REVISIONARY STUDIES ON THE TAXONOMY OF THE IMPORTED FIRE ANTS

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ABSTRACT

New data show that *two* species of imported fire ants (*Solenopsis richteri* Forel, *S. invicta,* n. sp.) occur in the United States. The two species originated from widely separated areas of South America. Hybridization has evidently not occurred in spite of their presence in adjacent areas in the United States. A taxonomic history of the *Solenopsis saevissima* complex is presented. *S. richteri* and *S. quinquecuspis* are resurrected from synonomy and elevated to species. *S. invicta* from Mato Grosso, Brazil, and the United States, and *S. blumi* from Uruguay are described as new.

Key Words: Fire ants, *Solenopsis, richteri, invicta, saevissima, blumi, quinquecuspis, interrupta,* taxonomy, imported, homeland.

Creighton (1930) gave an excellent taxonomic history of the *Solenopsis saevissima* (F. Smith) and *S. geminata* (Fabr.) complexes and substantially contributed to our understanding of the systematic relationships of the large polymorphic species of *Solenopsis.* He recognized eight subspecies or varieties of *S. saevissima* out of 16 forms previously described. Subsequently, most authors have tended toward further consolidation, as follows: Wilson (1951) in a thoughtful paper attempted to explain the territorially rapidly expanding "light phase" imported fire ant in the U. S. by postulating that a mutant, hypervigorous, lighter colored form had arisen in the original dark *richteri* population, known to have been in the Mobile, Alabama, area since 1918 and first recorded by Creighton (1930). Wilson (1952) later reversed this theory and postulated that one of a number of hybrid forms of *saevissima saevissima* × *saevissima richteri* had reached the U. S. in the Mobile area shortly after 1930 and that it was this second introduced *saevissima* variant which was spreading so successfully. In this same paper Wilson reduced the number of taxa recognized in the *saevissima* complex to three by several synonymizations, by raising *S. interrupta* Santchi to specific rank, and by placing *richteri* Forel as the only recognized subspecies of *S. saevissima* (F. Smith) other than the typical form. Based mainly on a large collection from Dr. Kusnezov of Argentina, Wilson set the approximate geographical distributions of these three taxa on the South American continent and postulated a large "blend zone" covering mostly Paraguay, Uruguay, southern Bolivia and Brazil and northern Argentina, where typical *saevissima saevissima* and *saevissima richteri* were meeting and hybridizing to form hybrid swarms of unstable variants. As postulated hybrids, he believed that these forms did not deserve taxonomic recognition. Dr. Wilson's paper offered what appeared to be an excellent taxonomic model which gave an entirely reasonable explanation for the origin of the "red form" or "light phase" imported fire ant. Certainly this paper was well accepted and was unquestioned at that time by

many American myrmecologists, including myself. To the present, it has remained the only accepted theory to explain the origin of the "red form."

Several additional papers must be noted as important to the history of the *saevissima* complex. Wilson and Brown (1958) published results of a re-exploration of some of the infested areas in southern United States and noted that the original dark form in the Mobile, Alabama, area seemed to be nearly absent and was being "absorbed" by the red form. In the Starkville and Meridian areas in northeastern Mississippi, where the dark form had also been introduced and may have been present as early as 1935 or 1940 (Wilson, 1951) they noted apparent evidence that the red form was overwhelming and absorbing the dark form in this region also although the dark form still occurred in unmixed populations in part of this area.

Snelling (1963) published a revision of the North American *Solenopsis (Solenopsis)* species, but made changes only in the *S. xyloni* complex. He did state that since the imported fire ant population in the United States now consisted almost entirely of the "light phase," the proper name applicable to this form was *Solenopsis saevissima* (F. Smith), rather than *S. s. richteri* Forel.

The most recent taxonomic paper is that of Ettershank (1966). In this treatment of the interrelationships of the Myrmicinae genera related to *Solenopsis, Pheidologeton, Megalomyrmex* and *Monomorium,* all of the previously recognized subgenera of *Solenopsis* are synonymized, and a list of all unchallenged taxa in *Solenopsis* given. This list presents all the taxa as species, but the name *richteri* is sunk as a synonym of *saevissima* without annotation. Thus, as of 1966, there have been only two recognized names, *saevissima* and *interrupta,* out of 17 taxa described previously. Since there are obvious color and size forms within the *saevissima* complex, what the Ettershank taxonomic model essentially says is that none of these differences, aside from those pertaining to *interrupta,* are taxonomically meaningful, and that all of the forms are merely local populations or segments of various clinal systems within an extremely protean and wide spread species. *Solenopsis saevissima,* rather than *S. saevissima richteri,* is the correct name for the imported fire ants within the United States, according to this model, and no taxonomic distinction is made between the original dark and the widely spread red or light form. This model appears to leave us without a reasonable explanation for the biological differences between the two forms and to largely negate Wilson's 1952 hypothesis as to the origin of the "red form" and his explanation of the biological and physical differences.

An article by Dr. E. O. Wilson (1958) probably summarizes many of his beliefs about the imported fire ants. Their economic importance is stressed, and mention is made that this is a case where an imported pest species, after years of maintaining a limited "beachhead," suddenly explosively spread. The original Mobile, Alabama, population is stated to be a dark form corresponding to the southern-most race of the mother population in South America, and which may have been imported from Buenos Aires or Montevideo. The explosively spreading era of fire ant history is attributed to a second importation, that of a light colored form whose origin is not positively known, but which may occur in northern Argentina and in Bolivia and also may have been imported through Buenos Aires or Montevideo. The light colored form is stated to be eliminating the dark form by genetic swamping and by competition in both the Mobile and the Meridian, Mississippi, areas. Hybrids are stated to be numerous in areas where they meet. The article concludes with the statements that biological control may eventually need to be tried for these pests and that these ants will provide valuable clues as to the kind of genetic processes which underlie the adaptation of

animal species to new environments. No taxonomic statements are given, and both the dark and light forms mentioned are included under the name, *Solenopsis saevissima.*

In this paper I wish to champion for the first time a new taxonomic model for the *saevissima* complex; namely, that this complex actually is a type of superspecies, consisting of several descrete, rarely hybridizing populations, each of which therefore must be accorded full specific status. Although the phenetic features which can be used to characterize these populations appear at first glance to be of trivial importance and also inconstant, analysis shows that the characteristics are actually very stable and can be used with assurance in diagnosis.

It should be noted that Creighton (1930) must have been thinking along the lines of superspecies model when he wrote as follows: ". . . it is obvious that in the forms of *saevissima* we have an unusually clear case of incipient production of new species. The absence of some of the transitional forms would make it difficult to include the extremes in the same species. Indeed, it is quite thinkable that subsequent investigations may so narrow the lines by which a species is delimited that all the forms of *saevissima* will be given specific status."

The new data that have influenced the derivation of the superspecies model may be listed as follows:

1. There now appears to be unequivocal evidence that the original imported fire ant, *Solenopsis richteri* Forel (sensu Creighton 1930) has not only persisted in the U. S., but has spread over a considerable territory, that it exists in unmixed populations in much of this territory, and shows little or no hybridization with surrounding populations of the "red form." (Since the ant form which has been known variously under the vernacular names, "*red richteri,*" and "light phase imported fire ant," will be shown to be an unnamed species and will be named and described as *Solenopsis invicta,* n. sp., I now propose to employ this name for the remainder of this paper to alleviate the awkwardness of continued use of the vernacular.).

2. The actual homeland of *S. invicta* appears to be in central Brazil, in the state of Mato Grosso, farther north than previously suspected. Several series collected in the Mato Grosso which have come into my hands correspond with the widespread populations of *invicta* in the United States, whereas examples from many other parts of the South American continent, including the blend zone of Wilson, do not correspond.

3. Specimens collected in 1968,-69,-70-71, in northern Mississippi and Alabama identifiable as *S. richteri* are taxonomically identical with specimens of the true *richteri* caught in the Mobile area in 1927 by Dr. Creighton and at least up to 1949 by Dr. Wilson and others. These specimens in turn correspond very closely with specimens of *richteri* collected in 1963 and 1969 in Uruguay and in 1971 in Uruguay and Argentina. Likewise, specimens of *invicta* collected in 1945, and the late 1940's and early 1950's in the Mobile area correspond taxonomically with specimens collected from all over the infested areas in the southern United States in the past few years and with the Mato Grosso specimens. In a total study collection consisting of 528 nest series from the United States, each series may be referred without question to either *richteri* or *invicta,* aside from a single series which does have a mixture of characteristics and may possibly be a true hybrid. Thus, there is no evidence that either *richteri* or *invicta* has changed in any important way from the South American mother populations since introduction, that either species has absorbed or swamped the other genetically, or that hybridization is occurring more than rarely. Instead, the evidence is very good

that both forms are stable species as judged by their extremely constant phenetic characters. The disappearance of *S. richteri* in the Mobile area thus appears to be due to displacement by a more vigorus species rather than genetic swamping. That *S. richteri* has not been similarly displaced in northern Mississippi perhaps indicates that this species also has great vigor and is capable of holding its own very successfully in areas which are ecologically favorable.

4. Recent collections and observations in Brazil, Uruguay, and Argentina show that other forms in the *saevissima* complex also possess phenetic stability and that there is no evidence of intergradation or hybridization between them in areas where they are sympatric. Instead, these populations act like species and must be taxonomically treated as species.

Although I do not have at hand enough collections to revise the entire complex over the South American continent, I believe there is adequate material to confidiently describe *Solenopsis blumi* as new, and to resurrect and raise to specific rank *quinquecuspis,* as well as *richteri.* The following species are thus recognized in the *saevissima* complex: *S. saevissima* (F. Smith); S. *interrupta* Santschi; *S. quinquecuspis* Forel; *S. richteri* Forel; *S. invicta* n. sp,; and *S. blumi* n. sp. This leaves unresolved the taxonomy of a large number of additional forms in the *saevissima* complex from many parts of South America east of the Andes. The present paper has been written mainly to correct long standing errors in the taxonomic treatment of the North American imported fire ants, and the treatments of the South American material have been mainly the necessary introductory concomitant studies. It can be anticipated that the taxonomy of the *saevissima* complex will remain extremely difficult for some time to come due to several factors: (1) the plethora of the older Forel and Santschi names, (2) the fact that these names were often based on small or incomplete nest series, that is, series in which the full range of polymorphism and intranidal variation is questionably represented, and (3) that there are no types of these purported taxa in the United States.

Characterizations of the six species which I presently recognize in the *saevissima* complex are presented herewith. Characters which are of generic or species group importance and need not be stressed or mentioned more than once are: antennal segments—workers 10, females 11, and males 12; worker and female funiculus with a large, distinct two-jointed club; second and usually third segments of the funiculus about twice as long as broad in large workers; clypeus strongly bicarinate, each carina ending anteriorly in a distinct tooth, often other smaller teeth on the clypeus; maxillary palpi geniculate; mandibles bearing four teeth; worker cast polymorphic, but heads and mandibles not strongly modified in the larger workers as in *S. geminata* (Fabr.); integument largely smooth and shining except for some sculpture on plural areas of thorax, a few other small areas, and punctures from which arise the pilosity; antero-ventral tooth of petiole very small or absent, unlike *S. xyloni* (MacCook); propodeum unarmed, and even the dorsal keels weak or absent, unlike *geminata;* pilosity usually consisting of erect hairs of various lengths, these numerous, but usually not as numerous as in *geminata* or *xyloni;* appressed pubescent hairs very sparse.

Solenopsis richteri Forel

S. pylades var. *richteri* Forel, Deutsche Ent. Zeitschr, p. 267 (1909).

S. geminata subsp. *saevissima* var. *richteri:* Wheeler, Bull. Amer. Mus. Nat. Hist., 34: 297 (1915).

S. saevissima var. *richteri:* Santschi, Physis Buenos Aires, 2: 381 (1916).

S. (Solenopsis) saevissima var. *richteri:* Creighton, Proc. Am. Acad. Arts Sci., 66: 87 (1930).

S. saevissima richteri: Wilson, Mem. Ins. Oswaldo Cruz, 50: 66 (1952).
S. saevissima: Ettershank, (in part), Aust. Jour. Zool., 14: 143 (1966).

Worker: Head length .79 to 1.40 mm, usually about 1.3 to 1.4 mm in the majors; width, .69 to 1.33 mm, usually about 1.2 to 1.33 mm in the majors. Scape length, 1.05 to 1.12 mm in majors. Thoracic length about 1.66 to 1.75 mm in majors.

Head with broadly ellipitical sides (Fig. 1a), broadest near mid-length of head, about even with rear border of eyes; rear border with distinct, crease-like median cleft; occipital lobe peaks relatively close to the cleft (Fig. 1a), scapes in majors reaching, or nearly reaching, these peaks. In small and medium sized workers head broader anteriorly, occipital cleft nearly absent or weak, and scapes distinctly surpassing rear border of head (Fig. 1b). Distinct ocellar pit present in the majors, but a developed ocellus apparently never occurs in the worker.

Thorax in largest caste with strong pronotal shoulders (Fig. 1c) and distinct promesonotal suture, median portion of pronotum immediately cephalad of this suture always shallowly but distinctly sunken; in profile (Fig. 1d) base of propodeum straight, or nearly so, appearing longer than the declivity; promesonotum weakly convex in profile, usually not rising much above level of propodeum. In small and medium workers pronotal shoulders weak or not apparent, the promesonotal suture obliterated dorsally. In profile small workers with promesonotum flattened or weakly convex, of about the same height as propodeum.

Sculpture on mesopleura of majors appears as very fine punctostriae, fore part of metapleura with similar pattern; on rear portion of metapleura the striae lose the intercalated punctures, and become distinctly stronger and more widely spaced; nearly always a clear, smooth shining space between striated area and propodeal spiracle, striae immediately caudad of spiracle usually very weak or obliterated. In small and medium workers sculpturing proportionally coarser and less dense than in large workers. Mesonotal-propodeal suture very strongly impressed and distinct in all size workers.

Petiole with thick, blunt scale in all size classes, proportionately thicker in small workers, seen in profile, In majors, in anterodorsal view, pedicel anterior to spiracles relatively slender, and scale with rounded outline dorsally; petiole with ventral keel, without anteroventral tooth; postpetiole a little wider than petiole, in posterodorsal view rounded or convex anteriorly, sides converging behind except in very large majors where they may be parallel; in profile usually a break in outline (Fig. 1e) due to transverse impression on rear dorsum near stridulative surface; in sculpture sides of pospetiole roughly and irregularly rugose and punctate; in dorsal view mid-frontal area usually smooth and shining or at least only weakly shagreened, a few transverse punctostriae on rear border.

Aside from sculpture described above, most surfaces smooth and shining, except for punctostriate areas in front of eyes. All parts with numerous erect hairs of various lengths; a few hairs on pronotum and mesonotum, and in double bilateral rows on the head much longer than others. Punctures from which this pilosity arises not very deep or large. Pubescent appressed hairs sparse or absent on nearly all surfaces.

Color distinctive due to large, often strikingly bright orange spot on first tergite of gaster; a similar large, bright spot present on first gastric sternite. These spots may not be present on all workers of any one colony, but are usually present in a majority of the largest caste, about half of the medium sized workers, and a few of the minors. The color of the spots is not a characteristic of the

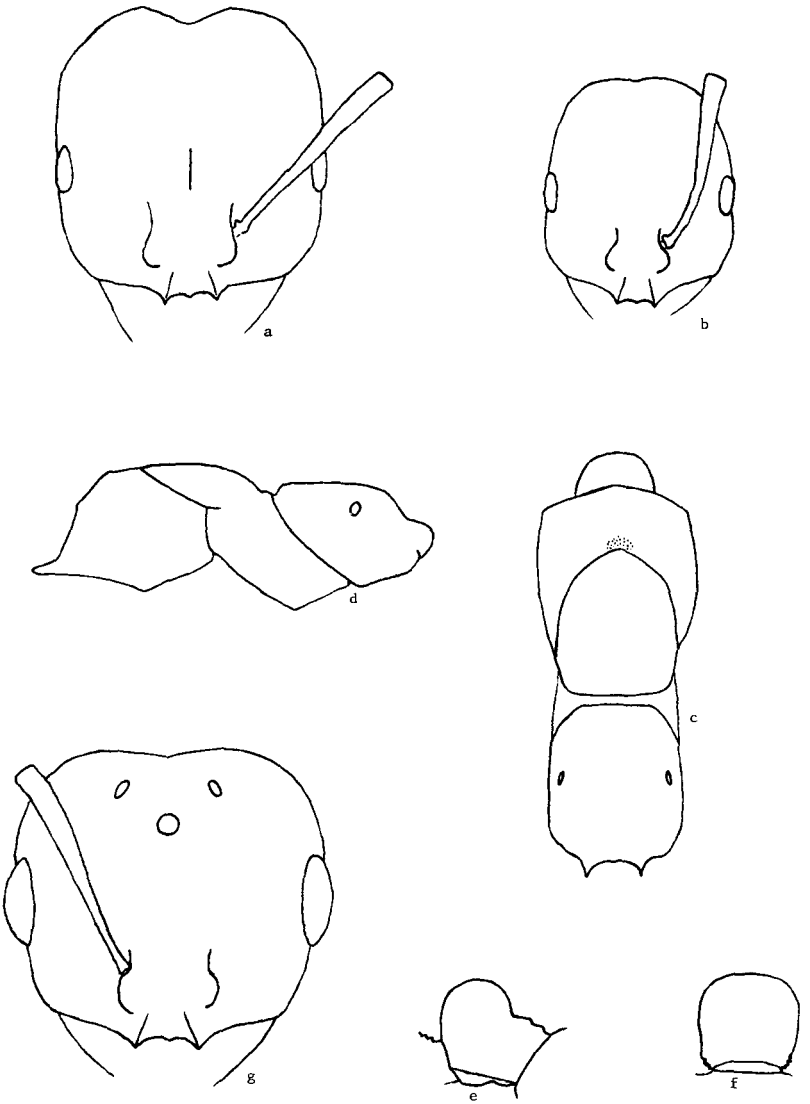

Figure 1. *Solenopsis richteri* Forel; a, head of major; b, head of minor; c, thorax of major, from above; d, thorax of major, profile; e, postpetiole of major, profile; f, postpetiole of major, from above; g, head of female.

integument, which appears to be colorless and transparent over these areas, but is due to a colored glandular or fatty mass lying just underneath the integument. Remainder of gaster very dark brownish black. Head, thorax, petiole, coxae, femora, tibiae, and scapes piceous brown. Mandibles, often lateral extensions of clypeus, cheeks, tips of scapes, funiculi, especially the clubs, and tarsi yellowish. In some colonies these areas concolorous with the rest of the head and thorax. Postpetiole sometimes concolorous with the dark colored surfaces, but often in majors bright orange except for an anteromedian V shaped mark. Variations on this basic color pattern often evident. Specimens from Uruguay and Argentina, for instance, often have the gastric spot brownish rather than orange, and have the yellow areas on the head more restricted or absent.

Female: Head length 1.25 to 1.30 mm, width 1.35 to 1.40 mm. Scape length 1.02 to 1.06 mm. Thoracic length 2.55 to 2.69 mm.

Head as in Fig. 1g, the scapes slightly exceeding hind border. Eyes large, ocelli present; ocellar area somewhat raised and distorting the surface. Occiput with a median crease-like excision. Scale of petiole thinner than in worker, often produced into a blunt median point above when seen from behind. Postpetiole wider than long, seen from above; sides sub-parallel or weakly concave.

Nearly all sclerites of thorax smooth and shining. Metapleura with fine longitudinal striae, these somewhat stronger and more widely spaced toward the rear as in the worker; nearly always a clear shining space between the striated area and propodeal spiracle. Sides of petiole finely punctate and roughened. Sides of postpetiole with fine punctures and rough, irregular rugae or striae, dorsum nearly smooth or with weak shagreening anteriorly, with some weak transverse striae medially and posteriorly.

Anterior faces of petiole and pospetiole and declivity of propodeum with moderately dense, appressed pubsecence. Erect hairs numerous and present on all surfaces.

Colors similar to those of the worker in mature alates. Head, scapes, thorax, legs, and petiole piceous brown. Gaster more nearly black, but with a bright orange spot on the anterior portion of the first gastric tergite. Postpetiole or the rear portion of it usually the same color as the spot.

Male: Head length .76 to .84 mm, width 1.02 to 1.06 mm. Thorax 2.60 to 2.69 mm long, 1.45 to 1.47 mm wide.

Mandibles with two teeth. Clypeus without trace of carinae. Scapes very short. Eyes and ocelli large. Scale of petiole with singular wing-nut-like appearance; from behind, dorsal border weakly to moderately concave. Erect hairs numerous on all surfaces.

Concolorously black except for the very pale antennae.

Remarks: I have examined 128 nest series of this species from the Mississippi localities of Tupelo, Pontotoc, Houlka, Cumberland, Houston, Starkville, Artesia, Columbus, Brooksville, Macon, McLeod, Shugulak, DeKalb and Meridian, and the Alabama localities of Pickensville, Aliceville, Esterville, Cochrane, Hamilton and Rogersville, all collected in the 1968 to 1971 period. I have carefully compared these specimens with the original Mobile, Alabama population of *richteri* studied and collected by Creighton in 1927 and preserved in the American Museum of Natural History, New York. Dr. Creighton has also kindly sent me a few specimens of this population. The recent specimens have also been compared with specimens collected by Wilson at Mobile, Alabama, and at Meridian, Mississippi in 1949, and with numerous recent and older specimens taken in Uruguay and Argentina and a single collection from the state of Rio Grande do Sul, Brazil. All of these specimens are clearly conspecific and may be

distinguished easily from all other species populations within the *saevissima* complex by the distinctive head and thoracic shapes as described and figured, and by the color pattern. The color pattern alone will not distinguish this species, as there is at least one other species (*S. blumi,* n. sp., described below) occurring in Uruguay which has a similar color pattern, and the other imported fire ant in North America, *S. invicta,* described below, is not sufficiently different in color to be unequivocally distinctive on this one character.

The biology of *S. richteri* has been extensively studied and recorded in the writings of Green (1952, 1967). The only point I might add is that this species occurs in pure populations and apparently does not normally tolerate admixture of the nests of other related species in the *saevissima* complex. Wilson (1951) records the occurrence of admixtures of the "dark phase" and the "light phase," but these observations were made on the basis of color alone which has a fairly wide range of intensity in both species. I have seen only one place (8 miles east of Aliceville, Alabama) where a single nest of *richteri* was within 50 ft. of nests of *invicta.* In this case there were only a few nests in the vicinity. At Meridian, Mississippi, both species occur in and near the city, but, from my observations, they occupy different areas and there are no admixtures. In Uruguay, Dr. Murray Blum (personal communication) observed a locality (Fortalesa Santa Catarina) where *richteri* occurred in a pure population on a low plain, but on an adjacent natural terrace approximately 5 ft. above, only nests of *quinquecuspis* could be found. In this case, it seems reasonable to suggest that *richteri* is the species which is the most active in enforcing this separation, since Dr. Blum later observed and collected in an area in Uruguay (near Colonia Suiza) where *quinquecuspis, blumi,* and *interrupta* were occuring sympatricly and the nests appeared to be admixed without territorial discreteness. Dr. Willard Whitcomb also, in recent collections in Argentina, found only *S. richteri* in pure populations at Las Flores, whereas he found two or more other forms occurring sympatricly in nearly all other collecting areas visited.

The distribution of *richteri* with respect to *invicta* in North America may be said to be abruptly parapatric, and this is one of the strong reasons for considering *richteri* and *invicta* as separate species. If they were only subspecifically distinct, zones of intergradation would be expected. In a study of 528 nest series, I have seen only one series (from a nest near Brooksville, Mississippi) which appears to have any possibility of being a hybrid. I interpret these findings to mean that hybridization is rare between the two forms and that taxonomic treatment of the two forms as separate species is the only logical action. My decision seems to be reinforced by the parapatric distribution patterns of *richteri* in its homelands, and by the phenetic constancy of the species in North America after approximately 50 years of separation from the mother population, along with what would seem to be massive chances for genetic drift via the hybridization process. That there is no discernable phenetic change in this species in any part of its present territory in North America ssems to indicate that hybridization with *invicta* has remained rare and negligible throughout the era when both species have been present.

The type locality of *S. richteri* is Buenos Aires. The species is certainly very vigorous and is the dominant formicid in all areas where it occurs. The mounds seem to be larger, or at least taller and more conical than is the case with *invicta,* and mature mounds occupy infested territory at the rate of about 20 mounds per acre. Undoubtedly many biological differences will be found, now that taxonomic separations can be made.

Solenopsis invica, n. sp.

S. saevissima saevissima × *saevissima richteri:* Wilson, Mem. Ins. Oswald Cruz, Vol. 50, p. 65 (1952).

Worker: Head length .77 to 1.41 mm, about 1.35 to 1.40 in majors; width .65 to 1.43 mm, about 1.39 to 1.42 mm in majors. Scape length .96 to 1.02 mm. in majors. Thoracic length 1.70 to 1.73 mm. in majors.

Head shape in majors as in Fig. 2a; head wider behind eyes, with rounded occipital lobes, lobe peaks further from the midline than in *richeri,* but occipital excision not as creaselike. Scapes in majors failing to reach occipital peaks in full face view by 1 or 2 scape diameters, a more noticeable space than in *richteri.* Scapes meeting occipital border in medium sized workers, slightly exceeding rear border in small workers. Head with more elliptical sides in medium or small medium workers. Only the small workers have the head slightly wider in front than behind.

Thorax of majors as in Fig. 2b and 2c; pronotum without angular shoulders or a sunken posteromedian area. In profile the promesonotum evenly and strongly convex, and the base of the propodeum also usually convex and rounded rather evenly into the declivity; base and declivity in profile about equal in length in very large workers. Promesonotal suture moderately strong to rather weak centrally in large workers.

Petiole with thick, blunt scale; seen from behind the scale is usually not as evenly rounded above as in *richteri* and may be subtruncate, but this character variable. Postpetiole large and broad, in very large workers much broader than long; seen posterodorsally, sides parallel or nearly so, in very large workers often broader behind than in front; transverse impression on rear dorsal surface present or very feeble, usually noticeably weaker than in *richteri.*

Sculpture similar to *richteri;* punctures from which the pilosity arises often shallowly elongate on dorsal and ventral sides of head; sculptured areas on cheeks in front of eyes less striate and more irregularly rugose than in *richteri.* Striae on sides of thorax less deeply etched and with fewer intercalated punctures than in *richteri.* Mesopleura with anteroventral portion of striate area usually obliterated and nearly smooth and shining in major workers. Petiole punctate on the sides. Postpetiole from above with strong shagreen anteriorly, medially and posteriorly with distinct transverse punctostriae, sides covered with fine, deep punctures, these appearing to be individually smaller but deeper than those in *richteri,* giving a more opaque appearance to this surface; some punctostriae may be present toward the rear.

Pilosity very similar to that of *richteri;* erect hairs numerous and of various lengths; some very long hairs always present on each side of pronotum and mesonotum and in longitudinal rows on head; appressed pubescent hairs on anterior face of the petiolar scale moderately numerous, apparently always sparse in *richteri.*

Gastric spot present only in some of the large workers, never as brightly colored as in *richteri,* usually occupying a smaller area on first gastric tergite, and with rather indistinct posterior border. Remainder of gaster very dark brown, in some large workers nearly black. Thorax concolorously light reddish brown to darker brown; legs, including coxae, usually of a lighter shade. Head with rather constant color pattern in large workers; occiput and vertex brownish as in the thorax, but the larger portion of head, including front, genae, and central body of

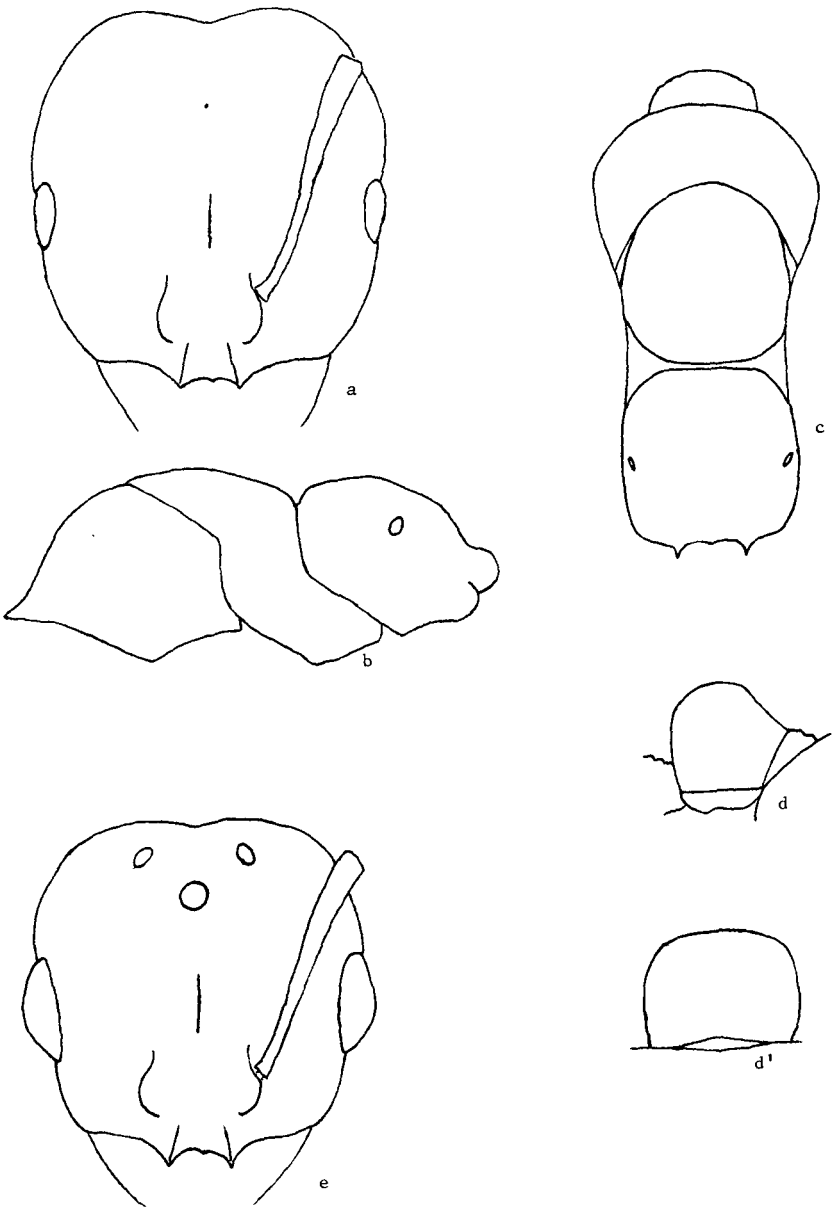

Figure 2. *Solenopsis invicta,* n. sp.; a, head of major; b, thorax of major, profile; c, thorax of major, from above; d, postpetiole of major, profile; d', postpetiole of major, from above; e, head of female.

the clypeus, yellowish or light yellowish brown; venter of head also usually light yellowish brown. Mandibles and anterior border portions of the genae dark brown or of about the same shade as the occiput; a small dark brown arrow-shaped or "rocket"-shaped mark centrally on front. Scapes and funiculi varying from matching the light colored area of the head to the same shade as occiput. In minors and medium sized workers, light colored area of the head restricted to frontal area, with dark arrow or rocket-shaped mark nearly always present. An occasional nest series with colors very much darker than described, large workers without trace of gastric spot and nearly concolorously very dark brown. Even in these specimens, the head similar to or approaching color patterns described above.

The sting venon constituents of *invicta* (MacConnell *et al.* 1971) appear to consist largely of the following alkylated piperidines; *trans*-2-methyl-6-*n*-undecylpiperidine, *trans*-2-methyl-6-*n*-tridecylpiperidine, *trans*-2-methyl-6-(*cis*-4-tridecenyl) piperidine, *trans*-2-methyl-6-*n*-pentadecylpiperidine, and *trans*-2-methyl-6- (*cis*-6-pentadecenyl) piperidine, of which the last four predominate. These constituents are different from those of *richteri,* in which the first 3 listed compounds predominate, and the last two are essentially lacking. (Unpublished data of Dr. John Brand and Dr. Murray Blum, Department of Entomology, University of Georgia).

Female: Head length 1.27 to 1.29 mm; width 1.32 to 1.33 mm; scapes .95 to .98mm. and thorax 2.60 to 2.63 mm. in length.

Head as in Fig. 2e, nearly indistinguishable in shape from *richteri,* except that the occipital excision is not as crease-like. The scapes appear slightly shorter in general than in *richteri.* Petiolar scale much as in *richteri,* very convex above, seen from behind. Postpetiole with rather straight sides, seen from above, the sides never concave, unlike *richteri.* Sculpture of thorax not appreciably different from *richteri,* clear space between metapleural striate area and propodeal spiracles absent or reduced to a narrow crease. Sides of petiole punctate. Sides of postpetiole opaque with fine punctures, without much of the irregular roughening seen in *richteri;* anterior portion of dorsum strongly shagreend; middle and rear portion with distinct, tranverse puncto-striae. Erect hairs present on all surfaces. Anterior faces of petiole and postpetiole with dense matts of appressed pubescence, similar pubescent matts usually present on rear surface of propodeum.

Colors similar to worker. Gaster very dark brown. Thorax, legs, and scapes light brown, often with three longitudinal very dark streaks on mesoscutum. Head yellowish or yellowish brown centrally, occiput and mandibles approximately matching thorax. Wing veins very pale brown.

Male: Not appreciably different from male of *richteri;* upper border of petiolar scale appearing more strongly concave, seen from behind, but there probably is overlap in this character. As in both species, the spiracles of the petiole and postpetiole are strongly projecting.

Concolorous black expect for the whitish antennae. Wing veins colorless to very pale brown.

Types: Holotype a major worker collected in the city of Cuiaba, Mato Grosso, Brazil, February 16, 1971, Willard Whitcomb and Roger Williams. Paratypes are numerous workers from the same colony as the holotype and from several additional colonies collected in February, 1971 by Whitcomb and Williams in Cuiaba and 42 km southeast of Cuiaba. I have also listed as paratypes

a small series of 10 workers from Chapada, Mato Grosso, Brazil, and several series from Daphne and near Mobile, Alabama. The holotype and representative paratypes will be deposited in the National Museum, Washington, D. C. Other paratypes will be deposited in the Museum of Comparative Zoology, Harvard University, and in the collections of the University of Florida and University of Georgia. I will retain a number of paratypes in my personal collection.

Remarks: The Mato Grosso specimens present what I consider unequivocal evidence that the origjnal homeland range of *invicta* is in central South America, perhaps largely or partially in the state of Mato Grosso, Brazil. In 1969, Father Walter E. Kempf of Sao Paulo kindly sent me a large number of small series of the *saevissima* complex from many parts of Brazil and other areas of South America. From this material I was able to sort out a single small series of 10 specimens marked "Chapada, Mato Grosso, Gilbert and Muller" which taxonomically corresponded with the wide spread populations of *invicta* in the U. S. As none of the other material sent by Father Kempf corresponded, nor did any of the other material from various parts of South America seen by me, this appeared to be the first and only clue as to the origin of the more successful of our two species of imported fire ants.

In February, 1971, Dr. Willard H. Whitcomb, University of Florida, made a trip to South America and collected *saevissima* complex fire ants in several localities, including, at my suggestion a short visit to Cuiaba, Mato Grosso. Dr. Whitcomb, accompanied by Dr. Roger Williams, collected a number of nest series in or near, and 30 and 42 kilometers southeast of Cuiaba, Mato Grosso. Some collections were made from nests on the grounds of the Agriculture Research Station in Cuiaba. These nest series are easily divisible into several separate forms or species, apparently living sympatricly. Of 13 nest series studied, 8 match the widespread populations of *invicta* in the U.S., leaving little doubt that central Brazil is, or is a part of, the original homeland of this species.

Father Kempf also recently (March 1971) collected in the Mato Grosso and sent me a single nest series of *S. invicta* from Coxim as well as several other forms from this area which I will not attempt to treat in the present paper. Probably the Mato Grosso does not constitute the entire homeland range of *invicta,* but the absence of the species in collections from other localities is suggestive of this possibility.

It is interesting to speculate about the possible distributions of *invicta* both in its homelands and in the U. S. To the north and west of the Mato Grosso altiplano are heavily forested areas and to the south in eastern Bolivia and northern Paraguay are extensive swampy areas (the Pantanal). It is possible that these areas act as barriers to the spread of *invicta* in these directions. Why it apparently has not spread further to the east and southeast is not at all clear, however, and warrants study.

In the U. S. the species obviously found no strong competitor except for *S. richteri* in the northern Mississippi area. One must keep in mind that the southern area of the U. S. now occupied by *invicta* was for the most part originally a forested area which never really developed a dominant ant fauna adapted to forest free conditions. So *invicta* may be thought to be occupying an ecological "vacuum" in one viewpoint. The only competitor for most of this area was the native fire ant, *S. xyloni,* a much less vigorous species, and itself probably a fairly recent invader in a historical sense to most of the cleared areas. The competitiveness of *S. geminata* against *S. invicta* also seems questionable,

although I would follow Wilson and Brown (1958) in the thought that the former appears likely to be able to compete successfully in certain rather wooded biotypes or perhaps in certain other areas in peninsular Florida.

It seems likely that the northward progression of *invicta* in North America will be, and probably is now being, limited by winter kill conditions. Present records seem to indicate that the species could be more successful in progressing northward in the eastern costal plains than in the central states.

To the west where *invicta* also seems to be making progress (personal communication from Department of Agriculture investigators), it seems reasonable to suggest that the progression will eventually be halted by the deserts of western Texas and northern Mexico. However, I see no reason why the species could not eventually become established in watered lawns and park areas in such western U.S. and Mexican cities as Laredo, Monterrey, Chihuahua, El Paso, Tucson, Phoenix, and many others. *S. xyloni* is numerous in many of these localities at the present time. Certain irrigated farm lands in this general area also seem amenable to invasion. Whether the species actually will ever invade the indicated areas remains to be seen.

How *S. invicta* traveled from the Mato Grosso to the Mobile, Alabama, area may never be known. The oldest series of *invicta* I have seen from the United States was collected from a large roadside nest on U. S. route 98 near Daphne, Alabama, May 29, 1945, W. F. Buren, collector. As Daphne is across the bay at some distance from Mobile, this record seems to indicate that the original importation of this species into the Mobile area may have been several years previous to 1945. Wilson (1951) records having seen the "light phase" in Mobile in 1941, but I am not certain that he actually collected the species at that time. We also know that the importation was subsequent to 1927 and 1928 when Dr. Creighton studies intensively in the area and found only *richteri.* By 1948 and 1949, when Dr. Wilson began his studies in the Mobile area, *invicta* was already well established and beginning its large scale territorial expansion.

It is realized only too well by the writer that the naming of this species as new is likely to be controversial; nevertheless, the inoxorability of the taxonomic logic which forces this decision is plain and unmistakable. The key to this logic is the retention in the U. S. of *richteri* in a form unchanged from the original Mobile population studied by Creighton or from the *richteri* populations present in Uruguay and other parts of its South America homelands. If *richteri,* in a considerable population in the U.S., has remained with unchanged morphological characteristics after many years of opportunity to hybridize with surrounding populations, and has also remained unchanged in its homeland, displaying parapatric distribution patterns in both locales, then it must be conceded that these *richteri* populations act like a species, and must be taxonomically treated as a species. If *richteri* is a species population, then the equally morphologically distinctive *invicta,* also demonstrating great phenetic stability over time and distance, must also be treated as a species.

The two species, *richteri* and *invicta,* present in the U. S. have been so thoroughly confused previously that some reiteration of their characteristics other than the formal descriptions seems warranted. The main difficulties seem to have been due to the apparent lack of clearcut differences in color and the attempts to separate the forms on the basis of subjective values of the color intensity, rather than attempts to find clearcut morphological differences which

would correlate with possible qualitative differences in color, as well as with other factors usually taken into account by taxonomists—distribution patterns, biology, etc.

In both *invicta* and *richteri,* as in many species, there is considerable variation in color, and this is particularly true in *invicta* and should be expected in the massive population now present in the U.S. Part of these color differences appear to be the normal types of differences found in any ant species, e.g., there is probably some darkening of an individual ant with age. Thus nest samples collected in early spring are likely to have a preponderence of overwintering workers, which may be older and possibly darker than samples of workers taken from the same nest in late spring or summer. Differences between side-by-side nests are also common. I have been unable to detect any noticeable north-south or east-west clines in the *invicta* population, however. In *richteri* also, there is considerable color variation, particularly as to the gastric spot. Since the integument over the spot is unpigmented and transparent and the color due to an underlying subintegumental body, it seems possible that the color of the spot might be influenced by the food resources and other biochemical parameters of individual nests.

The best and easiest method of distinguishing *invicta* from *richteri* is by the morphological characters given in the descriptions, particularly those concerning the shapes of the head, thorax, and postpetiole. Reiterated, in *richteri* the sides of the head are usually broadly elliptical in shape and lack the weakly cordate shape seen in *invicta;* the peaks of the occipital lobes nearer the midline and the occipital excision more creaselike in *richteri* than in *invicta;* scapes longer in *richteri* than in *invicta* in relation to their ability to reach toward the occipital peaks; pronotum with strong and rather angulate shoulders in *richteri,* this character nearly absent in *invicta;* a shallow but distinctly sunken area on posterior median dorsum of the pronotum of large workers in *richteri,* absent in large workers of *invicta;* the promesonotum strongly convex in profile in *invicta,* more weakly so in *richteri;* in profile the base of propodeum elongate and straight in *richteri,* convex and shorter in proportion to the declivity in *invicta;* the postpetiole wide and with straight or diverging sides posteriorly in *invicta,* narrower and usually with converging sides in *richteri;* transverse impression on posterodorsal face of postpetiole usually apparent and strong in *richteri,* usually weak or absent in *invicta.*

For those interested in the taxonomy and/or natural history of these ants, a trip to the northeastern areas of Mississippi and western areas of Alabama to observe and collect samples of *richteri* before this more limited population is eliminated by control operations can be recommended. As the name implies, the more wide spread population of *invicta* seems more likely to be with us for some time to come.

There remains the question of the separation of *invicta* from the true *saevissima,* in the sense of the latter's original describer, Frederick Smith. This question will be discussed under the next description.

The importance of a correct taxonomy in a group of animals is perhaps not readily apparent to those who would rather not be bothered with what they deem foolish and pedantic "name changes." I would argue that this is not a case of changing a name, but instead that no valid scientific name has ever been previously used for what is surely one of the most successful insects ever to invade the U.S.A., and that it is high time this is corrected. Aside from this academic

aspect, I would argue further that, due to the existence of a multiplicity of forms on the South American continent, until we can learn accurately to characterize and identify these populations, any progress in biological control investigations would be jeopardized by the chance of studying the wrong population in the wrong homeland.

Solenopsis saevissima (Frederick Smith)

Myrmica saevissima F. Smith, Trans. Ent. Soc. Lond. 3:166 (1855)
Solenopsis geminata subsp. *saevissima:* Wheeler, Bull. Amer. Mus. Nat. Hist., 34: 395 (1915).
S. saevissima: Santschi, Physis Buenos Aires, 2: 378380 (1916).
S. (Solenopsis) saevissima: Creighton, Proc. Amer. Acad. Arts and Sci., 66: 6683 (1930).
S. saevissima subsp. *saevissima:* Wilson, Mem. Inst. Oswaldo Cruz., 50: 63 (1952).

Worker: Head length .76 to 1.36 mm, width .64 to 1.37 mm; about 1.27 to 1.36 mm long, and 1.22 to 1.37 mm wide in majors. Scape length 1.00 to 1.04 mm in majors. Thoracic length 1.63 to 1.75 mm in majors.

Head wider behind the eyes (Fig. 3a) as in *invicta* but lacking the subcordate appearance, occipital lobes not well developed, and occipital excision weak. Sides of head weakly convex, sometimes nearly straight. Scapes reaching or nearly reaching peaks of occipital lobes in majors. Pronotum with weakly to moderately developed shoulders in majors (Fig. 3b). Pro-mesonotal suture always very weak, even in majors; pronotal surface anteromedially to this suture may be flattened, but never appearing actually sunken as in *richteri.* Pro-mesonotum in profile rather evenly and moderately convex. Base of propodeum straight or very weakly convex and longer than the declivity (Fig. 3c). Petiole with a high, ovate scale, usually as wide or nearly as wide as narrow postpetiole; postpetiole little if any wider than long except in larger majors; in posterodorsal view postpetiole in majors with convex anterior border and straight sides. Transverse impression or rear dorsal surface of postpetiole often distinct.

In medium and small sized workers, head wider in front than behind; scapes reaching or surpassing hind borders of head; pronotum without trace of humeri or flattened area; postpetiole small, with sides slightly converging to rear but maintaining approximate equality in length to width ratio.

Sculpture weakly etched, most surfaces smooth and shining; genae with weak, irregular striae in front of eyes; piligerous punctures weak and inapparent on nearly all surfaces; striate area of mesopleura consisting of very fine and usually weakly etched striae, in very large workers these occasionally somewhat obliterated; wide smooth shining areas usually apparent on all sides of propodeal spiracle. Sculpture nearly absent on petiole, rear face of scale appearing free of shagreen throughout the size range. Postpetiole in major workers with subopaque areas on sides caused by minute puncturing; posterodorsal face largely smooth and shining even in majors; some weak transverse punctostriae largely confined to small area behind transverse impression; in very large majors dorsal surface may be somewhat shagreened, a few punctostriae may occur in front of impression.

Pilosity not appreciably different from that of *richteri* and *invicta,* possibly a little sparser than in those species.

Colors largely pale to darker yellow or light yellowish brown in medium to large workers; small workers may show considerable infuscation. The color may fade with time in preserved specimens.

Mandibles and often antennae dark brown and distinct from yellowish head;

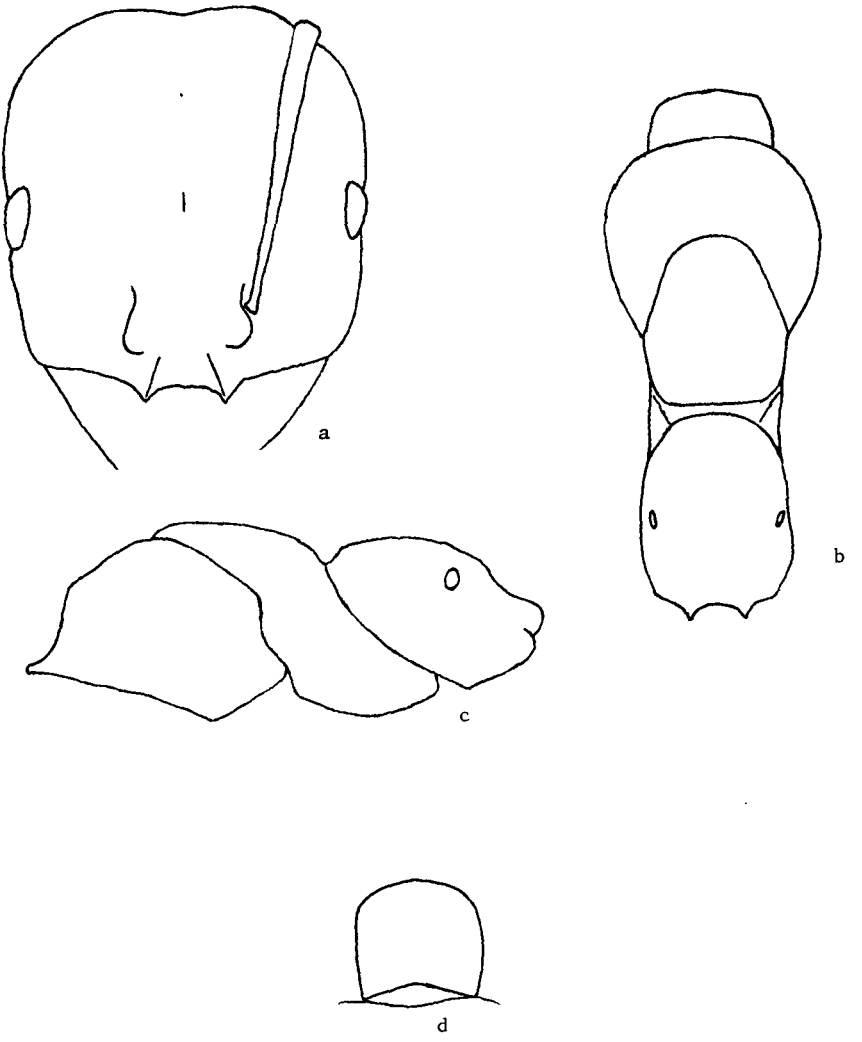

Figure 3. *Solenopsis saevissima* (F. Smith); a, head of major; b, thorax of major, from above; c, thorax of major, profile; d, postpetiole of major, from above.

occiput and vertex faintly to more definitely banded with brown. Thorax and large spot on 1st segment of gaster yellowish to yellowish brown in large workers. Remainder of gaster brown. Petiole, postpetiole, and legs usually a little darker in color. Medium and small workers with gastric spot usually absent, thorax and rear third or more of the head considerably darker in some workers. No median dark mark on front of head, contrasting with the condition in *invicta*.

Remarks: This species seems to occur over a large range. I have seen specimens from the type locality, Belem, Para, Brazil, from Surinam and British Guiana, and the states of Rio de Janeiro, Sao Paulo, Amazonas, and Minas Gerais, Brazil. Dr. Whitcomb and Dr. Williams also collected three nest series 42 km southeast of Cuiaba, Mato Grosso, occurring sympatricly with *invicta.* Since there are other distinct forms which occur in the Mato Grosso and in several of the other Brazilian states, the phenetic stability of this form over this extremely large range, both in areas where it apparently is the only *saevissima* complex species present and in other areas where it exists sympatricly with other species in the complex, strongly suggests that this form can only be viewed as a distinctive species population.

Although specimens which have a similar color have been collected in Argentina, an examination of these specimens shows that their morphology is quite different from that described above. I shall not attempt to treat these possibly unknown species in the present paper.

The hypothesis that the ant which I have named *invicta* could be the result of a hybridization between *saevissima* and *richteri* now seems extremely unlikely. Other than the fact that *invicta* displays a number of characters which are unlike either purported parental stock (for instance, large wide postpetiole in *invicta,* narrower postpetiole in both *richteri* and *saevissima,* short scapes in *invicta,* longer scapes in both *richteri* and *saevissima,* robust thorax without pronotal humeri in *invicta,* -more slender thorax with noticeable pronotal shoulders in both *richteri* and *saevissima*) the distributional data will no longer support this concept.

Pelotas, in the state of Rio Grande do Sul, Brazil, is the northeastern most record I have of *richteri,* and it is doubtful that this species, essentially from the pampas and probably occurring in Brazil only in limited southern coastal plains areas, ever is sympatric with *saevissima,* apparently mainly from areas far to the north. If central continental areas close to the Mato Grosso are the true home lands of *invicta,* as now seems strongly suggested, then there may be a gap of many hundreds of miles between the homeland ranges of *richteri* and *invicta.*

S. saevissima may be easily distinguished from both *invicta* and *richteri* by the characters given in the descriptions and figures. The major points in the separation of *saevissima* from *invicta* are in the habitus of the head, the thoracic shapes in major workers, the proportions of the postpetiole, the differences in sculpturing, and the differences in color in major workers. *S. richteri* and *saevissima* are not likely to be confused because of the strong differences in color. They are also different in many other ways including head shape, thoracic structure, and sculpturing.

Solenopsis quinquecuspis Forel

S. pylades var. *quinquecuspis* Forel, Bull. Soc. Vand. Sci. Nat. 49: 224 (1913).
S. geminata subsp. *saevissima* var. *quinquecuspis:* Wheeler, Bull. Amer. Mus. Nat. Hist., 34: 379 (1915).
S. saevissima var. *quinquecuspis:* Santschi, Physis Buenos Aires, 2: 381 (1916).
S. (*Solenopsis*) *saevissima* var. *quinquecuspis:* Creighton, Proc. Am. Acad. Art, Sci., 66: 86 (1930).
S. saevissima subsp. *richteri:* Wilson (in part) Mem. Inst. Oswaldo Cruz., 50: 57 (1952).

Worker: Head length .81 to 1.47 mm; width .66 to 1.48 mm. In majors, head length 1.40 to 1.47mm, width 1.36 to 1.48 mm, scape length .97 to 1.06 mm, and thorax length 1.73 to 1.86 mm.

Head shape in large workers as in Fig. 4a, rather cordate in shape, with developed occipital lobes and rather strong occipital excision; always broader posteriorly except in small and sometimes in small medium workers. Scapes in full face view not meeting peaks of occipital lobes; in small workers slightly surpassing rear borders. Ocellar pit deep in large workers, but developed ocelli rare. From above pronotal shoulders moderately developed in large workers (Fig. 4b), smoothly rounded in medium and small workers. Pro-mesonotal suture usually distinct medially in large workers, completely obliterated in medium and small workers. Pro-mesonotum in large workers strongly convex in profile (Fig. 4c), propodeum with longer base than declivity, base often straight, sometimes weakly convex, in either case at a different angle than the dorsum of the mesonotum. Seen from above, mesonotum nearly always of normal development, even in very large workers, propodeum usually without trace of longitudinal impression. Petiole with very thick, blunt scale, often subtruncate, sometimes with a weak notch posterodorsally. Postpetiole wider than long in large workers, with straight sides which may be slightly concave in medium and small workers. In a few very large workers the postpetiole may be wider in front than behind.

Genae with rough striae in front of eyes, these usually not extending far enough medially to meet with striae near antennal insertions. Punctostriae of meso- and metapleura very fine, often an area on lower mesopleura smooth and shining in large workers. Sides of petiole weakly punctate, front and rear faces smooth and shining. Sides of postpetiole partially or nearly completely covered with very fine, dense punctures. On posterodorsal face, front 1/3 or 1/2 smooth and shining or only weakly shagreened, rear 1/2 or 2/3 transversely punctostriate.

Pilosity of variegated pattern usual in *saevissima* complex; pilosity arising from moderately well developed punctures on head, many on both dorsal and ventral surfaces elongated shallowly. Pubescence sparse to moderate in density on front of petiole.

Concolorously piceous brown except for gaster which is a deeper, blackish brown. No trace of gastric spot; head colors, with minor exceptions, nearly uniform also.

Remarks: The name of this species was badly chosen, as many of the major workers in the *saevissima* complex have five teeth on the clypeus—the two major teeth, a smaller tooth immediately laterad of each of these, and one small median tooth. The color is rather distinct, as this is one of the few species within the complex which lacks a spot or pale area on the first gastric segment. From *richteri, quinquecuspis* can be distinquished by the strongly convex promesonotum in profile in large workers, by the absence of a posteromedian sunken area on the pronotum, and by the strongly cordate head as well as the distinct color differences. I have specimens of this species from Fortalesa Santa Catarina, Uruguay, where Dr. Blum collected from a number of colonies which were abruptly parapatric with *richteri.* Dr. Blum also collected this species at San Jose' and at Colonia Suiza, Uruguay. At Colonia Suiza the species was entirely sympatric with *interrupta* and *blumi,* n. sp. This suggests that *richteri* is the species which is mainly responsible for enforcing the territorial separation. I have also seen specimens of *quinquecuspis* from Rio Grande do Sul, Brazil. Dr. Whitcomb and Dr. Silveria-Guido collected this species in several localities within approximately 100 km of Montevideo, Uruguay. Available records suggest that it is a common species in Uruguary and probably adjacent regions of southern Brazil and Argentina, that it often occurs sympatricly with other species in the *saevissima* complex, and that it often occurs on hilly or rocky ground.

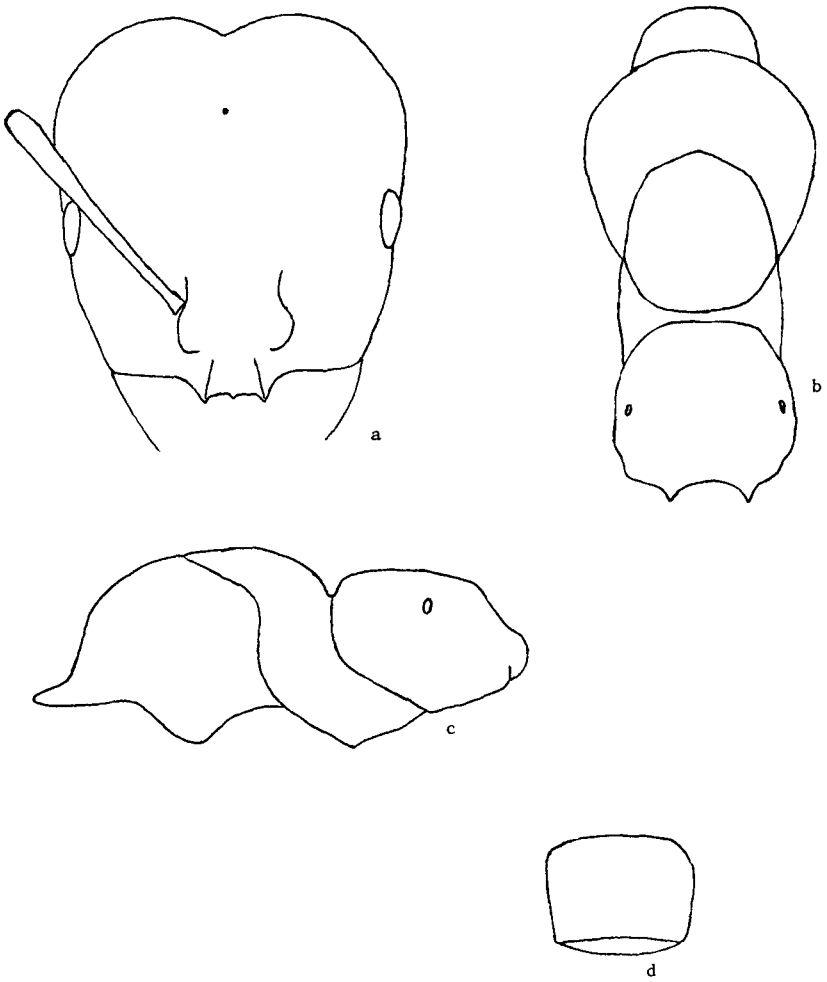

Figure 4. *Solenopsis quinquecuspis* Forel; a, head of major; b, thorax of major, from above; c, thorax of major, profile; d, postpetiole of major, from above.

The type locality of *quinquecuspis* is Bahia Blanca, Buenos Aires, Argentina. Until the types can be thoroughly studied, the identity of this species must remain in some doubt, but I follow Creighton in preserving this name for the common species of this area of South America which appears never to have any trace of a gastric spot or pale area. As the description will demonstrate, this is far from being its only diagnostic character, thus its resurrection from the synonymy.

Solenopsis blumi n. sp.

Worker: Head length .81 to 1.52 mm, width .71 to 1.56 mm; in majors about 1.37 to 1.52 mm long, about 1.37 to 1.56 mm wide. Scape length 1.04 to 1.08 mm, thoracic length 1.71 to 2.08 mm. in majors.

Head strongly cordate (Fig. 5a), similar in shape to *quinquecuspis* in large workers. Scapes not reaching the peaks of occipital lobes. In very small workers slightly surpassing the hind borders. Ocellar pit deep, only rarely with an actual, developed ocellus. Head wider behind than in front throughout most of the size range, in minors head slightly broadened toward front. Eyes large, usually noticeably larger than in *quinquecuspis*. Thorax very different from *quinquecuspis* both in profile and seen from above (Fig. 5b and 5c). Pronotum rounded laterally, without apparent shoulders. Mesonotum disproportionally large in large workers. In profile pro-mesnotum convex above but with a different set than in *quinquecuspis,* often front face of pronotum steeper and dorsal outline of mesonotum more level. Base of propodeum set at about the same angle in profile as dorsum of mesonotum; declivity usually longer than in *quinquecuspis.* Propodeum usually with shallow longitudinal median impression, usually rather distinct in comparison to other species in *saevissima* complex, although much weaker than in *geminata.* Petiole and postpetiole large and robust. Postpetiole much wider than long in large workers, often wider than long well down into the polymorphic series; subrectangular in large workers, anterior border nearly straight, or only weakly convex, sides straight. In very large workers postpetiole may be slightly wider behind than in front.

Striae on genae often becoming rather minutely cobble-stonelike toward mandibular insertions. Many elongate piligerous foveolae present on dorsum and venter of head and on pronotum. Pleura of meso- and metanotum with very fine punctostriae. No clear area between propodeal spiracles and striate area posteriorly, this also absent or narrow ventrally. Sides of petiole finely punctate, rear face strongly shagreened or finely punctate. Sides of postpetiole entirely fine and densely punctate and roughened; from above, entire posterodorsal face of postpetiole sculptured; shagreened or finely punctate in front, and towards middle and rear strongly punctate or transversely striato-punctate.

Pilosity with usual variegated pattern of the *saevissima* comlex, but long hairs of head and thorax not as long proportionately as in *richteri* and *invicta.* Pubescence on front face of petiole sparse or moderate in density.

Color pattern similar to *richteri* and thus simulating this species when seen in the field. Gastric spot in large workers usually not quite as large proportionately, usually occupying only about 1/2 of first gastric tergite seen from above rather than 2/3 or 3/4 as in *richteri,* but this is probably not a reliable character. The spot also more brownish rather than yellow or orange as is common in *richteri,* although this may not be a valid difference either since *richteri* in Uruguay and Argentina often also seems to have a darker gastric spot than in Mississippi specimens. Remainder of a gaster black. Postpetiole usually same color as gastric spot except for a broad roughly V shaped black mark anteriorly. Head, thorax, scapes, legs, and petiole dark piceous brown, sometimes some indistinctly delineated areas on thorax lighter in color. Lighter areas on head usually more extensive than in *richteri* and involve the mandibles, entire clypeus, large areas of the genae, areas surrounding the antennal insertions, and front, except for the usual dark median bar.

Types and other material: This species is named in honor of my friend and colleague, Dr. Murray S. Blum. Dr. Blum, accompanied by Senores C. Crisci and

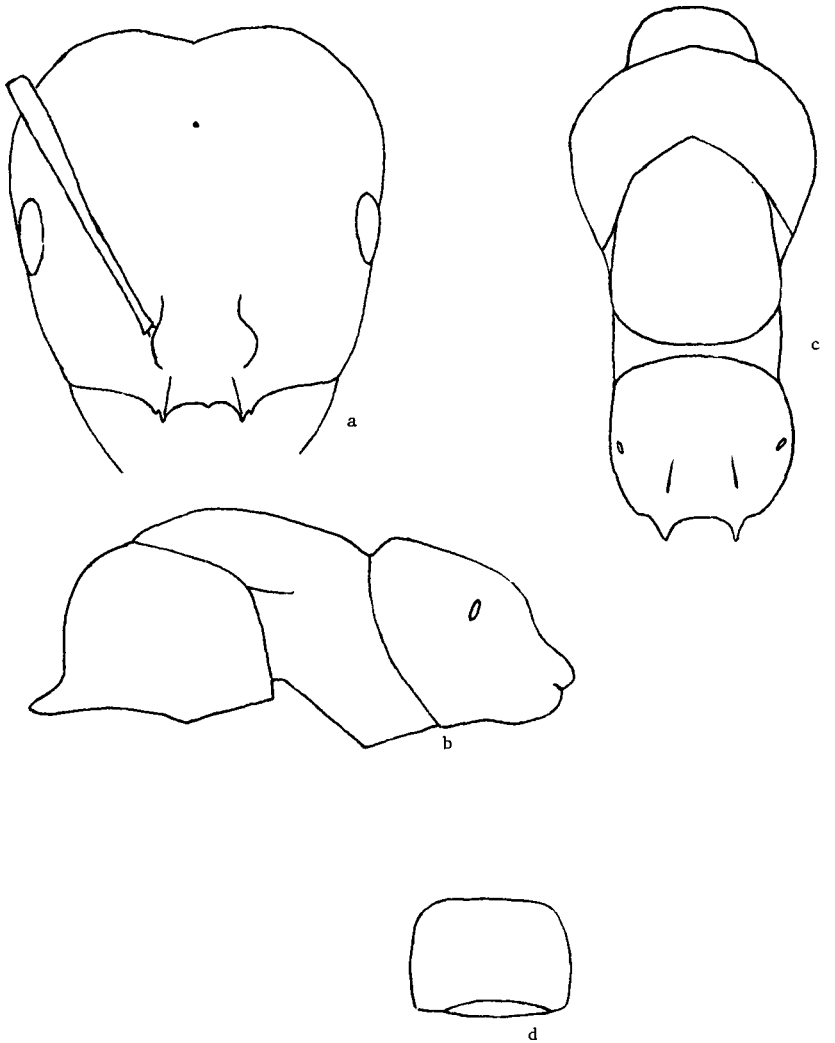

Figure 5. *Solenopsis blumi,* n. sp.; a, head of major; b, thorax of major, profile; c, thorax of major, from above; d, postpetiole of major, from above.

J. Carbonell, collected three nest series of this new species from roadside nests near Colonia Suiza, Uruguay, March 11, 1969. I have selected a large worker from one of these series as the holotype, and marked the rest of the specimens as paratypes. The holotype and a number of paratypes will be deposited in the National Museum, Washington, D. C., and a number of paratypes will be sent to the Museum of Comparative Zoology, Harvard University, and to the Department of Entomology, University of Georgia. I will retain a number of

paratypes in my personal collection. I have also seen this new species from Colonia Playa Formento, Uruguay, collected May 29, 1963, by C. Crisci and J. Carbonell. Dr. Whitcomb and Dr. Silveria-Guido also collected this species February 3, 1971, at Escuela Jackson, near Montevideo, Uruguay.

Remarks: This species is very distinct from any other form I have seen in the *saevissima* complex. The color pattern is similar to that of *richteri,* but the cordate head, deep thorax with enlarged mesonotum, lack of noticeable pronotal shoulders or pronotal median sunken area, and wide, robust postpetiole are characters never seen in *richteri.* From *invicta, blumi* also differs in a large number of characters as may be seen from the descriptions and the figures. Since their home ranges appear to be approximately a thousand miles apart probably no difficulties will arise. *S. blumi* differs from the sympatricly occuring *quinquecuspis* by the different set or habitus of the thorax (compare the figures), the enlarged mesonotum in large workers of *blumi,* the wider, more rectanguloid postpetiole of *blumi* with its stronger sculpture, the larger eyes, and the differences in color. The nests in the type locality were fully sympatric with those of *interrupta* and *quinquecuspis,* and the nest at Escuela Jackson was also sympatric with *quinquecuspis.*

Solenopsis interrupta Santschi

S. saevissima var. *interrupta* Santschi, Physis Buenos Aires, 2: 397 (1916).
S. (Solenopsis) saevissima subsp. *interrupta:* Creighton, Proc. Amer. Acad. Arts and Sci. 66: 89 (1930).
S. interrupta: Wilson (in part?) Mem. Inst. Oswaldo Cruz, 50: 61 (1952).

Worker: Head length .81 to 1.67 mm, width .69 to 1.79 mm; in majors length 1.59 to 1.67 mm, width 1.63 to 1.79 mm. Thorax 1.73 to 2.14 mm. long in majors. Scapes 1.06 to 1.12 mm. in majors.

Head strongly cordate in large workers, much broader behind than in front; with large, well developed occipital lobes, and strong occipital excision (Fig. 6a.) Ocellar pit deep, in large workers a developed ocellus often present. Scapes very short in large workers, often reaching only about mid-way between eyes and occipital lobe peaks. Eyes much smaller than in *blumi,* comparing workers of the same head wdth. The cordate head shape occurs down through the polymorphic series to about the medium sized workers; only small media with heads with elliptical sides, only minors with heads even slightly wider in front than behind. Scapes in minors slightly surpassing occipital borders.

Thorax of large workers as in Fig. 6b; pro-mesonotum in profile strongly convex as in *quinquecuspis* and in *blumi,* but with a different set, primarily in shape of propodeum whose base in large workers slopes downward toward rear, becoming gradually rounded into the declivity. Thorax in profile singular in one point in having mesonotum slope very gradually into the mesopropodeal impression without a sharp break in outline; but propodeum in front arising very sharply and precipitously. Thorax from above robust and very wide but with only weak pronotal shoulders. In large workers mesonotum well developed, sometimes approaching condition seen in *blumi* (Fig. 6c); often pro-mesonotal suture distinct and angulate or semi-angulate medially. Petiole and postpetiole large and robust, postpetiole often .47 to .49 mm long, .70 to .73 mm wide in large workers, larger than in any other species of the complex known to me. Postpetiole from above often wider behind than in front, or sides straight and parallel; anterior border feebly to more strongly convex.

Striae on genae similar to those on *blumi,* usually not reaching the antennal striae mesally. Piligerous foveoli and punctures on head less developed than in

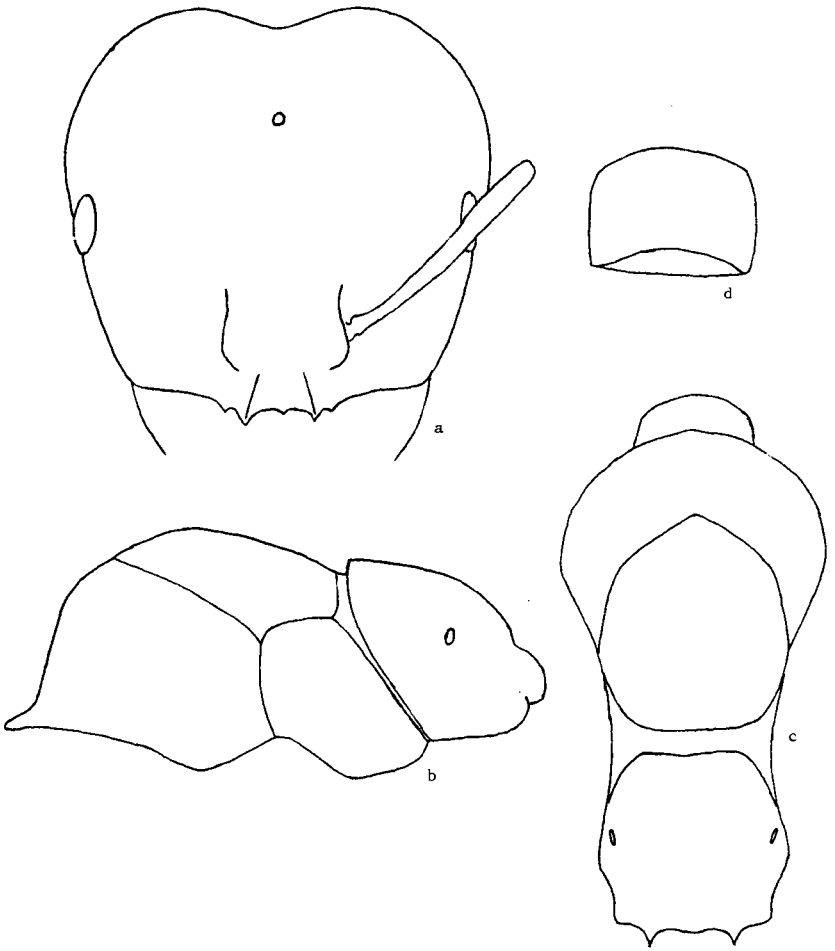

Figure 6. *Solenopsis interrupta* Santschi; a, head of major; b, thorax of major, profile; c, thorax of major, from above; d, postpetiole of major, from above.

either *blumi* or *quinquecuspis,* so that the cephalic integument appears much smoother than in those species. Several fine striae and a weak integumental fold often evident immediately mesad to eye. Mesopleura in large workers with very fine striae, these often obliterated and integument smooth and shining on the lower part of this sclerite. Metapleura with somewhat coarse striae, especially

toward the rear. Sides of petiole finely punctate. Sides of postpetiole densely punctate and opaque. On posterodorsal face, postpetiole shagreened in front, finely punctate in middle and behind, the transverse striae common in other species very weak or absent.

Erect hairs short and stout, not very flexuous; long hairs of head and thorax, usually greatly longer than remainder of pilosity in most species in the *saevissima* complex, not so clearly differentiated in this species. Pubescent hairs on front face of petiole sparse.

Color distinctive. Gaster very similar to that of *richteri,* with a large reddish yellow spot on first gastric tergite, remainder of gaster very dark brown or black. Remainder of body largely the same color as the gastric spot; the head, thorax, scapes and legs all reddish yellow, integument somewhat transparent. Mandibles, a small bar mark on front, and petiole and postpetiole somewhat deeper in color, usually brown or reddish brown. Smallest workers may lack gastric spot, otherwise its presence throughout polymorphic series appears uniform. The colors of preserved specimens brighter, i.e., somewhat more reddish, than in *saevissima.*

Remarks: The sting poison constituents have not been elucidated, but the sting of this insect is reported by Dr. Blum (personal communication) to be excruciatingly painful, much more so than any of the other species encountered by Dr. Blum in South America or in his experience with the two imported species in North America.

I have specimens from several nests of this species from near Colonia Suiza, Uruguay, collected by Dr. Blum, and Senores Crisci and Carbonell, and from Salto Camino a Bella Vista and San Jose, Uruguay, from LaPaz, Entre Rios, Argentina, and Banado Rio Salado, Santa Fe, Argentina. I have seen a number of series from northwestern Argentina and from Bolivia which are like *interrupta* in size and in prossessing a rather cordate head in large workers and a yellowish or reddish yellow color. However, these specimens do not agree in many other characteristics of structure, sculpture, and pilosity, and cannot be included in *interrupta* as I presently conceive the species. Some clarification of this matter will undoubtedly be gained from a thorough examination of the types and by additional collections. Since the type locality of *interrupta* is Bajo Hondo, in the state of Buenos Aires, Argentina, and since the species I have described is the only large reddish yellow species which seems to occur in Uruguay and eastern Argentina, I feel confident that this species is the true *interrupta* of Santschi. I have not seen enough material to grasp any species population concepts of the other large yellow forms from northern Argentina and Bolivia. Possibly several undescribed species occur in this region. In my opinion, however, the range of *interrupta* as given by Wilson (1952) may be too broad.

This study leaves many unanswered questions. Much of the South American material seen cannot be assigned to any known taxon. This situation can only be corrected by extensive collections throughout South America by trained myrmecologists, and thorough studies of the existing European types. The long tenure of *richteri* in North America in unchanged form, along with other evidence I have shown, however, cannot be ignored and must force this agonizing reappraisal of our viewpoints toward the realities of the *saevissima* complex. To continue to regard this complex as one or two protean species in the face of the new evidence would be unacceptable and would give us no points of focus for

ecological, biochemical, pathogenic, or zoogeographic studies. Although the present paper is only a beginning to a truly imposing and difficult task, hopefully it will prove instrumental in changing attitudes toward some of the basics in the study of these interesting and important insects. I would agree with Dr. Brown (1961), that a greater emphasis on basic research for these ants is much needed.

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This paper could not have been undertaken without the help and encouragement of many colleagues, several of whom should be commended for their long held, prophetic beliefs that the taxonomy of the fire ants was badly in need of revision, and for their willingness to unstintingly aid the project in a number of different ways. I refer particularly to Dr. Murray S. Blum, University of Georgia, Dr. William S. Creighton, Rockport, Ontario, Canada, Ing. Agr. Aquiles Silveira-Guido, Montevideo, Uruguay, and his assistants, Senores Crisci and Carbonell, and Dr. Henry B. Green, State University of Mississippi. I am also deeply appreciative of the loan or gift of many specimens essential to the study from Father Walter W. Kempf, O.F.M., Sao Paulo, Brazil, Dr. Willard H. Whitcomb, University of Florida, and Dr. John F. Lawrence, Museum of Comparative Zoology. Finally, I am grateful for the considerable help given by a large number of Department of Agriculture personnel in furnishing large numbers of collections from southern United States. These investigators will be listed individually in a planned publication further elucidating the extant ranges of *S. richteri* and *invicta* in North America.

LITERATURE CITED

Brown, W. L., Jr. 1961. Mass insect control programs: four case histories. Psyche, 68: 75-111.

Creighton, W. S. 1930. The new world species of the genus *Solenopsis* (Hymenoptera: Formicidae.) Proc. Amer. Acad. Arts and Sci., 66: 39-151.

Ettershank, G. 1966. A generic revision of the World Myrmicinae related to *Solenopsis* and *Pheidologeton* (Hymenoptera: Formicidae). Aust. J. Zool. 14: 73-171.

Green, H. B. 1952. Biology and control of the imported fire ant in Mississippi. Jour. Econ. Entomol. 45: 593-7.

_____ 1967. The imported fire ant in Mississippi. Bull. 737, Miss. State Univ., Agri. Exp. Sta. 23 pp.

MacConnel, J. G., M. S. Blum, and H. M. Fales. 1971. The chemistry of fire ant venom. Tetrahedron 26: 1129-39.

Snelling, Roy R. 1963. The United States species of fire ants of the genus *Solenopsis,* subgenus *Solenopsis* Westwood, with synonymy of *Solenopsis aurea* Wheeler. Occasional Papers—No. 3. Bur. of Entomol. Calif. Dept. of Agri. 1-11.

Wilson, E. O. 1951. Variation and adaptation in the imported fire ant. Evolution 5: 68-79.

_____ 1952. O complexo *Solenopsis saevissima* na America do Sul (Hymenoptera: Formicidae). Mem. Inst. Oswaldo Cruz 50: 49-68.

_____ 1953. Origin of the variation in the imported fire ant. Evolution 7: 262-3.

_____ 1958. The fire ant. Scientific American. March, pp. 36-41.

Wilson, E. O. and W. L. Brown, Jr. 1958. Recent changes in the introduced population of the fire ant *Solenopsis saevissima* (Fr. Smith.). Evolution 12: 211-18.

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NEW *RHINOSEIUS* SPECIES (MESOSTIGMATA: ASCIDAE) FROM COSTA RICAN HUMMINGBIRDS

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ABSTRACT

Two new species, *Rhinoseius richardsoni* and *R. colwelli,* both collected from flowers and hummingbirds in Costa Rica, are described and illustrated. Limited field observations on the mite-flower-bird relationship are included.

Key Words: Mite-flower-bird, *Rhinoseius,* Ascidae, Costa Rica.

The first record of ascid mites from the nares of hummingbirds was by Baker and Yunker (1964). These authors erected the genera *Rhinoseius* (one species) and *Tropicoseius* (10 species) for 11 new species of ascids from Venezuelan and Panamanian hummingbirds. In their review of the Ascidae, Lindquist and Evans (1965) synonymized *Tropicoseius* with *Rhinoseius* and redefined the genus. Recently Dusba'bek and Cerny' (1970) described a new species, *Tropicoseius bakeri,* (retaining the separation of *Rhinoseius* and *Tropicoseius*) from a Cuban hummingbird. Geographic distribution of the known species is subtropical or tropical from the nearctic and neotropical regions of the world.

In the present paper two new species of *Rhinoseius* are described from material collected in Costa Rica from trumpet flowers and from hummingbird nares. Individual flowers were field collected in alcohol and examined in the laboratory for mites. Mites were recovered from hummingbirds by collecting individuals which ran out of the nares when the beak was tapped and by exposing the turbinates and collecting mites from the exposed areas. Flower and hummingbird hosts from which mites were collected are given in Table 1.

In the descriptions below, taxonomic terminology and generic concepts follow Lindquist and Evans (1965). Type depositions for the new species are as follows: holotype: Acarine Collection, Department of Entomology, University of Georgia, Athens; paratypes: National Museum of Natural History, Washington, D. C.; Canadian Department of Agriculture, Ottawa, Ontario, Canada; Field Museum Natural History, Chicago, Illinois, and Bishop Museum, Honolulu, Hawaii.