal frontal carinae always fade out before reaching the spine-like occipital lobe; basal face of epinotum strongly and sharply carinate in its entire length; posterior mesonotal tubercles low, not tooth-like nor conical; petiole not noticeably constricted at each side just in front of postpetiolar insertion.

Nothing is known as regards the biology of *vorticis*.

12. *Cyphomyrmex salvini* Forel

(Figs. 3, 16, 36, 40)

Cyphomyrmex rimosus salvini Forel, 1899: 40, pl. 3, fig. 2 (Female; Panama: Bugaba). — Wheeler, 1907: 724 (Worker, male; Costa Rica: Port Limón). — Forel, 1908: 43 (Costa Rica: Isla de Cocos). — Weber, 1940: 412 (Worker, female, male; key).
Cyphomyrmex salvini: Weber, 1958: 261 (Worker).
Cyphomyrmex acutus Weber, 1940: 409 (Worker; Panama C. Z.: Barro Colorado Island). — Weber, 1941: 107-8 (Bion.). — NOV. SYN.
Cyphomyrmex salvini acutus Weber, 1958: 261 (Worker).

Type. — A lone dealate female, collected by Champion at Bugaba, Panama, presumably deposited in the British Museum (Natural History); not seen. Types of *acutus* in the Weber collection (NAW); not seen.

Worker. — Total length 3.3-3.8 mm; head length 0.80-0.93 mm; head width 0.69-0.83 mm; thorax length 1.07-1.28 mm; hind femur length 1.01-1.17 mm. Close to the preceding *vorticis*, with the following differences:

Head (Fig. 3): Frontal lobes somewhat pointed cephalad, nearly straight and strongly diverging laterad, conspicuously rounded caudad. Frontal carinae either reach (as in *rimosus*) or do not reach (as in *vorticis*) the occipital lobe. Occiput rather perpendicular than oblique. Funicular segment I shorter than II and III combined.

Thorax (Fig. 16): Antero-inferior corner of pronotum forming an obtuse angle. Posterior mesonotal tubercles conical, although rather low, but not welt-like. Pair of longitudinal carinae on basal face of epinotum blunt, usually confined to the anterior half; when extending over posterior half then only vestigial. Oblique welt on sides of epinotum usually not well developed. Hind femur shown in Fig. 40.

Petiolar node (Fig. 36) more strongly constricted behind, just in front of postpetiolar insertion. Median and lateral impressions in front of posterior border of postpetiole deeper, the paired tubercles, which separate these impressions, stronger.

Body hairs conspicuous, squamous, either appressed or recurved as on scapes and ventral borders of head and on legs.

F e m a l e. — This caste was described by Forel as follows:

“Long 3.7 millim. Lobe antérieur des arêtes frontales fort grand, plus grand que chez le *C. rimosus*. Angles postérieurs de la tête prolongés en oreilles recourbées plus longues que chez le *C. strigatus*, mais bien plus courtes que chez le *C. auritus*. Le bord médian des arêtes frontales forme deux arêtes qui bordent l'épistome et l'aire frontale en forme de triangle. Chaque ocelle est placé sur une élévation; celle des deux latéraux se prolonge en arête arquée vers l'angle postérieur de la tête. Le pronotum a devant, en haut, de chaque côté une forte dent triangulaire. Le mésonotum a devant, en haut, au milieu, un disque arrondi et bordé; au milieu, en arrière de ce disque, deux arêtes longitudinales très obtuses, de côté un large feston. Le proscutellum a un feston de côté. Le scutellum est profondément échancré et bidenté. Le métanotum a deux très petites dents. Les deux noeuds du pédicule rectangulaires, plus larges que longs, le 2^{me} beaucoup plus large. Abdomen très convexe, à peine subbordé, sans trace d'élévations ni de dépressions à sa surface. Mat. Microscopiquement raboteux; finement tuberculeux et rugueux. Tout le corps couvert, comme chez le *C. rimosus*, i. sp., d'une pubescence espacée, courte, épaisse, brillante et squameuse. D'un brun roussâtre ferrugineux. Tête et abdomen bruns foncés. — Diffère du *C. rimosus* para ses oreilles et ses arêtes beaucoup plus fortes”.

Male described by Wheeler (1907); see below under *championi*.

Distribution. — So far, *salvini* is known to occur in Panama and Costa Rica, also on the oceanic Isla de Cocos, off the west coast of Costa Rica, where it may have been imported (Forel, 1908: 43).

Specimens examined: 18 workers, 1 male, as follows: Panama Canal Zone: Barro Colorado Island, date unknown, W. M. Wheeler leg. n. 737, 3 workers (identified as *acutus* by Weber); same locality, January 1960, W. L. Brown & E. S. McCluskey leg. (M-66) 6 workers (WWK). — Panama: Cerro Campana, 800-950 m, January 17, 1960, G. B. Fairchild and W. L. Brown, Jr. leg. (B-85 and B-95) 5 workers (WWK). — Costa Rica: San José, date unknown, H. Schmidt leg. 1 worker (CTB); Port Limón, March 25, 1905, J. C. Paulmier leg. 3 workers, 1 male (MCZ).

Discussion. — Although resembling rather closely *vorticis*, from which it was already differentiated above, *salvini* presents an even more intimate relationship with *rimosus*, already shown by the fact that up to recently it had been considered just as a race of the latter. The larger size, the prominent tooth-like occipital corners, the salient supraocular teeth, the conical or spine-like mesonotal projections, the strongly developed ridges and impressions on head, the longer legs are the chief features that separate *salvini* from *rimosus*.

Attention is called to the fact that only the lone female from Panama, described by Forel (1899), is a type specimen (holotype). The association of the worker caste to this female, proposed by Wheeler (1907), although merely founded upon the similarity of differential characters, seems quite tenable.

Wheeler's workers from Port Limón, Costa Rica, both in the Wheeler and Forel collection, bear erroneously type labels. Moreover, the Forel collection, according to Weber (1958), contains another worker specimen lacking a locality label. Weber suspects that this is a syntype. However, inasmuch as Forel, in the original description of *salvini*, does not mention any worker specimens accompanying the female, it is quite improbable that this is a type. To the contrary, I rather believe that this worker is the specimen from Cocos Island mentioned by Forel in 1908.

In a revisionary note, Prof. Weber (1958) raised *salvini* to full specific category and reduced his own *acutus* to a subspecies of *salvini*. While I fully agree with the former step, I have come to the conclusion that *acutus* is nothing but a straight synonym of *salvini*. All the specimens coming from the type locality of *acutus*, i. e. Barro Colorado Island, agree completely with the Port Limón specimens, which are the digms for the worker caste of *salvini*.

Bionomics. — Very little is known of *salvini* in this regard. So far, no record of the nest structure and fungus garden has been published. Weber's (1941: 107-8) observations refer to stray workers on Barro Colorado Island. One of them carried a piece of substrate in its mandibles. Although this material could not be examined more closely because the ant dropped it while being picked up, it looked like the type of substrate used by the mycelium growers, not by the yeast cultivators. Incidentally, Weber turns this surmise into a condition for the definite separation of *salvini* from *rimosus* (a yeast cultivator), which to me looks like asking too much. Fore nobody doubts about the specific distinction among the mycelium growers in spite of the possibility that all or most of them cultivate the same kind of fungus.

13. *Cyphomyrmex championi* Forel

Cyphomyrmex championi Forel, 1899: 41, pl. 3, fig. 3 (Male; Panama: Volcano de Chiriquí).

Type. — A lone male (holotype) collected by Champion, deposited in the British Museum (Natural History).

Not being prepared for a critical study of *Cyphomyrmex* males, I gave this specimens only a perfunctory glance during my visit to the British Museum in August 1964. The specimen looks like a big *rimosus* male with comparatively huge frontal lobes. A future revision of the males of genus *Cyphomyrmex*

will probably show that *championi* is the male caste of *salvini* Forel. The types of both species are from Panama, and both were described by Forel in the same paper.

14. *Cyphomyrmex transversus* Emery, n. stat.

(Figs. 12, 24, 30)

- Cyphomyrmex rimosus transversus* Emery, 1894: 226 (Worker, female; Brazil: Mato Grosso). — Emery, 1905: 161 (Brazil, Mato Grosso: Coxipó). — Wheeler, 1907: 723-4 (Worker, female, male; Syn.; Brazil: Ceará; Pernambuco: Olinda). — Bruch 1915: 529 (Argentina: Salta, Tucumán). — Wheeler, 1925: 45 (Worker; Brazil, Rio Grande do Norte: Natal). — Borgmeier, 1927: 126-7 (Brazil: Rio Grande do Sul). — Santschi, 1931: 280, fig. 3 (Worker). — Santschi, 1933: 118 (Argentina, Misiones: Loreto). — Weber, 1940: 412 (Worker; key). — Kusnezov, 1949: 436, 442, figs. 6-14 (Worker; key; Argentina, Tucumán: Río Salí, Los Puestos; Salta: Río Saladillo, Cafayate, Cerro San Isidro; Santiago del Estero; Termas de Río Hondo, Santo Domingo, Palo Errao, Siete Árboles). — Kusnezov, 1957: (260-1) (Discussion; Syn.). — Weber, 1958: 260-1 (Worker, female; except new syn.).
- Cyphomyrmex dentatus olindanus* Forel, 1901b: 337 (Worker; Brazil, Pernambuco: Olinda).
- Cyphomyrmex rimosus* var. *pencosensis* Forel, 1914: 281-282 (Worker; Argentina, San Luis: Alto Pencoso). — Bruch, 1916: 323-4, fig. 14, pl. 10, fig. 1 (Worker). — Gallardo, 1916: 324 (Argentina, Buenos Aires: Buenos Aires, Tandil; Córdoba: Alta Gracia). — Bruch, 1923: 201-2, fig. 13, pl. 2, figs. 1-3 (Worker; fungus garden). — NOV. SYN.
- Cyphomyrmex rimosus transversus* var. *pencosensis*: Santschi, 1931: 278-9, figs. 4, 8, 9 (Worker, female, male; Argentina, Córdoba: Alta Gracia, Tanti Viejo, La Paz; Santa Fe: Fives Lille).
- Cyphomyrmex rimosus pencosensis*: Weber, 1940: 411 (Worker, female, male; key). — Kusnezov, 1949: 436, 441 (Worker; key; Argentina, Salta: Cafayate, Aguas Blancas; Tucumán: Saladillo, Tucumán). — Kusnezov, 1957: 10 (Worker; key).

Types. — Workers and a female, collected by P. Germain at an unidentified locality in Mato Grosso, Brazil, presumably in the Emery collection; not seen. One syntype worker of *olindanus* Forel received on loan from the MCZ. Types of *pencosensis* presumably in the Forel collection; not seen.

Worker. — Total length 2.7-3.4 mm; head length 0.67-0.83 mm; head width 0.64-0.80 mm; thorax length 0.88-1.09 mm; hind femur length 0.69-0.83 mm. Uniformly yellowish brown to more or less fuscous brown; especially cephalic dorsum and gaster are occasionally more distinctly infuscated. Integument finely and densely punctate-granulate, opaque.

Head as shown in Fig. 12. Mandibles reticulate-striolate and somewhat shining. Clypeus having the anterior border either straight or slightly concave, bearing on its corners a weak, blunt tooth. Frontal area impressed, without hairs. Frontal lobes semicircular, greatly expanded laterad; frontal carinae a bit sinuous and diverging caudad, attaining the slightly produced occipital corner. Midfrontal tumulus and transverse frontal groove extremely feeble; head disc nearly flat. Paired carinae on vertex blunt, low, extremely weak to vestigial. Preocular carina curving mesad above eye, not joining up with the feeble carina extending

from the occipital lobe forward to the postero-inferior border of eye. The latter with about 9-10 facets across its greatest diameter. Supraocular tubercle usually weak, contained in, and marked as a blunt angle of, the postocular carina. Inferior border of cheeks sharply marginate. Scape in repose surpassing the occipital corner by a distance subequal to its maximum width. Funicular segments II-IX not longer than broad; segment I a bit longer than II and III combined.

Thorax as shown in Fig. 24. Pronotum dorsally with four tubercles, the median pair smallest; antero-inferior corner with a prominent tooth; sides of dorsal disc feebly marginate in front of the blunt, lateral tubercles. Mesonotum shallowly impressed, flanked by two pairs of low, ridge or welt-like tubercles; both the anterior and the posterior pair often fused to each other forming transverse, semicircular ridges, somehow imitating the condition obtained in *peltatus* and *dentatus*. Mesoepinotal constriction usually rather shallow in profile, forming an extremely blunt angle. Basal face of epinotum subquadrate, laterally bluntly marginate, each side bituberculate, the anterior tubercle obtuse, the posterior usually more prominent and tooth-like, situated below the level of basal face on the upper third of the declivous face. Basal third of hind femora gradually incrassate on flexor face, then forming an obtuse angle; the distal two thirds attenuate; posterior border of flexor face sharply marginate or even carinulate especially on bent.

Pedicel as shown in Figs. 24 and 30. Petiolar node strikingly transverse, about thrice as broad as long, lacking a dorsally produced crest and teeth on posterior border; strongly constricted in front of postpetiolar insertion. Postpetiole likewise rather broad, with a usually deeply impressed midlongitudinal groove and a shorter and broader groove posteriorly on each side. Tergum I of gaster with an antero-median groove, at least as long as petiole and hairless; lateral borders of same tergum distinctly marginate.

Body hairs squamate and reclinate, unusually short, thick and conspicuous on head, thoracic dorsum and gaster; narrow, squamate and appressed hairs on scapes and legs.

Female. — Total length 3.5-4.2 mm; head length 0.80-0.93 mm; head width 0.76-0.88 mm; thorax length 1.09-1.33 mm; hind femur length 0.80-1.04 mm. This caste resembles quite closely that of *rimosus*. The lateral ocelli, not prominent nor placed on raised ridges; the distinctly dentate antero-inferior

corner of pronotum; the always well developed and salient epinotal spines; the striking width of the pedicelar segments, even better expressed in this caste than in the worker; the deep longitudinal furrow on the postpetiolar dorsum, distinguish *transversus* from *rimosus*. The squamate body hairs are of the same kind as in worker. Wings infuscated, venation as represented by Kusnezov (1949, pl. 1, fig. 15).

Male. — There is a scant diagnosis of this caste in Wheeler (1907: 724).

Distribution. — The present species is known to occur from northern Brazil to central Argentina. Being more xerophilous than the otherwise omnipresent *rimosus*, it even occurs in the dry northeastern Brazil as the only representative of the genus.

Specimens examined: 83 — 68 workers, 9 females and 6 males — as follows: *Argentina*, Chaco: R. Saenz Peña, October 19, 1933, A. A. Ogloblin leg. 1 female (MCZ); Santa Fé: Fives Lille, Weiser leg. 4 workers (CTB). — *Brazil*, Rio Grande do Sul: Porto Alegre, May-June 1926, Haertel and P. Buck leg. 4 workers (CTB); São Paulo: Agudos, 8 different collections between March 1952 and October 1957, W. W. Kempf and C. Gilbert leg. 29 workers (WWK); Rio de Janeiro: Cabo Frio, July 1926, T. Borgmeier leg. 4 workers, 2 females (CTB); Minas Gerais: Araçuaí, Nov. 1926 and October 1929, P. Thiemann leg. 9 workers, 3 females, 2 males (CTB); Goiás: Goiânia-Campinas, April 1927, S. Schwarzmaier leg. 5 workers, 1 female (CTB), Leopoldo Bulhões, May 1935, S. Schwarzmaier, leg. 1 female, 1 male (CTB); Bahia: Jacobina, December 1953, C. R. Gonçalves leg. 2 workers, 2 males (CTB); Pernambuco: Olinda, without date and collector, 3 workers including a syntype of Forel's *olindanus* (MCZ, CTB), Tapera, without date, B. Pickel leg. 2 workers (CTB); Ceará: Ubajara, December 1948, C. R. Gonçalves leg. 1 worker (CTB); Pará: Óbidos, January 1949, C. R. Gonçalves leg. 1 worker (CTB), Vigia, November 1943, C. R. Gonçalves leg. 2 workers, 1 female, 1 male (CTB); Amazonas: Manaus, October 1953, C. R. Gonçalves leg. 2 workers (CTB).

Discussion. — Emery's original description of the present species, in spite of its brevity, contains the main distinguishing features. Further descriptive details and discussions are contained in the papers by Wheeler (1907, 1925), Santschi (1931, fig. 3, which represents a profile of the thorax of a syntype worker), Weber (1940, 1958), Kusnezov (1949). Already in 1925 Wheeler suggested that *transversus* "might be

properly regarded as a distinct species". However, the conservative view prevailed and *transversus* has constantly been considered a subspecies of *rimosus* up to the present time.

Although *transversus* is doubtless a close ally of *rimosus*, it exhibits nevertheless a set of good distinguishing characters, constant throughout its vast range. Furthermore, both forms occur side by side over a vast part of South America. Hence full specific rank is evidently indicated for *transversus*.

The chief separatory characters between *transversus* and *rimosus* s. l. have already been given for the female in the foregoing diagnosis. The worker differs from *rimosus* in the feeble and low pair of carinae on vertex; the distinctly dentate antero-inferior corner of pronotum; the low mesonotal ridges, as seen in profile, especially the posterior pair — both pairs encircling the slightly impressed disc much as in *pellatus* and *dentatus*; the rather shallow mesoepinotal constriction, appearing as an obtuse angle in profile; the two pairs of tubercles on the posterior corner of the basal face of epinotum; the strikingly transverse pedicellar nodes, principally the petiole; the deeply impressed middorsal groove on postpetiole; the long and hairless antero-median groove on tergum I of gaster; the body hairs which are thickly squamate, especially on head, thorax and gaster. Although due to variation proper to this group some of the aforesaid characters may occasionally fail to reach their full expression — or *rimosus* in one or the other specimen may imitate one or very few of the characters of *transversus* — their ensemble will always be sufficient to separate *transversus* from *rimosus*.

Synonymy. — There is no doubt about the absolute identity between *transversus* and *olindanus*, first recognized by Emery (1905) and formally proposed by Wheeler (1907), who had received a syntype of *olindanus* from Forel. Recently, Weber (1958) sunk his own *rimosus venezuelensis* as a synonym of *transversus* after a comparison made between the respective types. Having seen three syntype workers of *venezuelensis*, I cannot agree with this procedure. Indeed, *venezuelensis* has exceptionally low mesonotal tubercles and a rather broad petiolar node, but fails to reproduce all other distinguishing features of *transversus*. Hence I propose to reinstate *venezuelensis* and place it provisionally under *rimosus*. Its final status depends from a through revision of the latter.

A new synonym for *transversus* is herewith proposed, namely *rimosus* var. *pencosensis* Forel. This form has been amply quoted (perhaps some records in the literature don't even refer to this form), but only Santschi (1931) seems to have given any thought to its systematic relationship. He showed that the closest relative is not *rimosus fuscus* Emery, as propounded by Forel, but *transversus*, from which it differs merely and exclusively in its darker color.

Unfortunately, Santschi did not sink *pencosensis* right there, but satisfied himself by lowering it as a variety under *transversus*. Weber (1940), in his synopsis of the genus, raised *pencosensis* to subspecific rank, probably overlooking Santschi's previous results. Kusnezov, (1949, 1957), fully aware of Santschi's opinion, chose to follow Weber's classification, distinguishing artificially both forms by the development of the thoracic tubercles in the worker caste. This character, admitting intergradation, is simply useless, and I can see no other solution than placing *pencosensis* into synonymy of *transversus*.

Bionomics. — From my field experience in Agudos I have come to the conclusion that *transversus* nests in dryer situations (open fields, parkland) than *rimosus* which prefers the more humid environment of

dense woodlands. The distribution of the former seems to confirm this rule.

Bruch (1923) has studied and pictured the fungus-garden and nest of "*pencosensis*" in the Argentine. In fact, this ant cultivates a yeast-like fungus on excrements of insects, principally acridid grasshoppers, much as the typical *rimosus* and its allies. Perhaps here lies the reason why Weber hesitated to separate the form from *rimosus*, being of the opinion that all *Cyphomyrmex* forms with this aberrant or — as he likes to put it — primitive type of fungus culture should be ranked under *rimosus*. I cannot follow this line of reasoning, inasmuch as species of *Acromyrmex* and *Atta*, cultivating the same basidiomycete fungus (*Pholiota gongylophora*) would have to be placed — a fortiori — into the same genus, if not to be declared conspecific!

15. *Cyphomyrmex hamulatus* Weber, n. stat.

(Figs. 9, 22, 39, 47)

Cyphomyrmex rimosus hamulatus Weber, 1938: 190 (Worker; Bolivia: C. Esperanza).
— Weber, 1940: 412 (Worker; key).

Types. — A few workers taken in March 1922 by W. M. Mann at Cachuela Esperanza on the lower Beni River in Bolivia. Four specimens (syntypes: NAW, MCZ, WWK) examined.

Worker. — Total length 2.7 mm; head length 0.66 mm; head width 0.63-0.66 mm; thorax length 0.88-0.93 mm; hind femur length 0.72-0.75 mm. Ferruginous, with head and gaster somewhat infuscated. Very close to *rimosus* but presenting the following particularities:

Frontal carinae (Fig. 9) quite sinuous. Antennal scape surpassing the occipital corner — which bears a minute acute denticle — by a distance equalling its maximum width. Funicular segments II and III combined as long as segment I. Eyes with 7-8 facets across the greatest diameter. All carinae very sharp and somewhat foliaceous. Promesonotal tubercles acutely pointed (Fig. 22). Basal face and upper half of declivous face of epinotum laterally carinate. Hind femora (Fig. 47) angulate at basal third, postero-ventral border with a narrow foliaceous crest. Petiolar node (Fig. 39) rather transverse, strongly constricted behind. Postpetiole with a shallow and broad postero-median impression, flanked by a pair of low and inconspicuous lateral ridges, terminating behind in a low rounded tubercle, not very prominent in profile; postero-lateral impressions rather deep. Tergum I of gaster with a very short and vestigial antero-median impression; sides of same tergum rather sharply marginate. Hairs short, simple and hooked, those of gaster are produced on distinct tubercles.

Female and male unknown.

Distribution. — Besides the types from Bolivia, the species has been recently collected on the Cerro Campana, Panama, at an altitude of 800-950 m, on January 17, 1960, G. B. Fairchild and W. L. Brown Jr. leg. 9 workers (B-92 and B-113).

Discussion. — The sharp carinae and spines and the striking hook-like pilosity arising from minute but sharp tubercles on gaster characterize the present species. Since *hamulatus* is now also known from Panama, the evidence in favor of its specific independence seems to me quite convincing.

16. *Cyphomyrmex rimosus* (Spinola)

Cyphomyrmex rimosus, presently taken as a polytypical species, is both the commonest form in the genus and at the same time a residue of classification. The puzzling variability of the complex, which gave rise to a number of infraspecific names in the past, needs a special study, not possible at this time.

Yet I must point out that the infraspecific arrangement for *rimosus*, as proposed at the beginning of this paper, does not imply a judgement upon the validity of the actually recognized 11 morphs and 6 synonyms. It only serves the purpose of keeping track of these names.

The separation of *hamulatus*, *salvini* and *transversus* as full species, and the return of *cochunae* and *venezuelensis* to the *rimosus* complex are novelties. The former step, i. e. the raising of the three "races" to specific category seems to be justified by morphological and distributional considerations; *cochunae*, elevated to species level by Kusnezov (1957) does not deserve this rank being probably just a synonym of one of the previously described morphs of *rimosus*; *venezuelensis* did not prove a synonym of *transversus*, as proposed by Weber (1958), and was put back under *rimosus* awaiting clarification of its true status.

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