

UNIVERSITY OF MICHIGAN  
MUSEUM OF ZOOLOGY

Miscellaneous Publications No. 23

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A Revision of the Puer Group of the North  
American Genus *Melanoplus*, with  
Remarks on the Taxonomic Value  
of the Concealed Male Genitalia  
in the Cyrtacanthacrinae.  
(Orthoptera, Acrididae)

BY  
THEODORE H. HUBBELL  
Department of Biology, University of Florida  
Gainesville, Florida

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ANN ARBOR, MICHIGAN  
THE UNIVERSITY OF MICHIGAN PRESS  
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#### ADVERTISEMENT

The publications of the Museum of Zoology, University of Michigan, consist of two series—the Occasional Papers and the Miscellaneous Publications. Both series were founded by Dr. Bryant Walker, Mr. Bradshaw H. Swales, and Dr. W. W. Newcomb.

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FREDERICK M. GAIGE,  
Director of the Museum of Zoology,  
University of Michigan.

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A REVISION OF THE PUER GROUP OF THE NORTH AMERICAN GENUS *MELANOPLUS*, WITH REMARKS ON THE TAXONOMIC VALUE OF THE CONCEALED MALE GENITALIA IN THE CYRTACANTHACRINAE.  
(ORTHOPTERA, ACRIDIDAE)

BY THEODORE H. HUBBELL

INTRODUCTION

At intervals during the past seven years I have carried on field studies of the Orthoptera of Florida, supplemented by occasional reconnaissance trips into neighboring states. From 1923 to 1925 Mr. F. W. Walker of Monticello, Florida, was also actively engaged in the same work. Our joint efforts have been devoted particularly to the investigation of the geographic and ecological distribution of the species inhabiting the southeastern coastal plain; but during the course of the work a number of undescribed forms have been discovered, including most of the new *Melanopli* described in the present paper.

The coastal plain of Georgia, Alabama, and Florida is rich in brachypterous species of the genus *Melanoplus*, many of which are very local in distribution. A number of these have been associated to form the Puer Group—an assemblage well represented in Florida, and comprising insects showing a considerable amount of diversity in form and structure. So many new species related to those placed in this group have been discovered recently that it seemed advisable to review the classification of the Puer Group as a whole in order to ascertain the relationships involved. In this study use has been made of hitherto neglected characters found in the concealed male genitalia, concerning which comments are made below.

I wish to express my great indebtedness to Mr. F. W. Walker, to whose skill as a collector the major portions of the series of several species are owing; to Mr. Morgan Hebard of the Academy of Natural Sciences of Philadelphia for the loan of material of the Puer Group from the Philadelphia collections; to Mr. Nathan Banks of the Museum of Comparative Zoology at Harvard University for allowing me to study the genitalia of a number of the Scudder types of *Melanopli*; to Mr. R. H. Beamer of the Department of Entomology of the University of Kansas for the loan of material; and to the Museum of Zoology of the University of Michigan, support from which made possible much of my field work in Florida. I am also deeply indebted to Miss Grace Eager of the last-named institution for the beautifully executed drawings shown in Plate III. Except as otherwise noted the specimens recorded in this paper are in the collection of the University of Michigan.

THE TAXONOMIC VALUE OF THE CONCEALED MALE GENITALIA  
OF THE CYRTACANTHACRINAE

Except in the Blattidae and a few other limited groups, the taxonomic characters in current use by American students of Orthoptera are almost wholly external. Great advances in taxonomic treatment of the order have been made since the time of Scudder, but these have, for the most part, been owing to more careful and detailed study of the same characters known to and used by the earlier workers. Increased recognition of the importance of geographic variation and more critical study of individual variation have made recent work on this group of insects exceptionally good. Indeed, the critical contributions of Rehn and Hebard have been held up to workers in other branches of entomological taxonomy as models of excellence, and well deserve such recognition. It is one of the objects of this paper to point out that in spite of this high standard of performance, at least one valuable group of characters has thus far been almost ignored—those found in the concealed genital structures of the male.

It is remarkable that the male genitalia have not been more used by taxonomic students of the order, in view of the fact that morphologists—notably Chopard<sup>1</sup> and E. M. Walker<sup>2</sup>—have specifically indicated their probable value in classification. A partial explanation may be found in the reluctance of many entomologists to damage specimens by dissection, together with the fact that most Orthoptera show excellent diagnostic characters in their external structure. If taxonomy is to be more than the distinction of species, however, every available characteristic must be considered in the attempt to determine phylogenetic relationships, and future studies should not ignore genital structures known to be of value.

I have examined the male genitalia of a large number of species belonging to many genera and to most of the subfamilies of the Acrididae. Judging by this preliminary survey it seems evident that in many subfamilies these organs will prove of value chiefly for the recognition of generic and group rather than of specific relationships. Thus in the Acrydiinae, Acridinae, and Oedipodinae little evidence of specific differentiation has been found. In the Cyrtacanthacrinae the case is different. Of the more than two hundred North and Central American species of this subfamily which

<sup>1</sup> Chopard, L. "Note préliminaire sur la conformation de l'organe copulateur des Orthoptères." *Bull. Soc. Zool. France*, (1918) 43: 59-67. "Recherches sur la conformation et le développement des derniers segments abdominaux chez les Orthoptères." *Theses de Paris*, (1920) Ser. A, No. 847, No. d'Ordre 1646, 352 pp., 7 pls. Rennes. "La valeur de l'Armure copulatrice comme caractere taxonomique chez les Orthoptères." *Ann. Soc. ent. France*, (1920) 89: 74-78.

<sup>2</sup> Walker, E. M. "The Terminal Structures of Orthopteroid Insects: A Phylogenetic Study." Part II. "The Terminal Abdominal Structures of the Male." *Ann. Ent. Soc. Amer.*, (1922) 15: 1-76, pls. I-XI.



I have studied, the majority show good specific characters in the penis or pseudosternite or in both. In some difficult genera, unfortunately, such as *Schistocerca*, *Aeoloplus*, and *Hesperotettix*, where reliable new characters would be welcome, specific differences are slight, though good generic characters exist. In other genera both generic and specific characters of value are to be found. In the great genus *Melanoplus*, on the other hand, the amount of specific differentiation is so great as to overshadow and conceal the features common to all members of the genus. The majority of the species of *Melanoplus* have the penis very distinctively specialized, often affording a sure means of distinguishing between species otherwise so closely similar that external features will hardly permit their separation. The more conservative pseudosternite often affords good group characters, and sometimes specific ones.

A technic of removing the concealed genitalia has been developed which largely obviates the objection that dissection involves injury to valuable and often unique specimens. A small dish of water supported over an alcohol flame provides a convenient and rapid means of relaxing specimens.<sup>3</sup> The end of the abdomen is held in the hot water for a short time, 10 to 30 seconds being usually sufficient; the entire specimen is then dipped momentarily, to soften leg joints and antennae and prevent breakage, and is laid on its side on the stage of a low-power binocular microscope. With a pair of fine dissecting tools (I find an eye-surgeon's cystotome and Graffe knife-needle convenient) the membrane between the distal tergites and sternites of the left side is cut, and the margins of the cleft separated. The membrane connecting the ventral surfaces of the paraprocts with the sclerotized plate at the cephalic end of the genital mass must also be cut or broken away.

The large, solid body exposed within the swollen ninth sternite is the genital mass, composed of the endapophyses, endoparameres, and rudimentary spermatophore sac, enclosed in the attached muscles and membranes, and overlain cephalo-dorsad by the peculiarly lobate, sclerotized *pseudosternite*. The caudal end of the genital mass is concealed by the fold of integument called the *pallium*, attached to the inner dorsal margins of the subgenital plate. This should be slipped off caudad, exposing the *penis*. The entire genital mass can now be lifted or rolled out of the cavity,

<sup>3</sup> The color and general appearance are not or are but slightly altered by the method of relaxing recommended; but care must be taken to keep the temperature of the water below the boiling point and to hold the specimens in the hot water no longer than necessary, especially in the case of those in a poor state of preservation. The advantages of this method are that one can dissect any specimen at short notice, and that the degree of relaxation can be accurately controlled. A certain amount of rigidity in all parts of the body except the tip of the abdomen makes the removal of the genitalia easier than if the entire specimen is very soft.

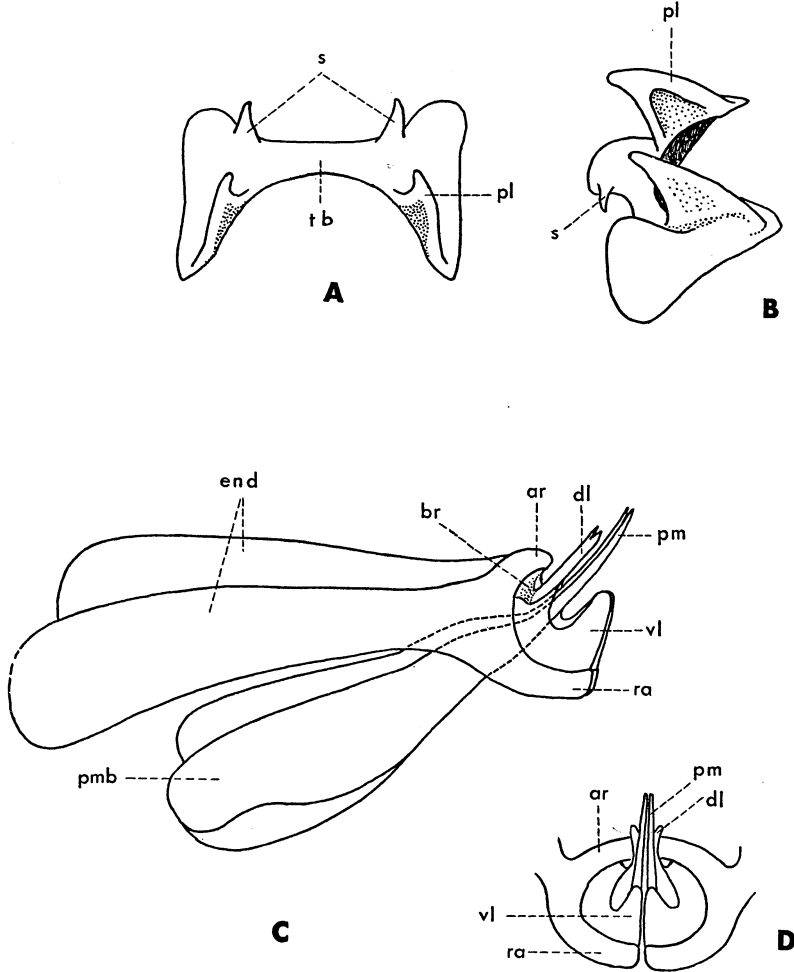
the attaching membranes being cut or pulled apart. After this operation the more or less distorted sclerites of the end of the abdomen may be gently poked back into shape, and the subgenital plate pushed up into normal position; if desired a small piece of cellu-cotton may be inserted to fill it out. With practice these parts are so little likely to be damaged that if they are carefully replaced in position the external appearance after drying is scarcely changed; in any case the structures most used in classification—cerci, furcula, and supra-anal plate—are unaffected. The entire dissection can be performed quite rapidly; I have removed and mounted the genitalia of as many as thirty specimens in an hour by this method.

If the detailed morphology of the genitalia is to be studied the genital mass must be treated with hydroxide solution and cleaned, after which it may be preserved in alcohol, or mounted on a point if sufficiently sclerotized to retain its form. For taxonomic purposes, however, removal of the tissues is seldom necessary, since the most highly differentiated structures are the penis and pseudosternite, both of which are fully exposed without further treatment. It may be necessary with a fine-pointed needle to remove from the apices of the penis lobes materials which have clotted around them; and the pseudosternite will often need to be pushed cephalad away from the penis, in order to straighten out the loose fold of integument connecting the two and thus expose the base of the penis. After a few moments of drying the entire genital mass may be mounted with acetone-celluloid cement or shellac on the end of a cardboard point placed on the pin which bears the specimen.

The morphology of the male genitalia of the Cyrtacanthacrinae has been clearly described by E. M. Walker in the paper already cited, to which reference should be made. The following brief account will suffice for the purposes of the present study. Resting upon the cephalic portion of the genital mass is the *pseudosternite*, a sclerotized plate lying in the membrane lining the genital cavity, and situated morphologically ventrad of the paraprocts and anus and dorsad of the penis, though actually cephalad of the latter. In the *Melanopli* this sclerite consists of a pair of enlarged lateral portions connected near their cephalic margins by a transverse bar of varying length and breadth. Each lateral portion of the pseudosternite bears a more or less erect, usually conspicuously elevated and flattened lobe; these lobes vary greatly in shape and show generic, group, or specific characters. Two short, more or less decurved, spinous processes project from the cephalic margin of the transverse bar; these exhibit generic and sometimes specific differences, but must be used with care, as they are subject to considerable individual variation in form.

At the dorso-caudal apex of the genital mass is the *penis*, composed of four paired structures and a dorsal, more or less divided lamina. The

paired structures are the free apices of sclerotized plates imbedded in the genital mass. The relationships of the sclerites constituting the entire apparatus are shown diagrammatically in the accompanying figures.



CONCEALED GENITAL SCLERITES OF THE CYRTACANTHACRINAE

A.—Dorsal view of pseudosternite of *Melanoplus rotundipennis* (Scudder). B.—Oblique dorso-lateral view of same. C.—Diagrammatic dorso-lateral view of genital sclerites of a Cyrtacanthacrid, after removal of pseudosternite and concealing tissues. D.—Caudal view of penis of above diagrammatic figure.

- |                                                      |                                       |
|------------------------------------------------------|---------------------------------------|
| ar. —endapophyseal arch                              | pm. —paramere                         |
| br. —bridge connecting base of dorsal lobe with arch | pmb.—endoparamere (paramere base)     |
| dl. —dorsal lobe of penis                            | ra. —ramus of endapophysis            |
| end. —endapophyses                                   | s. —decurved spines of pseudosternite |
| pl. —dorsal lobes of pseudosternite                  | tb. —transverse bar of pseudosternite |
|                                                      | vl. —ventral lobes of penis           |

Just cephalad of the base of the penis is a strong transverse bar of variable breadth and curvature (the *endapophyseal arch*), covered by the membrane which invests the dorsal surface of the genital mass. The ends of this arch curve cephalad on either side as elongate plates lying imbedded in the genital mass, their apices extending well beneath the pseudosternite; these lateral portions are the *endapophyses*. Connected with the sides of the arch and projecting caudad along the sides of the base of the penis is a pair of sclerotized bars, the *rami*, which may meet caudad in the median line. The ventral lobes of the penis are more or less broad, subventral, weakly to heavily sclerotized folds or plates continuous with the dorsal margins of the rami and more or less completely enfolding the bases of the ectoparameres. Proximad their dorsal margins are bound by a membranous tie to the lateral margins of the dorsal lobes; in some species the bond extends along the entire length of the approximated margins, and rarely the apices of the dorsal lobes are fused with dorsal projections from the ventral lobes.

Imbedded in the genital mass ventrad of and between the endapophyses are the *endoparameres*—a pair of sclerotized plates, expanded and thinly laminate cephalad, narrowing and convergent caudad. Where they approach one another in midcourse the endoparameres are bound together by a semitendinous sheet of tissue to enclose a cavity, the rudimentary spermatophore sac. The narrowed, approximated distal portions bend upward and pass through the opening formed by the endapophyseal arch and the latero-caudal rami and ventral lobes; their apices project as the *ectoparameres*, more or less enclosed below (caudad) and laterad by the ventral lobes of the penis, and above (cephalo-dorsad) by the *dorsal lobes*. The latter are the halves of a horizontal or distally elevated flap, an extension of the penis roof, bound at its base by a tendinous bridge to the middle of the ventral border of the endapophyseal arch. This structure is always undivided proximad; the distal portion may be more or less completely divided by a median cleft into lateral halves, or continue as an unpaired median structure. In the latter instance it may be called the *dorsal lobe*.

Taxonomically the dorsal and ventral lobes and the ectoparameres are by far the most important structures, on account of the great specific differentiation which they exhibit. In the genus *Melanoplus* I have not yet found two species with penes exactly alike, except in two instances where the specific status of the forms is not well established. Each of the above-mentioned structures is modified in many ways, and in combination an almost endless variety of types results. In one species the dorsal lobe is greatly produced and bent into an almost closed, compressed tube enclosing the slender, elongate ectoparameres, the ventral lobes forming a nar-

row collar at the base; in a second both dorsal lobes and ectoparameres are broadly laminate and involucrate; in a third the proximo-lateral portions of the ventral lobes are prolonged upward, concealing the dorsal lobe and partially enclosing the ectoparameres; while in a fourth both dorsal and ventral lobes are small and the ectoparameres themselves are greatly specialized and enlarged, forming most of the distal portion of the penis. The penis as a whole may be large or small, simple or very complex. Sometimes the parts are so involved that only treatment with hydroxide and dissection will enable their homologies to be ascertained.

Before the taxonomic characters found in the penis and pseudosternite can be used with confidence it is necessary to become familiar with the nature and extent of the individual variation to be expected in them. My own preliminary studies in the genus *Melanoplus* indicate that they are usually at least as constant in form within the species as are the cerci, furcula, supra-anal, and subgenital plates, upon the characters of which so much reliance is placed. At the same time they are so much more complicated that in most instances they furnish even better distinguishing characters, as well as a valuable check upon the phylogenetic relationships indicated by the external features.<sup>4</sup> Fortunately the parts of the concealed genitalia are almost always sufficiently sclerotized to maintain their form without serious distortion even when mounted dry on a point; but slight variations in position of the apices of the lobes and ectoparameres are often caused by desiccation.

#### THE "PUER GROUP" OF THE GENUS *Melanoplus*

In 1916 Rehn and Hebard<sup>5</sup> associated the following species to form the Puer Group of the genus *Melanoplus*: *puer* Scudder, *rotundipennis* Scudder, *stegocercus* Rehn and Hebard, *mirus* Rehn and Hebard, *scapularis* Rehn and Hebard, and *strumosus* Morse. In the previous year W. T. Davis<sup>6</sup> described *Melanoplus pygmaeus*, comparing it with *rotundipennis*. Blatchley's 1920 treatment<sup>7</sup> followed that of Rehn and Hebard, with the addition

<sup>4</sup> As an instance of this the Packardii Group may be cited. Hebard has recently published a preliminary account of the results of my examination of the genitalia of *packardii*, *stonei*, *foedus*, and *fluviatilis*, in *Proc. Acad. Nat. Sci. Phila.*, 83: 185-187. The Flavidus Group is another difficult assemblage in which the form of the penis appears to be the most reliable specific character. By its use *bowditchi* Scudder and *flavidus* Scudder can be separated with certainty, though the external characters are so nearly identical as to make identification by their means alone very laborious. Preliminary studies also indicate that *elongatus* Scudder, placed by Hebard as a race of *flavidus*, may in reality be a race of *bowditchi*. This, however, requires verification.

<sup>5</sup> *Proc. Acad. Nat. Sci. Philad.*, (1916) 68: 221.

<sup>6</sup> *Journ. N. Y. Ent. Soc.*, (1915) 23: 96.

<sup>7</sup> Blatchley, W. S. *Orthoptera of Northeastern America*, (Indianapolis, 1920) p. 379.

of *pygmaeus*. Still later *Melanoplus foxi* Hebard<sup>8</sup> was added, its relationships being with *strumosus*.

Rehn and Hebard did not attempt a formal definition of the group, though they gave as characteristic the following features: prosternal spine prominent and very broad, flattened cylindrical with apex transversely excised, the sides rounded; caudal tibiae glaucous, often more or less flavescent at base and tip, with spines black or black-tipped. In his manual Blatchley characterizes the Puer Group in the key and on page 379. On analysis the additional points of distinction between the Puer Group and the related Obovatipennis Group (= Tribulus Group of Rehn and Hebard) as given by Blatchley are as follows: size averaging smaller; postocular stripe often weakened or interrupted at principal sulcus of pronotum, often subobsolete in female; caudal tibiae with the coloration described by Rehn and Hebard, not dull greenish yellow; pronotum with sides of disk more divergent in both sexes than in Obovatipennis Group; caudal femora of male distinctly instead of slightly surpassing end of abdomen.

These characters do not always hold, even for the species hitherto included in the group. The shape of the prosternal spine is especially emphasized as characteristic both by Rehn and Hebard and by Blatchley. In *strumosus*, *foxi*, *scapularis*, *stegocercus*, *tumidicercus* n. sp., *mirus*, and *pygmaeus* it is normally of the form described; in *rotundipennis* it is often of this type, but is distinctly variable, with the apex often bluntly rounded or even subconical; and in *puer* and the remaining species it is usually considerably narrower, sometimes subtruncate but more often distally rounded to subconical. The addition of the new species described in this paper to the Puer Group serves to emphasize its rather heterogeneous nature, and widens the range of structural characters so much that it becomes difficult to find a common basis for associating the species. There appears to be little affinity between such species as *strumosus* and *scapularis* on the one hand and the *puer-tequestae* complex on the other; both of the former seem as closely related to members of the Tribulus Group as to the extremes of the Puer Group as at present constituted.

Rehn and Hebard recognized the lack of close relationship between the species at the time they delimited the Puer Group, for they state (1916: 221) that although the species are properly associated, "no one of them shows very close affinity to any of the others, as each has several decided and unusual characters peculiar to itself." Although the number of known species is now more than doubled, this statement still remains for the most part true, as shown not only by the external characters, but also by the high degree of divergent specialization found in the penis and pseudosternite.

<sup>8</sup> *Ent. News*, (1923) 34: 260.

Only *puer* and *adelogyrus*, and *insignis* and *forcipatus* form really close-knit units. In view of this lack of close relationship it has seemed best to subdivide the fourteen species now to be included in the "Puer Group" in its wide sense into four smaller and more natural groups, as is done in the following key.

KEY TO THE SPECIES OF THE "PUER GROUP" (S. L.) OF THE GENUS  
*Melanoplus*, BASED ON THE MALE SEX

1. Form rather robust, size large (body length usually over 16 mm.); tegmina ample, their inner margins subattingent to weakly overlapping; prosternal spine broad, flattened cylindric with apex transversely excised; caudal margin of pronotum evenly arcuate or very broadly obtuse-angulate, without or with at most a mere hint of a median notch; cerci never styliform nor roundly spatulate distad; furcula at least one-third as long as supra-anal plate or absent .....2
- Form less robust, often slender, size moderate to small except in one species (body length usually less than 15 mm., a little greater in *rotundipennis* and *pygmaeus*, as much as 17 mm. in *puer peninsularis*); tegmina smaller, always distinctly and usually rather widely separated; prosternal spine sometimes as described above but often subconical or bluntly rounded distad; caudal margin of pronotum usually emarginate or mesally notched (but evenly arcuate in *pygmaeus*, usually so in *apalachicolae*, and often in *rotundipennis*); cerci with distal portion styliform or spatulate; furcula short or absent .....7
2. Furcula one-third to one-half as long as supra-anal plate; cerci slender in distal two-thirds, extremity slightly enlarged and angulate ventro-distad; supra-anal plate with a conspicuous transverse ridge at about midlength.....STRUMOSUS GROUP 3
- Furcula absent; breadth of cerci at distal third equalling or exceeding that of base; transverse ridge of supra-anal plate not or but faintly indicated.
  - SCAPULARIS GROUP 4
  3. Furcula a pair of coarse, flattened, divaricate lobes with nearly straight axes, half as long as supra-anal plate, lying above elevated margins of mesal groove with apices touching transverse ridge, which does not extend laterad beyond them; supra-anal plate broadly triangular; ectoparameres of penis produced as a pair of very long, stout flagella, divergent proximad and in resting position curved down along caudal and ventral surface of penis.....*Melanoplus strumosus* Morse
  - Furcula a pair of narrow, subcylindrical processes one-third as long as supra-anal plate, divaricate proximad but subparallel distad, with apices lying laterad of elevated margins of mesal groove; transverse ridge extending full breadth of supra-anal plate; latter narrowly triangular; ectoparameres distally enlarged into hollow, thin-walled, conchate structures with apertures opposed, their caudal surfaces flattened, together slightly taller than broad and in this aspect resembling the ventral surface of a cloven hoof.....*Melanoplus foxi* Hebard
  4. Subgenital plate elongate, compressed into a scoop-shaped, subconical structure with sharply rounded apex; cerci moderately broad proximad, narrowing by arcuate excision of dorsal margin to half proximal breadth at middle, again expanding to proximal breadth and distad narrowing by oblique truncation of dorsal margin to the sharp, caudally directed ventro-distal angle; sides of supra-anal plate almost straight. (Concealed genitalia not studied.).....*Melanoplus mirus* Rehn and Hebard
  - Subgenital plate not as described above (moderately elongate in *tumidicercus*); cerci subquadrate or conspicuously broader distad than proximad; sides of supra-anal plate roundly angulate .....5

5. Cercus broad proximad, thence with side weakly curved, widening into an elongate subquadrate plate twisted apically so that its dorsal margin overlies apex of supra-anal plate, distal margin subtruncate or weakly convex; supra-anal plate with sides roundly angulate slightly beyond midlength. (Concealed genitalia not studied.)

*Melanoplus stegocercus* Rehn and Hebard

Cercus broad proximad, expanding distad to nearly twice or more than twice proximal breadth; supra-anal plate with side angulate at about distal third or quarter of their length.....6

6. Cercus abruptly narrowed just beyond base by excision of dorsal margin, thence with dorsal margin broadly convex to a point opposite distal third of ventral margin, apex diagonally subtruncate and weakly emarginate, ventral margin nearly straight in proximal four-fifths, thence rounding into the subventral, bluntly angulate apex; entire distal portion of cercus swollen, lateral face weakly umbonate distad, axial plane twisted as in *stegocercus*; supra-anal plate narrowly triangular; dorsal lobes of penis forming a narrow-shafted process expanding distad into a pair of subcontiguous, thinly laminate lobes, with dorsal surfaces nearly horizontal and weakly convex; ectoparameres elongate, aciculate, divaricate from beneath apices of dorsal lobes and passing caudo-ventrad, caudo-mesad, and caudo-dorsad in one complete turn of an open spiral, the apices crossing; dorsal and ventral lobes in lateral aspect widely separated.....*Melanoplus tumidicercus* new species

Cercus broad proximad, dorsal and ventral margins subparallel in proximal third or half, distal portion abruptly enlarged and distal margin broadly emarginate or bisinuate, with subacute apex directed disto-ventrad, entire cercus laminate, lying nearly in one plane, scapuliform; supra-anal plate broadly triangular; dorsal lobes of penis forming a short-shafted, Y-shaped structure, the short arms of the Y strongly divaricate, with submembranous apices curled meso-ventrad, and lateral margins rolled down to form a ventral groove enclosing the short, laminate apices of the ectoparameres, which are concealed from above; ventral lobes in lateral aspect rather closely appressed to ventral surface of dorsal lobes.

*Melanoplus scapularis* Rehn and Hebard

7. Distal portion of cercus spatulate or subspatulate in outline, as broad as or broader than interocular space; caudal margin of pronotum evenly convex or very weakly notched.....ROTUNDIPENNIS GROUP 8

Distal portion of cercus styliform or substyliform, never more than half as broad as interocular space, apex narrowly rounded or pointed; caudal margin of pronotum usually distinctly and often conspicuously emarginate mesad...PUER GROUP (s.s.) 9

8. Furcula absent; cercus with apex abruptly enlarged, slightly swollen, weakly but rather abruptly bent meso-dorsad from axis of shaft, ventral margin of cercus appreciably bisinuate just before apex; sides of supra-anal plate strongly convex distad; pallium low and rounded; subgenital plate narrower than long; penis similar to that of *scapularis*, but tips of ectoparameres projecting ventrad from beneath divaricate arms of dorsal lobes as short, sharp points, and ventral lobes represented only by a sheet of membranous integument extending between margins of dorsal lobes and of the broad, long, strongly sclerotized rami; pseudosternite lobes tumid, meso-dorsal angles bluntly rounded, dorsal margins convex-declivent latero-caudad; prosternal spine short, cephalic face flattened, apex broad and transversely excavate.....*Melanoplus pygmaeus* Davis

Furcula represented by short, flattened, widely separated lobes, variable in degree of development, but no longer than breadth of ninth tergite just laterad of their bases; cercus somewhat variable in form, apex weakly spatulate or with sub-



parallel sides, never abruptly angulate with shaft, lateral face of apical enlargement planate or weakly excavate, rarely slightly tumid; sides of supra-anal plate quite straight; pallium distinctive, strongly elevated as a narrowly conical, tent-shape membrane draped over end of rigid, elongate dorsal lobes of penis; subgenital plate as broad or broader than long; dorsal lobes of penis forming an erect, rigid sheath with down-bent margins enclosing the slender, elongate ectoparameres, the tips of which barely project from its end; sheath slightly angulate near base, tapering gently distad, as long as breadth of eye; ventral lobes similar to those of *pygmaeus* but weakly sclerotized; pseudosternite lobes unique in this section of genus, laminate, tall, falcate-triangular in outline, with acute apices.

*Melanoplus rotundipennis* (Scudder)

9. Cercus simple, styliform or substyliform, not or but slightly surpassing apex of supra-anal plate; dorsum of pronotum normally weakly tectate, median carina low but distinct (rarely subobsolete in *tequestae*); tegmina with dorsal and lateral fields not demarcate (but often just appreciably so in *tequestae* and rarely in *apalachicolae*) .....10
- Cercus highly specialized, shaped in lateral aspect roughly like a fist, inverted and with index finger extended and slightly bent, this slender, ventro-distal substyliform process reaching apex of subgenital plate; dorsum of pronotum convex-deplanate, median carina subobsolete; tegmina with dorsal and lateral fields separated by a slight but distinct angulation .....15
10. Postocular fuscous stripe broader on prozona than on metazona, often suffusing entire prozonal area, or weakened or interrupted on metazona; furcula present, shorter than breadth of ninth tergite just laterad of their bases, the lobes separated by an open, broadly U-shaped interval; ectoparameres aciculate, straight and flexible or rigid and spirally coiled, projecting dorso-caudad and not concealed by dorsal lobes; latter short, more or less completely enclosed laterad and often dorsad by upward prolongations of bases of ventral lobes; pseudosternite lobes broader than tall, with arcuate or subtruncate dorsal margins and more or less tumid mesal faces. (Size small to large for group) .....11
- Postocular fuscous stripe extending to caudal margin of pronotum, narrower and parallel-sided on prozona, broadening slightly or distinctly on metazona; furcula present or absent, when present not as described above; ectoparameres laminate, of various forms, more or less hidden in dorsal aspect beneath projecting apices of dorsal lobes; pseudosternite lobes as tall or taller than broad, slightly tumid, apices narrowly rounded or bluntly subconical. (Size small for group) .....14
11. Distal portion of cercus flattened, its margins subparallel or more often weakly divergent toward apex, distal breadth about half that of interocular space, apex narrowly rounded or subtruncate; subgenital plate in dorsal aspect narrowly rounded distad; supra-anal plate narrowly triangular; penis highly distinctive, apices of ectoparameres enormously enlarged as a pair of strongly sclerotized aciculae, each curved in an open, irregular spiral, and their distal halves crossed so that in dorsal aspect they present a somewhat pretzel-like appearance; dorsal lobes broad; ventral lobes swollen and with caudal margins appressed together to form a vertical median keel projecting caudad beneath the ectoparamere apices. (Size moderately large for the group) .....*Melanoplus adelogyrus* new species
- Distal portion of cercus very slender, tip very narrowly rounded or subacute, not or very slightly flattened; apex of subgenital plate subconical; supra-anal plate usually rather broadly triangular; ectoparameres not as described above; ventral lobes of penis with proximo-lateral portions projecting considerably dorsad, flank-

- ing and more or less enclosing dorsal lobes, ventro-caudal margins attingent but not flattened and strongly appressed ..... 12
12. Ectoparameres slender, elongate, flagellate processes, straight or curved (flexible in life); dorsal projections of ventral lobes erect, narrow in lateral aspect, with nearly vertical cephalic face, narrowly rounded apex, and very steeply declivent caudal face, their meso-cephalic margins attingent above surface of dorsal lobes, the two lobes taken together in caudal aspect forming a subpyramidal structure with rounded, mesially notched apex, the ectoparameres projecting from between the caudally concave bases of the lobes; meso-caudal margins of ventral lobes proper neither vertically laminate nor heavily sclerotized with disto-dorsal projections. (Size small. North-central peninsular Florida.)

*Melanoplus puer puer* (Scudder)

Ectoparameres more heavily sclerotized, less slender, bent into one or more turns of a corkscrew spiral, at least proximad; dorsal projections of ventral lobes not as described above; caudal margins of ventral lobes either thin and subvertically laminate or heavily sclerotized and produced beneath ectoparamere bases as a pair of short, stubby attingent fingers.....13

13. Ectoparameres elongate, extending dorso-caudad some distance beyond apices of dorsal projections of ventral lobes, coiled proximad in one to one and one-half turns of a spiral of distally increasing pitch, distal portions gently arcuate or sinuate; dorsal projections of ventral lobes abruptly narrowed above base and thence produced as a pair of subquadrate auriculate lobes, usually a little broader distad than proximad, and in caudal aspect flaring away from sides of penis, their cephalic margins widely separated and exposing dorsal lobes; caudal margins of ventral lobes narrowly explanate as thin, subvertical laminations, their caudal margins usually separated by an open V-shaped cleft, their disto-dorsal apices usually subrectangulate. (Size small, coloration like that of *puer puer*. South-central peninsular Florida.).....**Melanoplus puer seminole** new race

Ectoparameres short, scarcely or not surpassing apices of dorsal projections of ventral lobes, bent in a closer spiral and usually forming two complete turns; dorsal portions of ventral lobes thick, tumid, forming a broad collar enclosing ectoparamere bases, with meso-cephalic margins contiguous and concealing dorsal lobes, and dorso-caudal outline in lateral aspect only moderately declivent caudad; caudal margins of ventral lobes heavily sclerotized, attingent in the midline and lying in the same plane, with disto-dorsal apices projecting as a pair of short, bluntly rounded, flattened attingent fingers or marginal protuberances. (Size large for group, coloration usually rich and striking. Extreme southern tropical Florida.)

**Melanoplus puer peninsularis** new race

14. Antennae slender, approximately 1.3 times as long as combined length of head and pronotum; furcula present, lobes narrow, length slightly exceeding breadth of ninth tergite just laterad of their bases, axes subparallel or distally convergent, mesal margins separated by a narrow, sublinear interval; dorsal margin of cercus abruptly narrowed at base; ridges of proximal half of supra-anal plate narrowly separated, nearly parallel; distal portion of subgenital plate broadly rounded in dorsal aspect, marginate throughout, sides of subgenital plate not as described for alternative; pallium membranous, as broad as long, summit usually shallowly impressed in dried material; distal portion of penis thick and stubby, dorsal lobes elongate, with short, weakly divergent apices, the latter subtriangular in outline, with rounded-tetrahedroid dorsal surfaces, capping dorsal apices of ectoparameres; dorsal projections of ventral lobes large, produced disto-dorsad and overlapping

- margins of shaft of dorsal lobes; ectoparameres laminate-conchate, large and forming apex of penis, ventro-mesal margins thinly explanate, subvertical and parallel; pseudosternite lobes tall, thick but compressed, with strongly rounded apices ..... **Melanoplus apalachicola** new species
- Antennae short and thick, 1.0-1.1 times as long as combined length of head and pronotum; furcula absent; margins of cercus evenly convergent from base; ridges of proximal half of supra-anal plate convergent and meeting at middle of plate; subgenital plate narrow, sides compressed and incurvate proximo-dorsad, apex bluntly acute-angulate, usually more or less hidden in dorsal aspect by tumid sides of the weakly sclerotized, elongate-subquadrate, dorsally convex pallium, caudal surface of pallium continuous with that of subgenital plate, so that latter is not marginate distad and pallium in caudal aspect appears as a strongly elevated portion of its distal margin; apex of penis a slender, dorso-ventrally flattened projection, obliquely rising in proximal portion but subhorizontal distad, in dorsal aspect parallel-sided or weakly spatulate distad, this projection composed of the elongate dorsal lobes and fused lateral portions connected with bases of ventral lobes; ectoparamere apices concealed beneath apex of dorsal lobe; pseudosternite lobes tumid, very weakly subfalcate in outline, with blunt, subconical apices directed dorsad and slightly laterad..... **Melanoplus tequestae** new species
15. Dorsal and mesal portions of cercus abruptly truncate opposite distal fourth of supra-anal plate, margins of truncation roundly angulate, furnished with two small, thinly laminate rounded projections, one dorsal and subhorizontal, the other lateral and subvertical, both projecting distad and set close to and nearly at right angles with each other; large ventro-distal finger shorter, its dorsal surface rounded-angulate proximad, without trace of laminate expansion, its axis very weakly curved ventrad and still more weakly mesad; base of penis large, roundly subconical in caudal aspect and sloping up to base of much narrower distal portion, which is composed of a pair of curved laminate projections from bases of ventral lobes enclosing and concealing the deeply imbedded dorsal lobe, and exposing ventral margins of vertically placed laminate ectoparameres; apices of latter produced as a pair of extremely tenuous, divaricate, flagelliform processes with finely laminate meso-proximal angulations; cephalic portions of endapophyses narrow.<sup>9</sup>
- Melanoplus insignis** new species
- Truncation of proximal portion of cercus more oblique, dorso-lateral margin of truncation produced as a laminate projection with convex lateral surface and strongly rounded distal margin, corresponding in position to the vertical lamina of *insignis*, its margin continuous with that of a horizontal flange projecting mesad from the proximo-dorsal margin of the ventro-distal finger; this finger more elongate, strongly curved mesad as well as ventrad and partially enclosing pallium, so that cerci in dorsal aspect present a strongly forcipate appearance; base of penis large and heavily sclerotized, separated by a lateral construction from distal portion, which in caudal aspect is two-thirds as broad as base, glans-shaped, composed largely of the thickened, tumid dorsal projections of the ventral lobes; ectoparameres laminate and mesally concave with opposed margins, forming together a compressed tube, apices more slender and elongate than in *insignis*, of equal thickness and cylindrical in section throughout their length; cephalic portions of endapophyses broadly laminate, subfalciform with distally decurved apices.<sup>9</sup> ..... **Melanoplus forcipatus** new species

<sup>9</sup> Visible only in preparations which have been treated with hydroxide and cleaned.

## STRUMOSUS GROUP

*Melanoplus foxi* Hebard

(Plate II, Fig. 12)

Georgia: Two miles north of Wadley, Jefferson Co., July 5, 1925 (Hubbell), 3 males, 1 female.

This species was described from material taken by Fox near Macon, Georgia, in an open grove of mixed long-leaf pine and scrub oak in the Sand Hills, and has hitherto been known only from the small type series. The specimens recorded above were collected in an open grove of long-leaf pines growing on whitish-gray, clayey sand soil. The ground vegetation was composed predominantly of wiry grasses and thickets of shrubs and tree seedlings, including black-jack oak, sweet-gum, persimmon, sumac, hickories, and a species of *Vaccinium*; poison ivy, green-briar, and grape vines were also conspicuous. All of the individuals obtained were flushed from clumps of bushes. The description of the male genitalia given in the key was taken from the males of this series, not from the types.

*Melanoplus strumosus* Morse

(Plate II, Fig. 11)

Alabama: Choocolocco Mountain, Camp McClellan, Calhoun Co., July 13, 1925 (Dale Smith), 2 males.

Florida: DeFuniak Springs, Walton Co., June 5, 1924 (Hubbell), 6 males, 6 females, 4 juv.; Aug. 2-3, 1925 (Hubbell), 1 male, 1 female; Ponce de Leon, Holmes Co., Aug. 3, 1925 (Hubbell), 9 males, 10 females.

The specimens from Choocolocco Mountain were taken in the undergrowth of the open hardwood forests on the lower slopes of the mountain. At DeFuniak Springs, the type locality and hitherto the only one known for Florida, I found the species sparsely distributed in the scanty undergrowth of the scrubby oak forests which occupy the rather extensive but isolated sand area in which the town is situated. At Ponce de Leon the species was more common, occurring in a similar but more luxuriant type of growth.

## SCAPULARIS GROUP

Of the four species which I have placed in this group—*scapularis* Rehn and Hebard, *tumidicercus* new species, *stegocercus* Rehn and Hebard, and *mirus* Rehn and Hebard—only two are represented in the Michigan collections, *stegocercus* and *mirus* being known to me only from the descriptions.

*Melanoplus scapularis* Rehn and Hebard

(Plate II, Figs. 13, 14)

Florida: "Camp Torreya," Twp. 2 N., R. 7 W., Liberty Co., July 24-30, 1925 (Hubbell), 7 males, 9 females; Oct. 17, 1925 (Hubbell), 1 female.

This constitutes the second Florida record, and extends the range west from Woodville in Leon County. This series was taken in the turkey oak scrub which covers the sandy uplands lying east of the Apalachicola River, in the northwestern part of Liberty County. Here it occurred in company with *Melanoplus apalachicola*, described below. In this region the species seems to be decidedly scarce. The description of the male genitalia given in the key was taken from the males of this series.

***Melanoplus tumidicercus* new species.**

(Plate I, Figs. 9, 10)

Apparently most closely related to *Melanoplus stegocercus* Rehn and Hebard, agreeing with that species in its large size and rather robust build. The male cerci and supra-anal plate are somewhat intermediate in form between those of *stegocercus* and *scapularis*, though quite different from either. The concealed male genitalia are more highly specialized than those of *scapularis*. It has not been possible to compare these structures with those of *stegocercus* and *mirus*, but when this is done additional specific differences will probably be found. The peculiarly formed subgenital plate of *mirus* in particular suggests that the enclosed structures may show unusual and remarkable features.

Description of holotypic male (2.2 miles north of Uvalda, Montgomery County, Georgia, July 6, 1925 (Hubbell) [Museum of Zoology, University of Michigan]).—

Similar in size and form to *stegocercus*, slightly larger and more robust than *scapularis*. Compared with those species *tumidicercus* may be distinguished by the following features: pronotum similar in form to that of *stegocercus*, median carina distinct throughout, dorso-lateral shoulders moderately pronounced, nearly straight and gradually and evenly divergent caudad; prosternal spine unusually broad, cephalic face flattened, apex subtruncate, broadly transversely emarginate, the whole somewhat broader and blunter than in *scapularis*, resembling that of *pygmaeus* Davis; cephalic and median femora as in *stegocercus*, somewhat stouter than in *scapularis*; caudal femora stout, rather short; tegmina broadly ovate, dorsal margins weakly overlapping (usually attingent in *scapularis*, separated by a space of one millimeter in the type of *stegocercus*).

Terminal abdominal structures.—Extremity of abdomen enlarged, moderately upturned; supra-anal plate similar to that of *scapularis*, but narrower, lateral margins straighter, transverse ridge at midlength slightly more prominent; furcula absent; cercus distinctive, moderately broad at base, narrowing for a short distance and then rapidly broadening to a point opposite distal third and there nearly twice as broad as at base, dorsal mar-

gin strongly convex, distal margin oblique and weakly excavate, apex subventral, slightly acute-angulate and abruptly rounded, ventral margin nearly straight in proximal four-fifths, thence gently rounding up to apex; distal portion of cercus tumid with margins and apex thinner, lateral surface sloping up to a rounded prominence in center of expanded portion; shaft of cercus gradually twisted, axial plane of distal portion forming an angle of about  $45^\circ$  with that of base, dorsal margins of enlarged portion projecting mesad and overlying margins of supra-anal plate as in *stegocercus*. Subgenital plate in lateral aspect slightly more elongate than that of *stegocercus*, resembling more closely that of *scapularis*, distal margin broadly rounded in dorsal aspect; pallium low and rounded. Penis with dorsal lobes fused proximad into a narrow, subcylindrical shaft, flaring distad into a pair of thin, subhorizontal laminae, separated by a narrow mesal cleft, lateral margins rounded angulate, distal margins together biconvex, dorsal surfaces broadly convex, together forming a shallow hood twice as broad as long and nearly twice as broad as interocular space, concealing the ectoparameres and distal portions of ventral lobes in dorsal aspect; in caudal aspect the margins of the mesal cleft are seen to be formed by infolding of the mesal margins of the lobes, these margins appressed to mesal surfaces of divaricate proximal portions of ectoparameres and produced along them for a short distance, ending in narrowly rounded angulations, distal margins of lobes also narrowly recurvate so that each lobe is a subconchate structure with widely open ventral aperture; ectoparameres with proximal portions straight and contiguous, appressed to ventral surface of shaft of dorsal lobes, strongly divaricating beneath distal lobes and thence becoming slender, elongate aciculae, strongly sclerotized, subcylindrical except for a shallow grooving and weak carination along ventro-mesal surface; horizontal at base, these aciculae pass ventrad, mesad, and dorso-laterad in one complete turn of a widely open shallow spiral, their acute apices nearly reaching the distal margins of the dorsal lobes, and crossing near the apices of the ventral lobes; latter narrow in side view, produced ventro-distad as a pair of narrow, distally blunt-pointed, elongate, conchate lobes with concavities opposed, their apices extending as far caudad as base of expanded portion of dorsal lobes; between sides of shaft of dorsal lobes and dorsal margins of ventral lobes extends a taut subcoriaceous membrane with arcuate concave caudal margin continuing in lateral aspect the curvature of the disto-lateral margins of dorsal lobes, the surface of this membranous area forming a subhorizontal longitudinal ridge or fold proximo-laterad. Pseudosternite lobes of moderate height, meso-cephalic angles subrectangulate, bluntly rounded, crest subtruncate dorsad, gradually declivent latero-caudad.

Description of allotypic female (same date as holotype).—Very similar to females of *scapularis*, but with slightly broader tegmina which overlap

in this specimen; larger and more robust than *scapularis* and *mirus*, probably agreeing in these respects with the unknown female of *stegocercus*.

Measurements in millimeters					
	Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
MALE					
Holotype <sup>10</sup> .....	18.8	4.2	2.9	3.6	11.4
Paratopotype .....	17.4	4.2	3.0	3.6	11.6
FEMALE					
Allotype <sup>10</sup> .....	23.7	5.3	3.9	4.4	13.2
Paratopotype .....	22.4	5.2	3.9	4.6	13.2
Paratopotype <sup>11</sup> .....	21.0	5.2	4.0	4.1	13.4

In the male paratype and in all the females the tegmina are more or less truncate distad, instead of rounded as in the holotype; apparently a truncate or subtruncate tegminal apex is the normal condition in the species. The caudal margin of the pronotum is also slightly variable in form; in the holotype it is almost evenly rounded, with a barely perceptible median emargination, but in the females the margin is weakly sinuate, with the mesal third very faintly produced and just appreciably truncate or emarginate.

Coloration.—Very similar to that of *scapularis* and other members of the group. Postocular stripe intensely black, occupying dorsal half of lateral pronotal lobes and extending ventro-caudad on meso- and metapleura, interrupted by a diagonal ivory-white dash paralleling ventral margin of tegmen. Venter, face, ventral half of lateral pronotal lobes, and sides of abdomen Cream Buff to Honey Yellow,<sup>12</sup> sides of proximal abdominal segments strikingly marked with shining black blotches decreasing in breadth caudad and extending to fourth abdominal segment, dorsal portions of

<sup>10</sup> Additional measurements of the holotype and allotype are as follows (those of male given first): breadth of interocular space .5, .7; breadth of proximal antennal segment .4, .4; vertical diameter of eye 2.3, 2.6; length of infra-ocular sulcus 1.0, 1.3; cephalic breadth of pronotal disk 2.0, 2.8; height of lateral lobes to shoulder 2.6, 3.2; total height of pronotum in lateral aspect 3.2, 4.1; length of pronotum along shoulder 3.6, 4.4; breadth of tegmen in holotype 2.7, in male paratype 2.5, in allotype 3.3, in first female paratype 3.0; breadth of caudal femur in holotype and male paratype 3.0, in allotype 3.5, in first and second female paratypes 3.4 and 3.3; length of male supra-anal plate 1.8, proximal breadth 1.6; length of male cercus 2.0, least breadth .6, greatest breadth 1.1; length of antennae 7.6, 8.1; length of head and pronotum taken together 6.3, 7.6.

<sup>11</sup> Specimen teneral.

<sup>12</sup> Throughout this paper capitalized color names refer to the definite color standards given by Robert Ridgeway in his *Color Standards and Color Nomenclature*, (Washington: 1912).

eighth and ninth abdominal sternites marked with admesal sublunate blackish suffusions, cerci with a dark blotch on dorsal margin at narrowest part and with central margin narrowly outlined with fuscous, apex of subgenital plate margined with dark brown, terminal portions of abdomen otherwise concolorous with sides of abdomen; proximo-dorsal portions of abdomen Orange Cinnamon. Tegmina and dorsal surfaces of head and pronotum Walnut Brown. Cephalic and intermediate legs yellowish brown, intermediate femora marked in distal half with a pair of narrow infuscated bands on dorsal and cephalic surfaces. Caudal femora with dorsal and lateral surfaces Orange Cinnamon suffused in dorsal half with Drab Gray, twice banded on dorsal surface with fuscous fasciae, nearly interrupted between dorsal and dorso-lateral carinae, but distinct on dorso-caudal surface and on dorsal margin of lateral pagina, the proximal band continued very obliquely proximo-ventrad across base of lateral pagina as a dorsally cuneiform, ventrally linear dash reaching the angle of insertion of the femur; ventral sulcus yellowish, ventro-lateral surface Vinaceous Tawny, ventro-lateral carina Cream Buff; genicular arcs blackish, genicular lobes pallid. Caudal tibiae with base pallid, followed by an indistinct very dilute infuscation, remainder glaucous except for yellowish-brown distal portion. Coloration of female similar to that of male except as follows: postocular stripe deep black on prozona but abruptly lightened to Chestnut Brown on metazona in allotype, weakly indicated on both prozona and metazona by dilute brownish tints in both paratypes; dorsum and tegmina Bone Brown in allotype, predominantly Walnut Brown in paratypes; dorsal bars and oblique proximal marking of cephalic face of caudal femur very weakly indicated in the two light colored paratypes, in the allotype obscured by the general suffusion of the femoral surfaces with fuscous. The genicular lobes vary in the series from pallid to infuscate.

Specimens examined.—2 males, 3 females [holotype, allotype, and paratypes], 2 immature females, all taken with the holotype.

The type locality of *Melanoplus tumidicercus* is situated on the upper coastal plain in east-central Georgia. The species was very scarce in patches of oak runner (*Quercus minima* Sarg.), growing in dense mats a few inches tall and several square yards in extent, which formed a part of the undergrowth in an open hillside grove of long-leaf pines. Scattered among the pines were occasional scrubby oaks (*Quercus marylandica* Muench., *Q. catesbaei* Michx., *Q. cinerea* Michx.). Between the clumps of oak runner the light, sandy, residual soil was clothed with a sparse growth of wiry grasses. The entire series was taken by trampling down the patches of oak runner and capturing the specimens flushed in the process; sweeping and beating the vegetation proved unsuccessful.



## ROTUNDIPENNIS GROUP

*Melanoplus rotundipennis* (Scudder)

(Plate II, Figs. 17, 18, 19; Text Figs. A, B)

Specimens examined, 454 adults and 11 juveniles, as follows.—

Georgia: Jesup, Wayne Co., Aug. 30, 1923 (Hubbell), 1 male.

Florida: Waukeelah and El Destino in Jefferson Co., Aug. 4, 1925 (Hubbell), 6 males, 4 females; Perry, Taylor Co., Aug. 5, 1925 (Hubbell), 8 males, 2 juv. males, 4 females; O'Brien, Suwannee Co., Nov. 2, 1931 (Hubbell), 2 males, 4 females; Suwannee River, Columbia Co., Dec. 3, 1923 (Hubbell), 1 female; Anastasia Island opposite St. Augustine, St. Johns Co., Aug. 30–Dec. 9, 1923 (Hubbell and Walker), 18 males, 21 females; six miles south of Steinhatchee River, Buies, Eugene, and Oldtown in Dixie Co., April 19 (mostly teneral) and Aug. 5 to Nov. 21, 1925 (Hubbell), 9 males, 11 females; Gainesville, Archer, Newberry, Fairbanks, Newnan's Lake, Arredondo, Payne's Prairie, and Hawthorne in Alachua Co., adults in every month of year (Hubbell, Walker, and others), 105 males, 113 females, many immature specimens; Melrose and Palatka in Putnam Co., Sept. 20, 1930 and May 3, 1931 (Hubbell), 12 males, 8 females; Wacassassee River (Twp. 12 S., R. 16 E.) and Cedar Keys in Levy Co., Sept. 28–Oct. 19, 1923–1924 (Hubbell and Walker), 9 males, 5 females, 3 juv.; Belleview, Lake Weir, and Micanopy in Marion Co., Aug. 26–Mar. 30, 1924–1931 (Hubbell and Walker), 15 males, 9 females; Tavares and Eustis in Lake Co., July 23–Sept. 5, 1923–1926 (Walker and Hubbell), 4 males, 8 females, 2 juv.; Longwood and Altamonte Springs in Seminole Co., Aug. 29–30, 1923 (Walker), 1 male, 4 females; Apopka, Ocoee, Orlando, Clarcona, and Zellwood in Orange Co., Apr. 26–Dec. 30, 1923–1924 (Hubbell and Walker), 30 males, 41 females, 3 juv.; Haines City in Polk Co., Aug. 27, 1925 (Hubbell), 1 male, 1 juv. female.

This species is confined to southeastern Georgia and the northern half of peninsular Florida, limital records being as follows: on the north, Jesup and Thomasville, Georgia; on the west the latter locality and Waukeelah and Perry, Florida; southward in the peninsula it reaches from coast to coast and extends south to Orlando, Haines City, and Lakeland.

Within this territory it is by far the commonest and most ubiquitous of the brachypterous species of the genus. In open, rather dry hammocks it occurs in abundance, but is also numerous in flatwoods, high pine, scrub oak, and sand scrub habitats, as well as in weed-grown fields and other ruderal situations. In Alachua County adult specimens may be found in every month of the year, the individuals taken in January, February, and March being evidently survivors from the previous fall. Males begin to mature in April, and reach the height of their abundance between June and the end of September; females mature somewhat later, and are not abundant until July. They remain, however, abundant until late in the season, and are nearly as numerous in December as in the early fall; large numbers of them overwinter. It is probable that in this locality some individuals reach maturity during every month of the year except January and February.

Series of *Melanoplus rotundipennis* taken in xeric sandy habitats, as compared with those from more mesic situations, are of smaller average

size, and of lighter general coloration with the dark pattern more contrastingly developed. The exact form of the male cerci, the degree of development of the furcula, and the tegminal outline are individually and locally variable to a moderate extent. On the other hand the very remarkably specialized penis and pseudosternite are relatively constant in form throughout the range of the species. In material from the east coast of Florida and in the single specimen taken at Jesup, Georgia, the decurved caudal margins of the dorsal lobes are scarcely explanate proximo-ventrad, the lobes averaging slightly shorter than in more western material; in lateral aspect they are of subequal breadth and moderate, almost uniform curvature from base to apex (Plate II, fig. 17). Specimens of *rotundipennis* from the southwestern parts of its range (Jefferson, Alachua, and Orange counties) differ in having a greater degree of proximo-ventral lamination and angulation of the shaft of the dorsal lobes, which also average slightly longer (Plate II, fig. 19). In view of the constancy of every other feature of the distinctive genital armature these differences appear too slight to warrant taxonomic recognition.

*Melanoplus pygmaeus* Davis

(Plate II, Figs. 15, 16)

Florida: DeFuniak Springs, Walton Co., Sept. 11, 1929 (Hubbell), 8 males, 11 females.

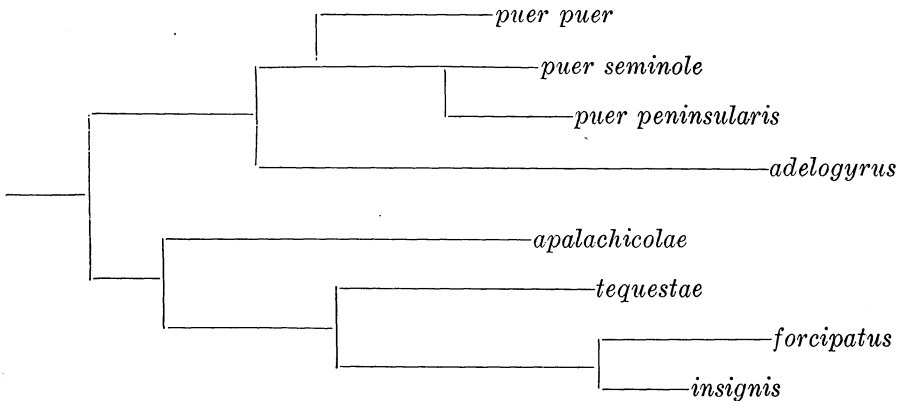
This interesting species is as yet known only from the above locality, from which it has been recorded by Davis in 1915 and by Blatchley in 1920. It is found in the undergrowth of the open scrubby forest of turkey oak (*Quercus catesbaei* Michx.) which covers the sandy uplands on all sides of the town. The species apparently matures rather late in the season, as I found no adults in the course of several days' collecting in June, 1924 and 1925, while my field notes record it as abundant on September 11. The large series secured by Rehn and Hebard was taken August 30, 1915.

PUER GROUP (S.S.)

The species which are here associated to form the Puer Group (s.s.) constitute a natural series; they are strongly differentiated from one another, but show much closer affinities within the group than does any one of them to a member of any of the preceding assemblages. Some students would perhaps prefer to retain *Melanopolus rotundipennis* and *M. pygmaeus* in the Puer Group. They are evidently not very closely related to one another, and both show resemblances to *puer*. Both of these species, however, are evidently much less closely related to *puer* than is that species to the rest of the forms which I group with it. The inclusion of *rotundipennis* and *pyg-*

*maeus*, with their distally spatulate male cerci, evenly convex or very weakly emarginate pronotal margin, and distinctively specialized penes, would impair such homogeneity as exists in the Puer Group as here limited, and tend to break down the distinctions between it and the Strumosus and Scapularis Groups.

The Puer Group (s.s) itself is divisible into two divergent series, the first including *puer* and *adelogyrus*, the second *apalachicola*, *tequestae*, *forcipatus*, and *insignis*. The following diagram illustrates my conception of the phylogenetic relationships involved.



#### *Melanoplus puer* (SCUDDER), AND ITS RACES

The range of *Melanoplus puer* is confined to peninsular Florida, extending from Alachua County (north-central) to the southern extremity of the state. Previous investigators have pointed out that specimens from the northern and central parts of the range are small and of moderately light average coloration, while those taken on the east coast in Dade County are very large and robust and more richly colored. Externally no obvious structural differences between specimens taken in different parts of the range appear to exist, though in the large form of the Miami region the cerci are on the average not quite so slender or sharply pointed as in northern specimens, and are often a little more flattened at the tip.

Study of the concealed male genitalia of the species, however, reveals a well-marked geographic differentiation in these structures. In an extensive northwestern area the penis is slender in lateral aspect, and terminates in a pair of flexible flagelliform processes showing no trace of spiral curvature, the apices of which project far beyond the summits of the dorsally produced ventral lobes; these dorsal prolongations extend upward laterad and cephalad of the ectoparamere bases and taper to narrowly rounded apices, their meso-cephalic margins being normally contiguous for some distance above

the surface of the concealed dorsal lobes. In a belt to the south of the first region the ectoparameres are shorter and spirally twisted, but still project strongly beyond the apices of the ventral lobes; the latter differ markedly in form from the first type, being small, subquadrate lobes, subtruncate distad and often a little constricted at the base, which flare away from the sides of the penis and fail to enclose it cephalad. From Fort Lauderdale southward on the east coast the penis is very broad and thick, stubby at the end, the dorsal portions of the ventral lobes being greatly swollen and enlarged, their dorsal margins obliquely truncate and their meso-cephalic margins contiguous above the concealed dorsal lobes; the ectoparameres are short, usually more heavily sclerotized than in the last type, more closely spiraled, and with their apices not or scarcely projecting as far as the apices of the ventral lobes. At Fort Myers on the west coast the penis is of a form most closely resembling the second type, but with some features approaching the third; material from this region is evidently more or less intermediate in structure.

Each of these three types is typically developed and quite constant over an extent of territory relatively large in comparison with the whole range of the species. The northern type (*puer puer*) passes by an abrupt transition into the central type (*puer seminole*) along a narrow and quite definite boundary. Specimens strictly intermediate between them have not yet been found, but the nature of the geographic relations of the two renders it almost certain that such intergradation exists. Owing to the fact that a broad belt of unworked territory extends between the area of known distribution of *puer seminole* and that of the southeastern form (*puer peninsularis*), it cannot at present be determined what the geographic relations of these two are; but it seems probable that they will be found to be similar to those between *puer puer* and *puer seminole*. Thus in spite of the inconspicuous nature of the differences which characterize these three populations, they appear to fulfill the essential conditions for their recognition as geographic races—relative constancy over definite geographic areas, and relatively abrupt transitions from one type to the next. I therefore feel constrained to regard *Melanoplus puer* as composed of at least three geographic races, the characteristics and distribution of which are described in greater detail below.

*Melanoplus puer puer* (Scudder)

(Plate III, Fig. 26)

1877. *Pezotettix puer* Scudder, Proc. Bost. Soc. Nat. Hist., 19: 87 [Fort Reed, Fla.].  
 1898. *Melanoplus puer* Scudder, Proc. U. S. Nat. Mus., 20: 252 [In part: Fort Reed, Fla.].  
 1905. *Melanoplus puer* Rehn and Hebard, Proc. Acad. Nat. Sci. Phil., 1905: 40 [In part: Tampa, Fla.].

1914. *Melanoplus puer* Rehn and Hebard, Journ. N. Y. Ent. Soc., 22: 108 [In part: Lakeland, Fla.].  
 1920. *Melanoplus puer* Blatchley, Orth. Northeastern Amer., 381 [In part: Fort Reed and Dunedin, Fla.].

Although I have been unable to examine the types of this species, a topotypic male in the collection of the University of Michigan Museum of Zoology enables me to place the name with certainty. The description of the concealed genitalia given in the key sufficiently expresses the characteristics of this race. The known range is defined by the following limital records: on the north Newberry, Gainesville, and Archer in Alachua County, thence southeast through Ocala in Marion County to Fort Reed (a suburb of Sanford) in Seminole County, south to Haines City and Highlands City in Polk County, and southwest to the Gulf coast at Tampa and Dunedin.

In Alachua County this race is very local in distribution, only a few colonies having been located in the course of much field work. It is practically confined in this region to xeric sandy areas. Most of the specimens were taken in turkey oak scrub on sandy uplands ("high oak"); others were found in open, second growth upland woods of long-leaf pine and various oaks, with sparse grassy undergrowth interspersed with patches of oak runner and dwarf chinquapin.

The Newberry and Archer series are strikingly colored, the dark femoral bars and pronotal markings standing out in strong contrast with the pale

	Measurements in millimeters			
	Length body	Length pronotum	Length tegmen	Length caudal femur
MALE				
Newberry, Florida .....	11.6-13.5	2.8-3.1	2.2-2.1	7.5- 8.7
Ocala, Florida .....	11.5-12.8	2.7-2.8	2.2-2.2	7.5- 7.9
Orlando, Florida .....	10.9-12.7	2.8-2.9	2.0-2.3	7.2- 7.9
Lakeland, Florida .....	12.3-12.3	2.8-3.2	2.1-2.4	7.6- 8.0
FEMALE				
Newberry, Florida .....	16.3-18.7	3.7-3.9	2.7-3.1	9.6-10.5
Ocala, Florida .....	15.9-16.8	3.6-3.8	2.4-2.8	9.4-10.3
Orlando, Florida .....	15.7-18.4	3.5-4.0	2.8-2.9	9.6-10.3
Lakeland, Florida .....	15.8-18.5	3.7-3.9	2.9-2.7	9.4-10.0

ground color. In these specimens the abdominal dorsum is also minutely but plainly mottled with darker and lighter shades of brown. This type of coloration is evidently associated with habitats in which the dry sandy soil is but scantily covered by ground vegetation and débris, since material taken near Orlando in scrub oak and sand scrub environments is also light

and contrastingly marked, while specimens found in somewhat more mesic forest near Tampa and in Polk County, where the ground is more shaded and more completely covered with dead leaves and other litter, are darker and more uniformly colored.

Scarcely any variation in the form of the penis is found in the rather extensive series studied. Size variation in this race is relatively slight, its extent being indicated by the preceding measurements of the smallest and largest individuals in the series from several localities.

Specimens examined, 244 adults, 39 immatures, as follows.—

Florida: Newberry, Archer, and Fairbanks in Alachua Co., July 27–Oct. 12, 1924–1929 (Hubbell and Walker), 96 males, 71 females; 27 juv. taken Mar. 30, July 10, Aug. 10, Aug. 22; Ocala, Marion Co., Sept. 19–20, 1917 (Rehn and Hebard), 16 males, 8 females, 3 juv. [Hebard Coll.]; Dunnellon, Marion Co., Sept. 19, 1917 (Rehn and Hebard), 6 females, 2 juv. [Hebard Coll.]; Trilby, Pasco Co., Sept. 16, 1917 (Rehn and Hebard), 2 males, 1 female, 1 juv. [Hebard Coll.]; Tampa, Hillsborough Co., Jan. 5–Feb. 23, 1924–1925 (Hubbell), 3 males; Oviedo, Seminole Co., Jan. 1, 1924 (Walker), 2 juv. males; near Fort Reed (Sanford), Seminole Co., May 3, 1931 (Hubbell), 1 male, 1 female (topotypes); Orlando, Orange Co., April 6–Sept. 3, 1924 (Walker and Hubbell), 11 males, 11 females, 1 juv.; Apopka, Orange Co., July 4–Aug. 30, 1923–1924 (Walker), 5 males, 7 females; 9 miles northeast of Bartow, Polk Co., Aug. 26, 1923 (Walker), 2 males, 1 female; Lakeland, Polk Co., Sept. 11, 1917 (Rehn and Hebard), 5 males, 9 females [Hebard Coll.]; Highlands City, Polk Co., March 31, 1931 (Hubbell), 5 males, 1 juv.

#### *Melanoplus puer seminole*, new geographic race

(Plate III, Figs. 27, 28, 29)

1914. *Melanoplus puer* Rehn and Hebard, Journ. N. Y. Ent. Soc., 22: 108 [In part: Punta Gorda [typical?] and Fort Myers [intermediate between *seminole* and *peninsularis*], Florida].

1920. *Melanoplus puer* Blatchley, Orth. Northeastern Amer., 381 [In part: Sarasota [typical] and Fort Myers [intermediate], Florida].

This race closely resembles *puer puer* in external features, though on the average the coloration is more uniform and the dark femoral bars do not stand out in such striking contrast. The characters of the concealed male genitalia are distinctive, and though locally and regionally somewhat variable, they clearly distinguish this race from both *puer puer* and *puer peninsularis*. Females are difficult to separate from those of *puer puer*, for the average colorational differences are not dependable characters. Degree of intensification or reduction of the color pattern appears in many Orthoptera to be largely affected by environmental conditions; and though *puer puer* and *puer seminole* characteristically occur in different types of habitats, each may be expected to approach the other in features of coloration where it locally invades pinelands and hammocks in the case of *puer puer*, or xeric sandy areas in the case of *puer seminole*.

Description of holotypic male (Arcadia, De Soto County, Aug. 27, 1923 (Walker)—1 mile south of city limits in typical wire grass-palmetto-scrub oak undergrowth of pine flatwoods) [Museum of Zoology, University of Michigan].—

Similar in size and all external structural features to *puer puer*, but differing in penis structure as follows: ectoparameres shorter, more heavily sclerotized and rigid, proximal portions thickened, compressed, coiled in a little more than one complete turn of a close spiral, distal half more slender, with twisted axis, somewhat sinuate and directed dorso-caudad; ventral lobes in cephalo-caudal direction broader than in *puer puer*, narrower than in *puer peninsularis*, their caudal margins in caudal aspect narrowly laminate-explanate, separated by a narrow V-shaped notch, abruptly terminated dorsad by an oblique truncation, the angle thus formed narrowly and abruptly obtuse-angulate; dorsal projections of ventral lobes abruptly narrower than ventral portions by reason of the rounded excision of caudal margin, produced as a pair of compressed auriculate flaps, lateral in position and flaring away from bases of ectoparameres, these flaps distally somewhat tumid and obliquely subtruncate with rounded angles, their distal breadth somewhat greater than proximal and about equal to proximo-distal length, their meso-cephalic margins separated by an interval as great as breadth of one of the lobes, exposing the dorsal surface of the dorsal lobes (in *puer puer* and *puer peninsularis* these margins contiguous and dorsal lobes concealed).

Description of allotypic female (topotypic, taken Sept. 12, 1917, by Rehn and Hebard) [in Hebard Coll.].—Similar in size and form to females of *puer puer*, and differing from the male as in that race. Except for average differences of coloration—the allotype being typical of the race in this respect—*puer seminole* is practically indistinguishable from *puer puer* in the female sex.

Individual, local, and geographic variation.—The form of the penis is almost constant in series from single localities. When series from different localities are compared each is found to exhibit local differentiation in varying degree. Material from De Soto and Manatee counties is regarded as typical, and shows but little variation in penis form (Plate III, fig. 27). Material from Osceola, Brevard, Indian River, and northeastern Okeechobee counties differs in certain respects from the typical form. In this eastern portion of the range of the race—east of Lakes Tohopekaliga and Kissimmee and the Kissimmee River—a cumulative tendency occurs toward elongation of the ectoparameres, which become less strongly spiralled and more arcuate distad, and in dorsal aspect tend to assume a distinctly caliperlike appearance. The eastern material is also distinguished by the much shorter

	Measurements in millimeters				
	Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
MALE					
Arcadia, Florida <sup>13, 14</sup> (holotype) .....	12.2	2.9	2.3	2.2	8.1
“ “ (paratopotype) .....	11.9	2.9	2.0	2.1	7.5
“ “ “ .....	13.9	3.1	2.4	2.7	8.4
Manatee, Florida (paratype) .....	11.7	2.8	2.0	1.9	7.3
“ “ “ .....	12.4	2.9	2.1	2.4	7.9
Okeechobee, Florida <sup>14</sup> .....	13.4	3.1	2.5	2.5	7.8
Near Olney, Florida (eastern phase) .....	11.8	3.0	2.3	2.3	7.8
Kissimmee, Florida “ “ .....	12.5	3.0	2.4	2.0	8.0
St. Cloud, Florida “ “ .....	13.7	3.0	2.4	2.4	8.0
Near Melbourne, Florida “ “ .....	13.8	3.4	2.7	2.8	8.7
Near Sebastian, Florida <sup>14</sup> “ “ .....	14.0	3.3	2.5	2.6	8.4
Forth Myers, Florida (intermediate) .....	12.6	2.9	2.2	2.0	7.8
“ “ “ “ .....	13.8	3.2	2.4	3.0	8.8
FEMALE					
Arcadia, Florida <sup>13</sup> (allotype) .....	16.3	3.7	3.4	3.0	9.9
“ “ (paratopotype) .....	14.6	3.7	2.8	2.2	9.3
Manatee, Florida (paratype) .....	14.2	3.3	2.8	2.0	8.3
“ “ “ .....	19.1	4.0	3.8	2.6	10.5
St. Cloud, Florida (eastern phase) .....	18.4	4.2	3.8	2.8	10.7
“ “ “ “ “ .....	18.7	4.3	3.5	2.8	10.4
Alligator Lake, Florida “ “ .....	18.8	4.5	4.0	3.0	10.8
Fort Myers, Florida (intermediate) .....	15.5	3.9	3.1	2.2	10.0
“ “ “ “ .....	17.5	4.1	3.6	3.2	10.5

dorsal projections of the ventral lobes (which are also more widely divaricate in caudal aspect) and by a considerable increase in breadth and length of the dorsal lobes. This tendency reaches its maximum expression in material from the vicinity of the east coast in Indian River and Brevard counties (Plate III, fig. 28). In such specimens the dorsal lobes are exceptionally broad and project considerably beyond the apices of the dorsal portions of the ventral lobes; their apices are distally truncate-emarginate or even broadly and weakly Y-shaped, causing the auriculate projections of the ventral lobes to be much more widely separated than in typical

<sup>13</sup> Additional measurements of the holotype and allotype are as follows, those of the male being given first: vertical diameter of eye 1.9, 2.0; length of infra-ocular sulcus .8, 1.2; interocular distance .3, .4; breadth of proximal antennal segment .3, .4; vertical height of lateral pronotal lobes to shoulders 2.0, 2.4; total height of pronotum in lateral aspect 2.4, 3.2; cephalic breadth pronotal disk 1.6, 2.3; breadth of tegmen 1.4, 1.7; length of male supra-anal plate 1.0, proximal breadth 1.0; length of male cercus .7; length of antenna 5.9, 7.0; combined length of head and pronotum 4.7, 5.7.

<sup>14</sup> Concealed genitalia of these specimens figured on Plate III, figs. 27, 28, 29.



material, the interval between their meso-cephalic margins being sometimes nearly twice the breadth of one of the lobes. There evidently exists in this part of the range of the race a strong tendency toward the development of a divergent group; but in my opinion this eastern material should be regarded as an atypical eastern phase of *puer seminole* showing incipient racial differentiation rather than as a distinct geographic race. A male from Okeechobee shows a condition of the penis structures nearly intermediate between those of the typical and of the eastern phases (Plate III, fig. 29).

The fairly large series from Fort Myers is distinctly atypical. The penis resembles that of *puer seminole* in the following respects: the ectoparameres project rather strongly beyond the apices of the dorsal prolongations of the ventral lobes, and the latter are relatively small, somewhat auriculate in form and fail to meet cephalad above the dorsal lobes. Approach to *puer peninsularis* is shown by the larger size of the penis (the ventral lobes and their dorsal projections being thicker and somewhat tumid), by the more subcylindrical form of the distal portion of the penis, by the fact that the projections of the ventral lobes more completely enclose the bases of the ectoparameres, and particularly by the form of the caudal margins of the ventral lobes. In the Fort Myers material, as in *puer peninsularis*, the dorso-caudal angles of the ventral lobes are rather heavily sclerotized as a pair of attingent marginal rods, the apices of which project dorsad as a pair of parallel-sided, distally subacute or narrowly rounded fingers, lying in a shallow depression on the caudal face of the penis. The length and diameter of these fingers vary individually, as in *p. peninsularis*, but in the Fort Myers series they average a little more slender and less heavily sclerotized than in *puer peninsularis*. In *puer seminole* the caudal margins are laminate, with scarcely a trace of a more heavily sclerotized marginal rod, and dorsally these laminae terminate in mere angulations of varying degrees of abruptness. I regard the Fort Myers series as virtually intermediate between *puer seminole* and *puer peninsularis*, though material from localities north and south of this point will need to be studied before this can be accepted as evidence of intergradation.

Coloration.—Similar to that of *puer puer*, but differing as follows: dorsum showing practically the same range of color tones, but averaging slightly darker, the lightest colored males in this series having the pronotal disk Cinnamon, the darkest ones almost black, and females averaging a more reddish brown; bars of dorsal surface of caudal femora rarely strongly contrasted with a light ground color, usually faint either by dilution or by general suffusion of dorsal surface with fuscous; dorsal surface and dorso-lateral carina often thickly dotted with blackish brown; external face almost uniformly pale or with a strong distal suffusion of dark brown which may spread nearly to base, genicular arcs usually dark brown or black. No

constant colorational differences distinguish *puer puer* and *p. seminole*, though specimens with strongly barred caudal femora are common in the former and rare in the latter. A few dark individuals in the Manatee series have a narrow pale mid-dorsal line, giving them a strong resemblance to a color phase of common occurrence in *puer peninsularis*.

*Melanoplus puer seminole* is usually encountered in pine flatwoods, composed either of long-leaf or of Caribbean pine. In Manatee County it was found for the most part in flatwoods on poorly drained or even marshy soils, though some specimens were taken in open grassy fields near the edges of the Manatee River marshes, and in sandy upland pastures and fields overgrown with tall clumps of palmetto and dog-fennel (*Eupatorium capillifolium* (Lam.) Small). In Osceola, Brevard, Indian River, and Okeechobee counties the race was found in small numbers in the undergrowth of various types of pine forests—sometimes in grassy situations, elsewhere, for example, in dense growths of scrub palmetto. Where sandy ridges supporting a stand of scrub oak occur within its territory it also inhabits this environment, and in such situations is often more abundant than in adjacent pinelands. The series from St. Cloud was taken in an isolated patch of *Quercus catesbaei* Michx. and *Q. cinerea* Michx., as were also the specimens from Olney.

The range of this race cannot yet be defined with accuracy, but it evidently occupies a diagonal belt of territory to the south of that in which *puer puer* occurs, and southward, at least along the east coast, is replaced by *puer peninsularis*.

Specimens examined, 117 adults and 10 immatures, as follows.—

Typical *puer seminole*

Manatee, Manatee Co., Jan. 2, 1925 (Hubbell), 1 male [paratype]; Aug. 18–22, 1925 (Hubbell), 20 males, 18 females [paratypes], 3 juv.; Arcadia, De Soto Co., Aug. 27, 1923 (Walker), 1 male [holotype]; Sept. 12, 1917 (Rehn and Hebard), 19 males, 5 females [allotype and paratypes], 1 juv. female [Hebard Coll.].

Atypical eastern phase of *puer seminole*

Kissimmee, Osceola Co., Sept. 9–10, 1917 (Rehn and Hebard), 6 males [Hebard Coll.]; St. Cloud, Osceola Co., Aug. 27, 1925 (Hubbell), 2 males, 3 females, 1 juv. female; near Alligator Lake, Osceola Co., May 24, 1931 (Hubbell), 3 males, 1 female, 3 juv.; 5 miles west of Melbourne, Brevard Co., May 24, 1931 (Hubbell), 1 male; 10 miles north of Sebastian, Brevard Co., May 24, 1931 (Hubbell), 1 male; 3 miles south of Sebastian, Indian River Co., May 24, 1931 (Hubbell), 1 male; near Olney, 23 miles north of Okeechobee, Okeechobee Co., May 24, 1931 (Hubbell), 1 male, 6 juv.; 2 miles north of Okeechobee, Okeechobee Co., May 24, 1931 (Hubbell), 2 males (intermediate between typical and eastern phases).

Intermediate between *puer seminole* and *puer peninsularis*

Fort Myers, Lee Co., Sept. 13–15, 1917 (Rehn and Hebard), 22 males, 11 females, 2 juv. females [Hebard Coll.].

**Melanoplus puer peninsularis** new geographic race

(Plate III, Fig. 30)

1905. *Melanoplus puer* Rehn and Hebard, Proc. Acad. Nat. Sci. Phil., 1905: 40 [In part: Miami, Florida].
1907. *Melanoplus inops* Rehn and Hebard, Proc. Acad. Nat. Sci. Phil., 1907: 295 [In part: Lemon City, Dade Co., Florida].
1912. *Melanoplus puer* Rehn and Hebard, Proc. Acad. Nat. Sci. Phil., 1912: 262-264, figs. 17, 18 [Miami and Homestead, Florida. Detailed notes on size, variation, coloration, and habitat].
1914. *Melanoplus puer* Rehn and Hebard, Proc. Acad. Nat. Sci. Phil., 1914: 397 [Homestead and Detroit, Florida].
1914. *Melanoplus puer* Rehn and Hebard, Journ. N. Y. Ent. Soc., 22: 108 [In part: [?]  
Marco in Collier Co., Florida (specimens not seen)].
1915. *Melanoplus puer* Hebard, Ent. News, 26: 407 [Miami Beach, Southside, Virginia Key, and Cape Florida on Key Biscayne, all in Dade Co., Florida].
1920. *Melanoplus puer* Blatchley, Orth. Northeastern Amer., 381-382, figs. 133a, 133b [In part: Miami, Florida. Figures after Rehn and Hebard, 1912].

This race is distinguishable from *puer puer* and *puer seminole* by the larger size and distinctly more robust form, by the richer and deeper coloration, and, in the male, by the form of the penis, which is the most reliable character.

Description of holotypic male (5 miles northeast of Paradise Key (Royal Palm Park), Dade County, Florida, Sept. 19, 1929 (Hubbell)—in *Pinus caribea* flatwoods on jagged eroded surface of Miami oölite) [Hebard Coll.].—

Large for the Puer Group, distinctly larger and more robust than *puer puer* or *puer seminole*. Compared with those races it differs as follows: pronotum heavier and more inflated, dorsum of prozona gently convex in a cephalo-caudal direction as well as transversely, median carina distinct but less pronounced than in *puer puer*, especially on metazona; pronotal shoulders more broadly rounded in section and less straight in dorsal aspect, dorsal portions of lateral lobes more tumid, especially on prozona (subplanate and usually nearly vertical in other two races); caudal femur very stout, conspicuously more so than in *puer puer* and than the average in *puer seminole*, outer surface strongly convex and carinae bounding external pagina indistinct proximad; cerci with distal half a trifle broader than in the other races and with tip appreciably flattened, though subacute. Penis with ectoparameres considerably sclerotized and spirally coiled as in *puer seminole*, but shorter and making almost two complete turns (seldom more than one and one-half in *seminole*), their apices in lateral aspect not surpassing extremities of dorsal projections of ventral lobes (shorter to barely longer in series); latter thickened and enlarged, broad in lateral aspect, completely encircling bases of ectoparameres and concealing dorsal lobes,

cephalic margins attingent; the two ventral lobes together forming a somewhat tumid, distally oblique-truncate, short, thick, subcylindrical structure; meso-caudal margins of ventral lobes sclerotized as a pair of vertical, attingent rods, the apices of which project dorsad as a pair of blunt, stubby fingers caudo-ventrad of the ectoparamere bases.

Description of allotypic female (same data as holotype).—Differing from the male as in the other races. Distinguishable from females of *puer puer* and *puer seminole* by the larger size, more robust form, and richer and darker coloration. In series the caudal margin of the pronotum also averages a little more strongly emarginate than in those races.

	Measurements in millimeters				
	Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
MALE					
Near Paradise Key, Fla. <sup>15</sup> (holotype) .....	16.6	4.1	3.1	3.1	9.8
Homestead, Florida (paratype) .....	13.8	3.4	2.4	2.3	9.0
“ “ “ .....	16.8	4.0	2.9	3.4	10.1
Miami, Florida “ .....	13.1	3.5	2.7	2.2	9.2
“ “ “ .....	14.7	3.9	2.8	2.2	10.2
Miami Beach, Florida “ .....	16.1	3.8	2.8	2.8	9.9
Deerfield, Florida “ .....	13.1	3.3	2.5	2.5	8.4
Fort Lauderdale, Florida “ .....	14.0	3.3	2.6	2.3	8.3
“ “ “ .....	14.8	3.6	2.9	2.8	9.6
FEMALE					
Near Paradise Key, Fla. <sup>15</sup> (allotype) .....	22.5	5.0	4.4	3.8	11.7
Homestead, Florida (paratype) .....	19.4	4.5	3.8	3.4	10.9
“ “ “ .....	22.5	5.3	4.6	3.6	11.6
Miami, Florida “ .....	18.9	4.1	3.8	2.9	10.4
“ “ “ .....	19.4	4.8	4.0	3.3	11.2
Fort Lauderdale, Florida “ .....	18.0	4.2	3.4	2.6	10.5
“ “ “ .....	19.2	4.2	3.8	3.6	11.1

Aside from differences in size, and considerable variation in the form and dimensions of the tegmina—especially in the degree of distal truncation and curvature of the ventral margin—such as occur in all three races of *puer*, the present race exhibits but little structural variation. The caudal

<sup>15</sup> Additional measurements of the holotype and allotype are as follows, those of the male being given first: vertical diameter of eye 2.4, 2.5; length of infra-ocular sulcus 1.0, 1.3; interocular distance .3, .45; breadth of proximal antennal segment .45, .45; cephalic breadth of pronotal disk 1.8, 2.2; vertical height of lateral pronotal lobes to shoulders 2.9, 3.2; total height of pronotum in lateral aspect 3.3, 4.0; breadth of tegmen 1.8, 2.4; breadth of caudal femur 3.0, 3.4; length of male supra-anal plate 1.4, proximal breadth 1.4; length of male cercus 1.1; length of antenna 8.3, 9.8; combined length of head and pronotum 6.5, 7.1.

margin of the pronotum varies somewhat in the degree of angulate emargination, but this is at a maximum in this race, not only for the species, but for the Puer Group as a whole. The male furcula are often somewhat more sharply pointed than in the other two races, but their form is not constant in *puer peninsularis* any more than in the others. The male cerci vary somewhat in length, degree of curvature, and form of distal portion; in most specimens they are appreciably broader distad than in *puer puer* and *puer seminole*, but they are often indistinguishable from those of specimens of those races. Occasional individuals show a slight but appreciable tendency to develop a narrowly subspatulate cercal tip. The form of the penis is quite constant, that of the ventral lobes particularly so; but the apices of the ectoparameres are sometimes a trifle longer than in the holotype, and a little more or less tightly spiraled.

Coloration.—The color description given by Rehn and Hebard in 1912 for *puer* applies to this race. In the male the ground color varies from Russet to Drab tinged with Raw Umber, in the female from Burnt Umber to Clove Brown tinged with Vandyke Brown. A few individuals, however, are much darker in general tone, and have the pronotal disk a rich brown approaching black, while in others of both sexes the dorsum of the pronotum is contrastingly light in tint—in one instance Ivory Yellow—and very often conspurcate or mottled with brownish flecks. In the male the customary dark patch on the sides of the prozona is very pronounced, piceous, and more conspicuous than is usually the case in *puer puer* and *puer seminole*. The piceous maculae on the sides of the first four abdominal tergites are also enlarged and confluent to form a pair of intensely black bands, between which the lighter colored dorsum often stands out as a conspicuous mid-dorsal stripe, sometimes continued nearly to the apex of the abdomen. In dark-colored specimens the median carina of the pronotum is sometimes pale, forming a narrow line continuing the abdominal stripe. The black pronotal markings are much less conspicuous in the female, being reduced in size and in intensity, and usually contrasting less with the average darker ground color; in this sex the lateral abdominal markings are faintly suggested in only a few of the most intensively colored specimens. The caudal femora in both sexes are usually heavily twice-banded, with the apex also infusate. In the darkest individuals these bands may be faintly indicated on account of their slight contrast with the ground color. The ventral face of the caudal femora in the male is Gamboge Yellow, sometimes changing distad to Deep Chrome; in females it is Saturn Red, usually grading into Flame Scarlet along the outer margin. In this respect females of this race are more strikingly colored than the majority of those of *puer puer* and *puer seminole*, in which the ventral surface of the caudal femur is usually some shade of yellow or only weakly tinged with red. The caudal tibiae

in both sexes of *puer peninsularis* are almost always Pale to Deep Heliotrope Purple. A few specimens in this series have the tibiae yellowish, bluish, or brownish, though even in these a purplish or lavender tinge may be observed in some lights. In *puer puer* the tibiae are usually yellowish or glaucous; in *puer seminole* yellowish, glaucous, or occasionally lavender.

*Melanoplus puer peninsularis* has been taken in Dade County chiefly in *Pinus caribaea* flatwoods growing on sandy soils or on the jagged, unevenly eroded surface of the Miami oölitic limestone. My own observations agree with those of Rehn and Hebard, who state that it is local in distribution, and usually found in small colonies in the undergrowth of the pine woods. At Fort Lauderdale, in Broward County, this race was taken in small numbers in sandy pine forests, among clumps of saw palmetto (*Serrenoa serrulata* [Michx.] Hook.); in a marshy situation at the edge of a cypress swamp bordering South Middle River; in a mixed growth of pine and cypress on the bank of the North Fork of New River; and in slightly greater abundance in an open pine-oak grove on sandy soil, where the vegetation showed a definite sand-scrub element—rosemary (*Ceratiola ericoides* Michx.), dwarf oaks, and other plants. Local environmental influences apparently affect the size and coloration of *Melanoplus puer peninsularis* to a considerable degree, specimens from Miami Beach, Homestead, and the type locality near Paradise Key being larger, more robust, and more richly colored than the average of the Miami and Fort Lauderdale series.

Specimens examined, 96 adults [holotype, allotype, and paratypes] and 21 immatures, as follows.—

Florida: Boca Raton, Palm Beach Co., March 1, 1916 (Hebard), 1 juv. male [Hebard Coll.]; Fort Lauderdale, Broward Co., Aug. 29–Sept. 4, 1925 (Hubbell), 9 males, 2 females, 2 juv.; Miami, Dade Co., Feb. 6–March 28, 1904–1919 (Hebard), 26 males, 15 females, 12 juv. [Hebard Coll.]; Miami Beach, Dade Co., March 3–12, 1915–1916 (Hebard), 14 males, 7 females [Hebard Coll.]; Virginia Key, Dade Co., March 11, 1915 (Hebard), 1 female [Hebard Coll.]; Cape Florida on Key Biscayne, Dade Co., March 12, 1915 (Hebard), 1 juv. male [Hebard Coll.]; Deerfield, Dade Co., March 1, 1916 (Hebard), 1 male [Hebard Coll.]; Biscayne Bay, Dade Co., Feb. 29, 1916 (Hebard), 1 female [Hebard Coll.]; Little River, Dade Co., Nov. 28, 1912 (Fred. Knab), 1 male [Hebard Coll.]; Cocconut Grove, Dade Co., Aug. 9, 1930 (L. D. Tothill), 1 male, 1 juv. male [Univ. Kansas]; Homestead, Dade Co., March 17–19, 1910 (Hebard), 6 males, 5 females, 2 juv. males [Hebard Coll.]; July 10–12, 1912 (Rehn and Hebard), 1 male, 1 juv. male [Hebard Coll.]; Aug. 31, 1925 (Hubbell), 2 males; Detroit, Dade Co., July 12, 1912 (Rehn and Hebard), 1 female, 1 juv. female [Hebard Coll.]; five miles northeast of Paradise Key, Dade Co., Sept. 19, 1929 (Hubbell), 1 male, 1 female [holotype and allotype].

### *Melanoplus adelogyrus*, new species

(Plate III, Fig. 31)

A close relative of *Melanoplus puer*, it replaces that species east of the St. Johns River in Volusia County, Florida. This species is very similar

in size and coloration to *M. puer seminole*, but may be distinguished from all the races of *puer* by slight though constant differences in the form of the cerci, supra-anal plate, subgenital plate, and pallium in the male sex. The penis of *adelogyrus* is of unique and distinctive form, much more highly specialized than in *puer*, though apparently derived from a condition similar to that found in the eastern atypical phase of *puer seminole*. Females of *adelogyrus*, *puer puer*, and *puer seminole* are almost indistinguishable, though the last two are on the average darker and more uniform in coloration.

Description of holotypic male (De Leon Springs, Volusia County, Florida, Sept. 8-9, 1917 (Rehn and Hebard) [Hebard Coll.].—

Similar in size and form to *M. puer seminole*, agreeing with that race except in the following respects: supra-anal plate more elongate, sides convergent and weakly convex to just before apex, there more abruptly convergent and very weakly emarginate, apex acute-angulate; furcula as in *puer*; cerci abruptly narrowed at base by excision of dorsal margin, thence subequal and gently upcurved, margins weakly convergent in proximal half, just appreciably expanding distad, distal third flattened, compressed, distal end rounded-subtruncate, distal breadth half that of interocular space; subgenital plate similar to that of *puer seminole* but more ample, distal margin in dorsal aspect more broadly rounded; pallium tumescent, broad and low, occupying most of space within margins of subgenital plate.

Concealed genital structures.—Penis with dorsal lobes short, undivided, distal portions moderately explanate laterad, distal margin broadly convex, shallowly notched at middle, entire distal portion forming a thin, dorsally somewhat convex laminate sheath appressed to proximo-dorsal surfaces of the greatly enlarged, highly specialized ectoparameres. Proximal portions of latter heavy, abruptly bent so as to project laterad from beneath apex of dorsal lobe with dorsal surface subhorizontal and axes divaricating almost 180 degrees, these divaricate proximal portions in dorsal aspect with cephalic margins slightly oblique but caudal margins together forming an almost straight line across midplane; shafts beyond immediate base curving rapidly caudad with dorsal margins subhorizontal until axes are subparallel, thence bending rather abruptly dorsad, at the same time curving mesad until they reach and cross midplane at an elevation above that of bases; curvature continued ventrad, laterad, and dorsad in an irregular, broad, shallow spiral to subacute apices. The distal portions of the ectoparameres cross, and the two are not strictly symmetrical, the one which lies within the curvature of the other having the ventrally directed segment curving slightly cephalad so that it forms a less regular spiral. In dorsal aspect the ectoparameres are broadest proximad, narrowing slightly in lateral sub-

parallel segments, increasing slightly in breadth toward summit of inward curve, thence tapering regularly to apices. In this view the coiled, distally crossed form of these structures gives the terminal portion of the penis a distinctly pretzel-like appearance. In lateral aspect ventral margin just distad of base expanded into a low, rounded prominence, making breadth greatest at this point; the caudal surface of this prominence marks the beginning of the upward bend. Inner face of each coil shallowly grooved from base to apex, outer face strongly convex; at point where meso-dorsal curvature begins the morphologically ventro-lateral margin of this groove explanate as a low, curved, laminate keel, broadest at this point and decreasing in height to summit of dorsal curve. Ventral lobes with sides not produced dorsad as in *puer*, caudal portions thin, slightly concave plates appressed together to form a vertical median keel with arcuate caudal margin.

Description of allotypic female (same data as holotype).—Similar in all structural characters to females of *puer puer* and *puer seminole*, agreeing in coloration with last, and differing from male as in the instance of females of those races.

The structural variation found in *Melanoplus adelogyrus* is similar to that which occurs in *Melanoplus puer* and its races. The caudal margin of

	Measurements in millimeters				
	Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
<b>MALE</b>					
Holotype <sup>16</sup> .....	14.6	3.3	2.6	2.5	8.7
Paratopotype .....	12.5	3.0	2.3	2.2	7.7
Paratopotype .....	14.8	3.6	2.7	3.1	9.7
Paratype <sup>17</sup> .....	14.6	3.1	2.4	2.7	8.3
<b>FEMALE</b>					
Allotype <sup>16</sup> .....	19.3	4.4	3.9	3.3	11.4
Paratopotype .....	18.6	4.0	3.7	3.5	10.8
Paratopotype .....	21.0	4.6	4.0	3.8	12.1

<sup>16</sup> Additional measurements of the holotype, paratypic male from Enterprise Junction, and allotype are as follows, given in the order named: vertical diameter of eye 2.1, 1.9, 2.3; length of infra-ocular sulcus .9, .9, 1.25; interocular distance .4, .3, .5; breadth of proximal antennal segment .4, .35, .45; cephalic breadth of pronotal disk 1.9, 1.9, 2.6; height of lateral pronotal lobes to shoulder 2.2, 2.0, 2.6; total height of pronotum in lateral aspect 2.5, 2.4, 3.3; breadth of tegmen 1.4, 1.4, 2.0; breadth of caudal femur 2.6, 2.3, 3.0; length of male supra-anal plate 1.4, 1.3, proximal breadth 1.1, 1.1; length of male cercus 1.0, 1.0; dorsal length of male subgenital plate 1.4, 1.2; midventral breadth 1.1, 1.0; length of antenna 6.2, 5.5, 7.3; combined length of head and pronotum 5.5, 4.9, 6.8.

<sup>17</sup> Enterprise Junction, Volusia Co., Florida.



the pronotum is emarginate to a somewhat variable degree. The tegmina rarely fall short of the caudal margin of the first abdominal tergite and sometimes extend nearly to the middle of the second; their apices are usually weakly to distinctly truncate, but in a small number of specimens are almost evenly rounded distad. The male supra-anal plate often has a pair of short, weakly developed ridges extending proximad from the disto-lateral angulations of the margin. The distal portions of the cerci are always broader and thinner than in *puer*, but the distal margin is sometimes roundly subspatulate as in the holotype, sometimes with a slight ventro-distal angulation reminiscent of the similar but much more pronounced condition found in *strumosus*. The size and form of the furcula vary as in *puer*. The penis is quite constant in form in those specimens in which it has been studied, the variations in minor details of thickness, degree of ventral lamination, and exact form of curvature of the ectoparameres being too slight to warrant description.

The series taken by Rehn and Hebard at De Leon Springs contains an interesting gynandromorphic male, of the most common type encountered in the Acrididae. The specimen is male in all particulars, with the exception of the left half of the terminal abdominal segments. The supra-anal plate is asymmetrical, the left half being of the female, the right of the male form; the right cercus, right furcular lobe, and right half of the subgenital plate are of normal male form. On the left an almost normal ventral ovipositor valve is present; the dorsal valve is probably represented by a club-shaped body the apex of which appears beneath the tip of the supra-anal plate. The left cercus is of normal form for the female. Another abnormal specimen found in this series is a male with the right cercus normally formed but the left short and broad, resembling that of *Melanoplus scudderi*.

Coloration.—Very similar to that of *puer seminole*. All the males of this series possess an intensive type of coloration in which the entire prozonal portion of the lateral lobes is deep black, this infuscation continuing across the dorsal portions of the metazonal sections and ventrad along their caudal margins so as to outline a strikingly pale ventro-caudal spot with rounded dorsal margin. In most specimens the entire exposed portions of the meso- and metapleura are also infuscated, but in some the diagonal pallid line normally present in *puer* is fairly well-marked, though commonly interrupted at the middle or at least broadest ventro-caudad. Most of the females are similarly colored and hence darker than those of *puer*, but there is greater variation in the size and intensity of the black markings than in the male, and in some specimens those of the pronotal lobes are interrupted or very dilute caudad of the principal sulcus. In these

paler specimens the cephalic margin of the pronotal lobes is often narrowly margined with yellowish or cream-white. So far as may be judged by the series at hand, *Melanoplus adelogyrus* appears to show a greater average intensity of coloration and a smaller degree of variability in this respect than any of the races of *puer* except perhaps *peninsularis*.

Until last year the original series of this species collected by Rehn and Hebard at De Leon Springs in 1917, and a single male taken by F. W. Walker at Enterprise Junction were the only specimens known. In 1931 two trips were made to the region east of the St. Johns River in an attempt to discover more about the distribution of the species and its geographic relations with the races of the closely allied *Melanoplus puer*. It was found that *Melanoplus adelogyrus* is most abundant in scrub oak ("high oak") habitats similar to those in which *puer puer* occurs farther west. The largest series were taken in open groves of *Quercus catesbaei* Michx. and *Q. cinerea* Michx., with rather sparse undergrowth of oak seedlings, patches of oak runner, wire grass, and many annual Compositae. One such locality is situated about three miles south of De Leon Springs; another, where the species was quite numerous, is near Emporia, just east of the St. Johns River and three miles east of Astor in Marion County. A few immature specimens were also taken in a rather open, dry "high hammock" on a sandy slope just south of De Leon Springs. The species has not yet been found outside of Volusia County, though it probably has a somewhat wider distribution than is indicated by the records given below. Situations which appeared suitable for the species in the neighborhood of Palatka, San Mateo, Cisco, and Crescent City in Putnam County, and bordering the St. Johns in Marion County were examined, but no specimens were found.

No evidence of intergradation with any of the races of *Melanoplus puer* has been found, and the extent of specialization of the male genital structures makes it unlikely that such intergradation occurs. It appears probable that *adelogyrus* has been derived from a common ancestor with *puer* which entered the region east of the St. Johns from the south. This broad, sluggish river may itself constitute a barrier which has isolated *adelogyrus* from *puer*, since the former occurs almost to its bank on the east shore, while *puer seminole* is found just across the river at Sanford. Farther north along the eastern side of Marion County the river barrier is reinforced by a broad belt of dry sandy hills and plains, covered with a xerophytic sand scrub; in this region no material either of *puer* or of *adelogyrus* could be found.

Specimens examined, 85 adults [holotype, allotype, and paratypes] and 58 immatures, as follows.—

Florida: De Leon Springs, Sept. 8-9, 1917 (Rehn and Hebard), 8 males, 12 females [including holotype and allotype], 14 juv. [Hebard Coll.]; May 3, 1931 (Hubbell), 4

juv.; 3 miles south of De Leon Springs, May 3, 1931 (Hubbell), 3 males, 6 females, 21 juv.; 2.2 miles west of Emporia (2.9 miles east of Astor in Marion County), May 3, 1931 (Hubbell), 14 males, 17 females, 10 juv.; May 23, 1931 (Hubbell), 12 males, 10 females, 9 juv.; Enterprise Junction, Aug. 15, 1923 (Walker), 1 male.

### *Melanoplus apalachicola*, new species

(Plate I, Figs. 1, 3; Plate II, Fig. 20)

This species is very similar in size and general appearance to *Melanoplus tequestae*. Males are easily distinguished by the presence of well-developed furcula and by numerous distinctive features in the remaining terminal abdominal structures. Females of *apalachicola* may be separated from those of *tequestae* by the normal presence of a distinct blackish postocular stripe on the pronotal lateral lobes in the former. In both sexes the relatively longer antennae, somewhat more attenuate form, and very weakly notched or evenly arcuate caudal pronotal margin of *apalachicola* will also aid in its distinction. From *puer* and *adelogyrus* this and the remaining species of the group are easily separable by differences in pronotal coloration, by the usually weaker median carina of the pronotum, and by male genital characters.

Description of holotypic male ("Camp Torreya," Twp. 2 N., R. 7 W., Liberty County, Florida, July 29, 1925 (Hubbell)—in *Quercus catesbaei* grove on sandy cut-over pineland).—Size small for the group, very small for the genus, similar to that of *tequestae* and small individuals of *puer puer*; form rather slender. Head large; eyes moderately prominent, interocular space narrow, slightly more than half as broad as proximal antennal segment; frontal costa extending almost to clypeal suture, distinctly broader than interocular space, sides subparallel to above suture, thence gently convergent to junction with fastigium, surface shallowly sulcate at and below ocellus, planate above; fastigium verticis strongly declivent, in lateral outline rounding broadly into frontal costa as in *puer* (less protuberant than in *tequestae*); antennae slender, moderately elongate as in *puer*, 1.3 times as long as head and pronotum taken together. Pronotum rather elongate; disk depressed, very weakly tectate, median carina very low and rounded but pereurrent and equally distinct on both prozona and metazona; dorso-lateral shoulders rounded-angulate, nearly straight and distinctly divergent caudad; sulci weakly impressed, surface of prozonal disk scarcely, of metazonal disk more plainly but weakly punctate; lateral lobes subvertical, their surfaces weakly tumid in each of divisions marked by sulci, prozonal portion sparsely and minutely, metazonal portion more closely and coarsely punctate; caudal margin of dorsum subtruncate, very shallowly and minutely notched mesad (usually strongly notched in *puer* and *tequestae*). Prosternal spine short, subconical, very weakly compressed,

strongly rounded distad. Abdomen moderately compressed, dorsally tectate and carinulate to seventh tergite as in other members of the group. Tegmina lobate, sublateral, extending to proximal fourth of second abdominal tergite, dorsal margins separated by an interval more than half as great as tegminal breadth, these margins gently arcuate to near apex and thence increasingly so, ventral margins straight to about midlength, thence strongly and evenly convex to apex, which is median in position and abruptly rounded, not at all truncate. Cephalic and intermediate limbs moderately stout, the femora about equally swollen; caudal femur of about same proportions as that of *tequestae*, slightly more slender than in most specimens of *puer*, a little less than two-thirds as long as body, surpassing end of abdomen by about one-fifth of its length.

Terminal abdominal structures.—Furcula well-developed, somewhat flattened subparallel fingers nearly twice as long as breadth of ninth tergite just laterad of their bases, lying upon ridges of supra-anal plate; latter 1.2 times as long as broad, subtriangular with obtusely rounded apex, sides nearly straight, just appreciably bisinuate, surface divided into proximal and distal halves by a low, transverse ridge just proximad of midlength, surface of distal portion very weakly depressed below plane of proximal half; median groove distinct in proximal half, bordered by low, abruptly angulate parallel ridges, which fuse distad to form a low, broad medio-longitudinal ridge; surface of plate laterad of ridges shallowly concave. Cerci shorter than proximal breadth of supra-anal plate, nearly straight, styliform, dorsal margin abruptly narrowed at base, thence evenly convergent with ventral margin to slender, narrowly round-pointed apex. Subgenital plate short, rounded trigonal in lateral outline, midventral breadth three-quarters as great as dorsal length; in dorsal aspect nearly as broad as long, sides weakly incurvate proximad, thence convex-convergent to the more abruptly rounded apex, margins of equal elevation throughout except for subproximal ampliation. Pallium large, filling almost entire space enclosed by margins of subgenital plate, in lateral aspect one-third as tall as dorsal length of subgenital plate, caudal and lateral surfaces tumid, convex, cephalic face subplanate, steeply declivent (summit and cephalic face usually showing a broad meso-vertical impression in dried specimens, divided into an oblique apical concavity and a groove in middle of cephalic face). Pseudosternite lobes tall, thickened, and in lateral aspect strongly rounded at dorsal extremity (relatively narrower and more abruptly rounded dorsad than in *puer* and *adelogyrus*, approaching those of *tequestae*, *forcipatus*, and *insignis* in form), latero-caudal and meso-cephalic margins nearly straight, former nearly twice as long as latter. Penis with distal portions enlarged to form a sizable mass; dorsal lobes expanded distad as a pair of

thin, subtriquetrous, distally pointed lobes, connected laterad with the dorsally produced lateral portions of the ventral lobes described below, and each covering like a cap the summit of the corresponding ectoparamere tip. Ventral lobes structurally similar to those of *puer peninsularis*, distal ends of sclerotized caudo-mesal margins projecting beneath bases of ectoparameres as a pair of stubby, rounded, mesally concave projections, surface of each ventral lobe laterad of apices of these projections elevated into a distinct, rounded umbonate protuberance; lateral portions of each ventral lobe projecting dorsad as a pair of lappets enclosing sides of dorsal lobes, these lappets large and peculiarly shaped, composed of a large basal part, with strongly convex cephalic margin and shorter, nearly straight caudal margin arising from surface of umbonate prominence mentioned above, and of a narrower distal lobe projecting dorso-caudad from the basal portion, with obliquely subtruncate distal margin, its meso-dorsal margins fused with sides of distal expansions of dorsal lobes. Ectoparameres highly specialized, forming a pair of large conchate structures, nearly concealed from above by dorsal lobes and enclosed at sides and base by ventral lobes, their exposed surfaces facing ventro-caudad and visible from side and rear; these structures are externally convex, internally hollow, with elongate-ovate opposed apertures which gape sufficiently to expose to view the margins of a pair of transverse, flattened, inner laminae; the caudal margins of the apertures project ventro-caudad as a pair of subvertical, approximate lamellae,

	Measurements in millimeters				
	Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
MALE					
Holotype <sup>18</sup> .....	13.6	2.9	1.9	2.5	8.5
Paratopotype .....	13.3	2.8	1.8	2.3	8.3
Paratopotype .....	14.3	3.1	2.1	2.2	9.6
FEMALE					
Allotype <sup>18</sup> .....	20.2	3.9	2.8	3.2	11.6
Paratopotype .....	17.0	3.7	3.1	2.9	11.1
Paratopotype .....	19.5	4.0	3.1	3.1	12.3

<sup>18</sup> Additional measurements of the holotype and allotype are as follows, those of the male being given first: vertical diameter of eye 1.8, 2.1; length of infra-ocular sulcus .9, 1.1; interocular distance .25, .30; breadth of proximal antennal segment .4, .4; height of lateral pronotal lobes to shoulders 1.9, 2.5; total vertical height of pronotum in lateral aspect 2.4, 3.1; cephalic breadth of pronotal disk 1.3, 2.0; breadth of tegmen 1.3, 1.8; breadth of caudal femur 2.1, 2.9; length of male supra-anal plate 1.2, proximal breadth 1.0; length of male cercus .7; dorsal length of male subgenital plate 1.2, midventral breadth .9; length of antenna 5.9, 7.4; combined length of head and pronotum 4.6, 6.0.

with broadly convex ventro-caudal margins as seen from the side. All the surfaces of the described structures are minutely and closely scabrous as usual in this group, except the proximal portions of the dorsal lobes and the marginal sclerotizations of the caudal portions of the ventral lobes.

Description of allotypic female (same data as holotype).—Agreeing with male except as follows: size larger and form slightly more robust, but slender for group; interocular space three-quarters as broad as proximal antennal segment; apices of caudal femora barely attaining end of abdomen; cerci short, trigonal, straight-sided; ovipositor valves slender, scoop of dorsal valves shallow, apices slender and but little upturned.

Size variation in *Melanoplus apalachicola* is not great, the specimens selected for measurement representing the extremes found in this series. The prosternal spine varies from subconical and scarcely compressed, with narrowly rounded apex, to a broader, distinctly flattened type with rounded subtruncate apex, the latter sometimes weakly impressed in the middle of the caudal face. The form and size of the tegmina are distinctly variable in both sexes. In specimens showing the greatest reduction of these organs the apices fail to reach the caudal margin of the first abdominal tergite; in others they extend past the middle of the second tergite. In most specimens the apex is roundly pointed, as in the holotype; in others it is evenly convex, and the tegmina of two of the males are very weakly subtruncate. The tegmina also vary in breadth, so that the outline may be rather narrowly to broadly ovate. In robust females the pronotal shoulders diverge caudad much more strongly than in more slender average individuals. The male cerci are sometimes rigidly straight, sometimes weakly incurvate. The furcula is also moderately variable; normally composed of slender processes at least 1.5 and often 2.0 times as long as the admesal breadth of the ninth tergite, in some specimens these processes are shorter, broader, and more flattened, though always larger and more closely approximated at the base than in *puer*; their axes are also as often convergent distad as subparallel, the apices being sometimes attingent.

Coloration.—Dorsum of head, pronotum, and base of abdomen Mars Brown to Wood Brown, distal portion of abdomen Sayal Brown; front Ochraceous Buff to Ochraceous Tawny, eyes Hayes Russet or Kaiser Brown, antennae Russet distad, slightly paler proximad; dorsal portions of lateral lobes of pronotum broadly infuscated by a brownish black postocular band reaching caudal margin,<sup>19</sup> broader and more brownish on metazona than on prozonal portion, continuous with a postocular infuscation of same breadth

<sup>19</sup> Occasional females of strongly recessive coloration have the postocular pronotal bands reduced to faint traces or even lacking altogether, the abdominal bands being correspondingly reduced. Such pallid individuals strongly resemble females of *tequestae*, in which species the females are normally much more weakly pigmented than the males.

on head; ventral portions of lateral lobes and diagonal pale metathoracic stripe Warm Buff, remainder of meso- and exposed portions of metapleura infuscated, this infuscation extending as a shading to the base of the tegmen and along its cephalic margin to about midlength; sides of first three or four abdominal segments heavily infuscated in both sexes;<sup>19</sup> venter Naples Yellow; cephalic and intermediate legs Warm Buff, more or less clouded, especially on tibiae, with brownish; caudal femora Warm Buff ventro-proximad on external face, deepening to Pecan Brown or Orange Cinnamon distad and on dorsal surface; latter crossed by a distinct blackish band at proximal third and usually by a weaker, sometimes interrupted band at distal third; external face of caudal femur in recessively colored specimens with an oblique proximal shading extending proximo-ventrad from the proximal dorsal band, and narrowing to a more deeply infuscated linear or wedge-shaped marking with its apex curved downward and touching the angle of insertion of the femur; external face of caudal femur in intensively colored specimens with fuscous shadings intensified and enlarged, coalescing and spreading to form a broad blackish band occupying entire dorsal half of external pagina and narrowly connected distad with the black genicular arcs; ventral genicular lobes pallid; ventral surface of femur Naples Yellow or Warm Buff in male, usually dilute Coral Red to Carnelian Red in female; caudal (internal) face faintly to distinctly bifasciate with dilute fuscous; caudal tibiae Light Glaucous-Blue to Colombia Blue, usually tinged proximo-laterad with yellowish or brownish.

*Melanoplus apalachicola* is as yet known only from a small area in Liberty County, Florida. The sandy uplands east of the Apalachicola River in the northwestern part of this county are covered with an open scrubby forest of turkey oak (*Quercus catesbaei* Michx.), together with occasional long-leaf pines, blue jack oaks (*Q. cinerea* Michx.), and other trees. In places undergrowth covers much of the ground, and consists of wire-grass, scattered oak seedlings, and other plants; elsewhere much of the sandy soil is exposed, and patches of oak seedlings and dwarf species of oaks are practically the only ground vegetation. This species was found in both types of habitat, though nowhere in large numbers. A few specimens were also taken in grassy long-leaf pine groves on sandy hillsides, but only near the margins of scrub oak patches. These insects are extremely agile, strong leapers; when at rest on the sandy soil they are also nearly invisible, since their coloration blends perfectly with that of the environment. For these reasons it proved difficult to secure the series recorded below.

Specimens examined, 42 males, 30 females [holotype, allotype, and paratypes].— Same data as holotype, but taken July 28–30, 1925 (Hubbell), 34 males, 26 females; 2 miles east of Alum Bluff, near Bristol, Liberty Co., Florida, Nov. 1, 1931 (Hubbell), 8 males, 4 females. The holotype, allotype, and most of the paratypes are in the Museum

<sup>19</sup> See note at bottom of page 44.

of Zoology, University of Michigan; other paratypes have been deposited in the Hebard Coll., and in the collections of the Museum of Comparative Zoology, Philadelphia Academy of Natural Sciences, U. S. National Museum, and University of Kansas.

**Melanoplus tequestae**, new species<sup>19a</sup>

(Plate I, Figs. 2, 4; Plate II, Fig. 21)

Though very similar to *Melanoplus apalachicola* and evidently related to it, the pronotal and tegminal characters and detailed morphology of the male genitalia of this species indicate a somewhat closer affinity to *insignis* and *forcipatus*. The points of resemblance which lead to this conclusion are the rounded subconical (instead of flattened and dorsally arcuate) dorsal lobes of the pseudosternite, the entire absence of furcula, the form of the supra-anal plate, the narrowed, elongate subgenital plate and its relation to the pallium, the prominent, more angulate frontal costa, the weak angulation between dorsal and lateral fields usually present in the tegmina of *tequestae* (such angulation being stronger in and characteristic of *insignis* and *forcipatus*), and the broader pronotum, with dorso-lateral shoulders more abrupt and caudal margin more emarginate in these three species than in *apalachicola*. Detailed comparison of *tequestae* with *apalachicola* has been made in the description of the latter; from *insignis* and *forcipatus* the present species is at once separable by its simple, styliform cerci and by other features mentioned in the diagnoses of those species.

Description of holotypic male (Orlando, Orange County, Florida, May 10, 1924 (Hubbell)—in "sand scrub" area 5.5 miles west of town on Ocoee road).—

Size and form similar to those of *Melanoplus puer puer*, slightly more robust and compact than *apalachicola*. Head of moderate size, as broad as cephalic portion of pronotum, occiput gently convex and moderately elevated above surface of pronotum; interocular space narrow, two-thirds as broad as proximal antennal segment; fastigium verticis rather strongly declivent, but distinctly less so than in *apalachicola*; frontal costa extending three-fifths of distance from median ocellus to clypeal suture, margins parallel below median ocellus, weakly but rather abruptly expanding just dorsad of it and there nearly as broad as proximal antennal segment, thence with sides gently convergent to junction with vertex, in lateral aspect more strongly protuberant and roundly angulate dorsad of antennal sockets than in *apalachicola* or *puer*, resembling, in this respect *insignis* and *forcipatus*; eyes large, but slightly prominent; antennae unusually short and stout, only 1.1 times as long as combined lengths of head and pronotum. Pronotum rather short, disk 1.4 times as long as caudal breadth, prozona

<sup>19a</sup> The Tequesta or Tekesta were a small independent tribe which inhabited a part of the lower east coast of Florida at the time of the Spanish exploration of the region.



nearly twice as long as metazona, dorsum distinctly depressed, very weakly tectate, median carina percurrent and equally distinct on prozona and metazona, but scarcely at all elevated, sulci strongly impressed, both posterior sulci cutting median carina, anterior sulcus broadly interrupted mesad, dorso-lateral shoulders rather abruptly rounded-angulate, nearly straight, and distinctly divergent caudad, surface of prozona nearly impunctate except along margins, of metazona closely and moderately coarsely punctate; lateral lobes subvertical, very weakly inflated just ventrad of shoulders, similar in form to those of *puer*. Tegmina as described for *apalachicolae* (similarly variable in series), differing in the weak but appreciable angulation between the dorsal and lateral fields (this feature also somewhat variable in series); tegminal apices rounded, not quite attaining caudal margin of first abdominal tergite. Cephalic and intermediate legs stout, femora of cephalic pair scarcely exceeding those of intermediate pair in thickness. Caudal femora moderately stout, less slender than those of *apalachicolae*, 3.7 times as long as greatest breadth, surpassing end of abdomen by about one-fourth their length. Prosternal spine similar to that of *apalachicolae* but somewhat more flattened.

Terminal abdominal structures.—Furcula absent. Supra-anal plate triangular, nearly as broad proximad as long, sides sinuate-convergent to rounded-acute-angulate apex, proximal half of lateral margin elevated, straight in lateral aspect, falling abruptly to level of distal portion of surface at midlength, surface of plate subplanate, mesal groove subobsolete, represented by a faint triangularly impressed meso-proximal area bordered by broad, weak swellings, distal half of surface plane except for short linear meso-distal impression. Cerci tapering gradually from base to apex, ventral margin slightly more oblique than dorsal, distal third subcylindrical and bluntly rounded at tip, latter extending to a point opposite apex of supra-anal plate. Subgenital plate trigonal in lateral aspect, dorsal margin one-fifth longer than midventral breadth, in dorsal aspect with dorso-proximal portions strongly incurvate and sides compressed, so that space enclosed within margins is elongate, its proximal breadth three-quarters of the length, its margins subparallel for a short distance proximad, thence gradually convergent to the strongly rounded apex. Pallium low, convex, elongate, filling entire space within margins of subgenital plate, its distal surface not separated from apex of subgenital plate by a marginal groove as in most species of the genus, but rising directly from the margin at this point, the junction forming an obtuse angulation in lateral aspect. Pseudo-sternite with dorsal lobes rather small, their apices produced as blunt, rounded-conical protuberances directed dorso-laterad. Penis with dorsal lobes elongate, projecting dorso-caudad, broadened and gently decurved at

apex; ventral lobes broad and vertically sublaminar ventro-caudad, narrowing above by recession of their caudal margins, the cephalic portions of their sides projecting dorsad as a pair of lateral lobes enclosing the sides of the dorsal lobes, extending distad along the margins of the dorsal lobes, and at the apex fused with those lobes and taking part with them in the formation of the distal hoodlike expansion. The entire dorsal projection thus made up may be likened to an inverted, stubby ladle with shallow, transversely flattened bowl. Beneath the decurved apex of this structure appear the tips of the ectoparameres, as thinly laminate, mesially concave opposed plates, which together form a delicate, compressed, open-mouthed tube with aperture directed ventro-caudad and concealed from above by the over-arching apex of the dorsal projection.

Description of allotypic female (same data as holotype).—Agrees with male except as follows: size larger, form more robust. Pronotum relatively broader, 1.1 times as long as caudal breadth, dorso-lateral shoulders more

		Measurements in Millimeters				
		Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
MALE						
Orlando, Florida <sup>20</sup>	(holotype)	13.0	2.8	2.0	2.2	7.8
“	“ (paratype)	11.5	2.6	2.0	2.2	7.6
“	“	11.8	2.8	2.1	2.3	8.0
“	“	14.6	3.1	2.2	2.7	8.3
Altamonte Springs, Fla.	“	12.8	2.8	1.9	2.4	7.8
Sebring, Florida	“	12.1	2.6	1.9	2.4	8.1
Childs, Florida	“	12.8	3.0	2.1	2.5	8.2
FEMALE						
Orlando, Florida <sup>20</sup>	(allotype)	19.6	3.4	3.0	2.8	10.0
“	“ (paratype)	16.9	3.2	2.7	2.9	8.7
“	“	20.2	3.9	3.4	2.9	11.0
Altamonte Springs, Fla.	“	17.9	3.5	3.2	2.7	10.2
Sebring, Florida	“	18.8	3.6	3.3	3.3	11.4
Childs, Florida	“	18.9	4.0	3.4	3.2	11.2

<sup>20</sup> Additional measurements of the holotype and allotype are as follows, those of the male being given first: vertical diameter of eye 1.8, 2.0; length of infra-ocular sulcus .8, 1.1; interocular distance .2, .25; breadth of proximal antennal segment .3, .35; cephalic breadth of pronotal disk 1.5, 2.2; height of lateral pronotal lobes to shoulder 1.9, 2.3; total height of pronotum in lateral aspect 2.3, 3.0; breadth of tegmen 1.2, 1.5; breadth of caudal femur 2.1, 2.6; length of male supra-anal plate 1.1, proximal breadth 1.0; length of male cercus .8, of female cercus .5; dorsal length of male subgenital plate in lateral aspect 1.2, midventral breadth 1.0; length of antenna 5.0, 5.8; combined length of head and pronotum 4.6, 5.4.

abruptly angulate, dorsum transversely more strongly convex and less tectate, principal sulcus alone strongly impressed; caudal femora extending to end of abdomen; cerci trigonal, short, straight-sided, with bluntly rounded apex; ovipositor valves small, rather slender, dorsal valves similar in form to those of *apalachicolae*. Comparison has already been made with the corresponding sex of that species; from females of *forcipatus* (which occurs in the same localities and habitats as *tequestae*) and *insignis* this species may be separated by the straight dorsal margin of the cercus and the normal absence or very weak indication of the dark postocular band on the dorsal portions of the pronotal lobes.

The tegmina of *Melanoplus tequestae* vary in form and size to a considerable extent, the variation being similar to that encountered in *apalachicolae* and other members of the Puer Group. The distal margin of the tegmina often shows traces of oblique truncation, and the apex is usually situated a little closer to the cephalic margin than in *apalachicolae*. The angulation between the dorsal and lateral fields can be made out in all but one or two specimens of the series studied, but it is never as marked as in *insignis* and *forcipatus*. The posternal spine varies in much the same manner as in *apalachicolae*, though it averages somewhat broader and more flattened than in that species. The form of the penis is relatively constant, the only variation noted being in the breadth of the decurved portion of the dorsal process. In material from Orange County this process expands distad as described for the type, while in specimens from Childs and Sebring the sides are subparallel to the apex.

Coloration.—Male with vertex and pronotal disk Drab to Army Brown, (Saccardo's Umber in holotype); front nearly concolorous or slightly lighter than pronotal disk; antennae Cinnamon proximad, deepening distad to Mikado Brown; genae and ventral portions of lateral pronotal lobes Pinkish Buff; brownish or blackish postocular bar on head continuous with broad brownish black band across dorsal portions of lateral lobes, broadening caudad; meso- and metapleura solidly blackish brown except for narrow, conspicuous buffy stripe running diagonally along epimeron and terminating opposite ventral angulation of tegmina; latter slightly infuscate proximad, distally concolorous or somewhat lighter than pronotal disk; dorsum of abdomen similar in color to pronotal disk, sides paler, marked on tergites 1 to 5 with infuscated blotches decreasing in size caudad and usually separated from one another by pallid caudal margins of tergites; cephalic and intermediate limbs brownish, weakly mottled with darker brown; caudal femora with external face Cinnamon Buff proximo-ventrad, darkening to Sayal Brown distad, dorsal surface crossed by two equally spaced blackish bands and with genicular region darkened, a narrow but distinct blackish band extending across cephalic face from proximo-dorsal

band very obliquely to angle of insertion of femur, genicular arcs blackish, ventral genicular lobes Clay Color, *ventro-lateral sulcus infuscated*, ventral sulcus yellowish, internal face pallid with two broad distinct blackish bands continuous with those of dorsal surface; caudal tibiae Pale Glaucon Blue, often somewhat brownish proximad and distad. Female almost unicolorous, lacking the lateral black bands on head, thorax, and base of abdomen, and with only faint traces of the oblique band on proximo-cephalic face of caudal femur; general hue of dorsum ranging from Fawn Color or Army Brown to Olive Brown. Otherwise as in male, except for the usually pinkish coloration of the ventral sulcus of the caudal femur.

The nature of the changes which take place in the coloration of this species in drying are indicated by comparison of the above description (made from museum specimens) with the following color notes made on living males from Orlando. Face Light Gull Gray varying to Medici Blue, in one specimen with slight brownish tinge on lower face; dorsum of head and pronotum Light Mouse Gray to Olive Gray, minutely and thickly mottled with blackish; eyes Light Mouse Gray, mottled with black, and with a narrow horizontal black bar extending across their upper third and continuous with dorsal portion of postocular stripe; dorsal half of lateral pronotal lobes shining black, slightly less intense and more brownish on metazona; ventral portions of lateral lobes Livid White; tegmina with veins minutely but contrastingly outlined in pale against a darker background, giving the effect of uniform Mouse Gray as seen with unaided eye; antennae Walnut Brown at tip, paler proximad.

*Melanoplus tequestae* is as yet known only from five localities situated in the Ridge Section of central peninsular Florida, and extending from Seminole County in the north to Highlands County (northwest of Lake Okeechobee) in the south. Its distribution is apparently almost coincident with that of *Melanoplus forcipatus*, and the two are usually found associated in the same types of habitat. The type locality for both species is the same as that of *Schistocerca ceratiola* Hubbell and Walker, described in 1928.<sup>21</sup> Here *Melanoplus tequestae* was found in moderate numbers by Walker and myself, both in the sand scrub habitat and in the open forest of turkey oak (*Quercus catesbaei* Michx.) and blue jack oak (*Q. cinerea* Michx.) growing on the sandy slopes above the sand scrub flats. At Apopka the species was found by Walker in sand scrub, and in scrub oak at Altamonte Springs and at Sebring. R. H. Beamer writes that the female which he collected at the latter locality was taken near a lake a few miles from town, "under live oaks growing on sandy soil" with herbaceous undergrowth resembling the "wild meadow association of Kansas"—evidently a situation which would be classed as open dry hammock or a modification

<sup>21</sup> *Occ. Pap. Mus. Zool. Univ. Mich.* No. 197 (1928).

of it. At Childs, Beamer took a small series in an abandoned citrus grove on sandy soil, partially overgrown with goldenrod and other weeds.

Specimens examined, 159 adults [holotype, allotype, and paratypes] and 15 immature specimens, as follows.—

Florida: Altamonte Springs, Seminole Co., Aug. 29, 1924 (Walker), 1 male, 1 female; vicinity of Orlando, Orange Co., April 26, 1924 (Walker), 2 males, 2 females; May 10, 1924 (Walker and Hubbell), 35 males, 44 females [including holotype and allotype], 10 juv.; July 4–Sept. 21, 1924 (Walker and Hubbell), 25 males, 37 females, 5 juv.; Apopka, Orange Co., Dec. 30, 1923 (Walker), 1 male; Sebring, Highlands Co., Sept. 20, 1926, 1 female; Jan. 7, 1927, 1 male; April 10, 1927, 1 female (all Walker); Aug. 5, 1930 (R. H. Beamer), 1 female [Univ. Kansas]; Childs, Highlands Co., Aug. 6, 1930 (R. H. Beamer), 4 males, 2 females, [Univ. Kansas]. The holotype, allotype, and most of the paratypes are in the Museum of Zoology, University of Michigan; other paratypes distributed to the repositories listed under *apalachicolae*.

### *Melanoplus forcipatus*, new species

(Plate I, Figs. 5, 6; Plate II, Figs. 22, 23)

This species is very closely allied to *Melanoplus insignis*, but differs from that species in details of form of the male supra-anal plate, cerci, penis, and endapophyses. From other members of the group these two species are distinguishable at once by the very remarkably specialized cerci of the male, and by the rather strongly angulate pronotal shoulders and the demarcation between the dorsal and lateral tegminal fields in both sexes. The concealed male genitalia are also highly characteristic. As pointed out above, *Melanoplus tequestae* appears to be rather distantly related to *forcipatus* and to *insignis*; *apalachicolae* shows a lesser degree of affinity. Though totally unrelated to it, *forcipatus* and *insignis* remind one rather strongly in miniature of *Melanoplus* (or *Eotettix*?) *davisii* Rehn and Hebard.

Description of holotypic male (5.5 miles west of Orlando, Orange County, Florida, Sept. 6, 1924 (Walker)—in "sand scrub" area).—

Similar in size and form to *Melanoplus tequestae* (averaging in series a trifle larger and more robust). Head slightly broader than in *tequestae*; vertex gently convex and moderately elevated; eyes large, about as prominent as in *puer* and *tequestae*; interocular space narrow, not quite as broad as proximal antennal segment; fastigium verticis strongly declivent, shallowly sulcate, formed as in *tequestae* and (as in that species) projecting more strongly cephalad in dorsal aspect than in *apalachicolae* or *puer*; in lateral aspect its junction with frontal costa more abrupt and rounded-angulate than in those species; frontal costa as described for *tequestae*, but slightly narrower and with sides above antennal sockets less strongly convergent dorsad; antennae short and thick, similar to those of *tequestae*, 1.2 times as long as combined length of head and pronotum. Pronotum short, 1.25 times as long as caudal breadth, agreeing with that of *tequestae* except as follows:

dorsum strongly depressed, gently convex in transverse section, median carina percurrent and moderately and equally distinct on both prozona and metazona, but scarcely elevated above surface, cut only by principal sulcus; shoulders distinctly more abrupt, lateral lobes more nearly vertical than in *tequestae*, especially in metazonal portion, pronotum in section therefore more distinctly subquadrate (in *tequestae* more nearly elliptic). Tegmina strongly abbreviate, slightly surpassing caudal margin of first abdominal tergite, dorsal margins separated by an interval slightly more than half as great as tegminal breadth, similar in form to those of *tequestae* but distal margin obliquely subtruncate beginning at apex of anal field, dorsal and lateral fields demarcate by a weak but easily appreciable angulation. Prosternal spine subconical, slightly compressed, distally rounded-conical, similar in form to those of *apalachicola* and *tequestae*, though more pointed than in most specimens of the latter. Cephalic and intermediate femora about equally stout; caudal femora similar to those of *tequestae*.

Terminal abdominal structures.—End of abdomen moderately upturned; furcula represented only by a pair of strongly divaricate rounded ridges on surface of tenth tergite; supra-anal plate 1.2 times as long as proximal breadth, lateral margins concave, strongly convergent in proximal half, becoming subparallel distad, apex strongly rounded, its margin almost semicircular; margins of plate strongly elevated in proximal half, becoming gradually lower and merely tumid distad, fusing with the elevated meso-distal ridge near apex; median sulcus distinct in proximal half of plate, margined by low but distinct convergent ridges which meet and merge in distal half to form a broader, rounded median ridge; surface between lateral margins and admesal ridges deeply impressed. Cerci remarkably specialized, in lateral aspect with proximal half broad and subequal, dorsal and ventral margins nearly parallel, this proximal portion terminating in a short, stubby, rounded dorsal projection and a long, gently decurved ventral finger; in dorsal aspect the meso-dorsal margin bears a bluntly rounded, mesally directed prominence at distal third of broad basal portion, followed distad by a small emargination the dorsal edge of which is elevated as a thin, subvertical flange forming the dorsal projection visible in lateral aspect; the margin of this flange curves ventrad to form the angle between the dorsal projection and the ventral finger, and thus narrows, but is continuous with a flange along the meso-dorsal margin of the ventral finger which projects inward as a subhorizontal shelf-like plate with rounded subtruncate mesal margin, extending along proximal third of finger and abruptly terminated by a truncate-emarginate distal margin; ventral finger in dorsal aspect weakly concave laterad in proximal half, curved strongly mesad in distal half, distal portion nearly straight, apex acutely rounded;

the apices together nearly enclose the strongly elevated pallium. Subgenital plate distinctive; dorsal margin straight, not at all ampliate proximad and thus forming an exception to this generic character, distal portion continuous with subvertical caudal sclerotized surface of pallium, which appears like an enormously elevated protuberance of the apical margin of subgenital plate; pallium tall and tetrahedroid, apex rounded-subtruncate, in resting position in contact with disto-ventral surface of supra-anal plate. Pseudosternite as described for *tequestae*. Penis broad and thick, dorsal portion in caudal aspect broadly glandiform, bridge connecting endapophyseal arch with dorsal lobes longitudinally compressed and elevated, summit expanded into a subhexagonal, slightly transverse cap with gently convex dorsal surface; dorsal lobe unpaired, enclosed and completely concealed by overlapping mesal margins of large dorsal projections from sides of ventral lobes; when exposed by separation of these projections the dorsal lobe is visible as a median plate shaped like a broad spear blade, with sharply obtuse proximo-lateral angles and straight sides meeting in an acute point distad; ventral lobes in lateral aspect subquadrate, equally broad throughout, with subvertical attingent caudal margins, separated from their dorsal projections by a straight, horizontal lateral fold; these projections broad at base, dorso-cephalic portions thick and tumid, forming an oblique roll with its cephalic margin extending obliquely dorso-caudad to rounded apex; caudal portion of dorsal lobes subvertically laminate at base, these laminae meeting thickened oblique roll mentioned above midway of caudal margin in an obtuse-angulate emarginate junction, dorsad of which the margin is vertical; in dorsal aspect cephalo-dorsal surfaces of projections of ventral lobes transversely flattened, impressed near base with a longitudinal sulcus on each side; apices of ectoparameres projecting caudad and slightly dorsad from between laminate portions of dorsal projections of ventral lobes as a pair of rather narrow, subvertical, thinly laminate plates, with concave mesal surfaces appressed to form a vertically flattened tube, disto-dorsal angles of ectoparameres produced as a pair of slender flagellate processes as long as exposed laminate portions, directed dorsad and slightly sinuate. In caudal aspect dorsal portion of penis nearly two-thirds as broad as base, separated from ventral portion by a broad, deep, rounded lateral groove on each side. Removal of the tissues concealing the endapophyses shows that the cephalic portions are broad, subfalcate plates, their dorsal and cephalic margins evenly arcuate and almost semicircular, their rounded apices directed ventro-caudad and laterad, their greatest breadth (at about distal third) nearly twice that of narrowest point (at about proximal third).

Description of allotypic female (same data as holotype except taken September 3, 1924).—Agrees with male more closely than is the case in

*tequestae*, differing from that sex as follows: size distinctly larger and form more robust. Pronotum relatively broader and expanding caudad more abruptly; pronotal shoulders almost as angulate as in male, but dorsum transversely more convex; tegmina with angulation between dorsal and ventral fields weaker than in male but distinct; caudal femora reaching end of abdomen; cerci short, rather broad, subtrigonal, with very bluntly rounded apex and a just appreciable angulation of the dorsal margin at distal third (this best seen in dorso-lateral aspect); ovipositor valves slender, more strongly exerted than in *tequestae*, dorsal valves shallow, apices directed caudad and only slightly dorsad; prosternal spine more distinctly transverse than that of male.

Measurements in Millimeters					
	Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
MALE					
Orlando, Florida <sup>22</sup> (holotype)	13.1	2.8	2.2	2.8	8.0
“ “ (paratype)	11.7	2.7	2.2	1.7	7.6
“ “ “	14.4	3.1	2.4	3.0	8.6
Apopka, Florida “	13.9	3.0	2.3	2.2	8.0
Zellwood, Florida “	11.7	2.7	2.1	2.2	7.3
FEMALE					
Orlando, Florida <sup>22</sup> (allotype)	18.4	3.9	3.4	3.2	10.2
“ “ (paratype)	20.2	3.9	3.6	3.2	10.3
Apopka, Florida “	16.9	3.6	3.3	3.0	9.9
Childs, Florida “	20.4	4.1	3.7	3.0	11.2

Variation in size and form of the tegmina of this species is practically the same as described for *tequestae*. A larger proportion of males than of females has the tegminal apices distinctly truncate, though a truncate condition is more characteristic of both sexes of *forcipatus* than of *tequestae*. Little variation in the male genital structures is found in the series studied.

Coloration.—*Melanoplus forcipatus* resembles *M. tequestae* in coloration, and can best be described by comparison with that species. The gen-

<sup>22</sup> Additional measurements of the holotype and allotype are as follows, those of the male being given first: vertical diameter of eye 1.8, 2.1; length of infra-ocular sulcus .9, 1.3; interocular distance .25, .30; breadth of proximal antennal segment .30, .35; cephalic breadth of pronotal disk 1.5, 2.3; height of lateral pronotal lobes to shoulder 1.8, 2.2; total height of pronotum in lateral aspect 2.2, 3.1; breadth of tegmen of holotype 1.3, of paratypic males in order given above 1.0, 1.4, 1.4, 1.3; of allotype 2.1; breadth of caudal femur 2.2, 2.6; length of male supra-anal plate 1.2, proximal breadth 1.0; length of male cercus 1.4, breadth of proximal portion .5; length of antenna 5.5, 6.4; combined length of head and pronotum 4.6, 6.0.



eral color of the dorsum averages more reddish brown than in *tequestae*, though the series from Apopka and a few specimens from Orlando are grayish in hue. The eyes are similarly banded in both species, but more of the specimens of *forcipatus* have retained this feature after drying than in the case of *tequestae*. Conspicuous average differences are as follows: females of *forcipatus*, unlike those of *tequestae*, usually resemble the male in having well-marked fuscous postocular bands on the lateral pronotal lobes. These bands are never as intense in the female as in the male, fading out ventrad instead of having a clear-cut ventral border; the infuscation in the female seldom covers the entire exposed area of the meso- and metapleura, but the light diagonal stripe is usually margined ventrad with blackish. This pale diagonal stripe is usually conspicuous in both sexes, and extends to the ventro-caudal margin of the sclerite, while in *tequestae* it terminates midway, or is at least interrupted for a short distance at midlength. The margins of the disk of the pronotum in *forcipatus* are usually bordered by a light line at the upper edge of the postocular stripe. The caudal femora are of similar coloration to those of *tequestae*, and show the same oblique, narrowly cuneiform or linear dash at the base of the external face in some specimens; in most individuals, however, this proximal mark broadens into a conspicuous shading of the dorsal portion of the proximal third or half of the external pagina, and in very intensively colored individuals it spreads over the entire dorsal half of this surface from base to apex. The ventro-lateral sulcus is blackened as in *tequestae*. The transverse bands of the dorsal surface are subobsolete, being represented by a dilute infuscation or by groups of maculae on the dorsal surface caudad of the median carina; the internal surface, however, is distinctly banded. The genicular arcs are usually brownish and not black. A characteristic feature of the coloration of this species and *insignis* is the elongate-trigonal black mark extending from the apex of the subgenital plate toward the apex of the pallial elevation. Though the same elements are present in the pattern of *forcipatus*, *tequestae*, and *apalachicola*, the different emphasis placed upon them gives each of these species a characteristically different facies which makes its field recognition relatively easy, even in the instance of the female.

The known distribution of *Melanoplus forcipatus* is practically coincident with that of *tequestae*, as stated above, and the two have usually been found together. Most of the specimens in the series studied were taken in the type locality near Orlando, where *Schistocerca ceratiola* and *Melanoplus tequestae* were also first discovered. It is possible that *Melanoplus insignis* may prove to be a geographic race of *forcipatus*, in which event the range of the species will be extended considerably to the

southeast. The present species is as yet known, however, only from scrub oak and sand scrub habitats in the interior of the peninsula, *insignis* from sandy areas on the east coast. Their ranges may be discontinuous, as these two sandy regions are separated by a belt consisting prevailing of pine-land and swamp, in which xeric sandy areas are probably small and isolated. If intergradation between the two cannot be demonstrated they will have to be regarded as distinct species, in spite of their close similarity. This problem can only be solved by additional field work, and in view of the many differences in the male genitalia of the two forms it seems best to accord *insignis* specific rank.

Specimens examined, 98 [holotype, allotype, and paratype], as follows.—

Florida: Zellwood, Orange Co., Sept. 9, 1924 (Walker), 1 male; Apopka, Orange Co., Sept. 21, 1924 (Walker and Hubbell), 5 males, 4 females; vicinity of Orlando, Orange Co., July 4–Sept. 20, 1924 (Walker and Hubbell), 53 males, 34 females [including holotype and allotype]; Childs, Highlands Co., Aug. 6, 1930 (R. H. Beamer), 1 female [University of Kansas]. Specimens located as in the instance of *tequestae*.

### *Melanoplus insignis*, new species

(Plate I, Figs. 7, 8; Plate II, Figs. 24, 25)

Very closely allied to *Melanoplus forcipatus*, this species is characterized by differences in the male genital structures, particularly the shorter, straighter ventro-distal finger of the male cerci, which lacks a meso-proximal horizontal laminate projection; the less elevated, more sinuate margins of the supra-anal plate; and the very different form of the penis and cephalic portions of the endapophyses. As suggested above, it may eventually prove to be only a geographic race of the last species.

Description of holotypic male (Lighthouse [= Jupiter], Palm Beach County, Florida, August 7, 1930 (R. H. Beamer)—in sandy area).—

Agrees with *forcipatus* except as follows: size and form as in that species (but averaging slightly larger in series). Supra-anal plate similar in form to that of *forcipatus*, but sides nearly straight in dorsal aspect, less elevated in proximal half, median sulcus broader and marginal ridges less elevated, apex of plate subtrigonal with arcuate-convergent margins meeting in a right angle. Cerci similar to those of *forcipatus*, but ventro-distal finger shorter, in dorsal aspect nearly straight, somewhat vertically compressed and with proximo-dorsal margin evenly convex, without trace of the horizontally laminate expansion found in *forcipatus*; distal face of enlarged proximal portion more abruptly subtruncate, furnished at disto-dorsal angle with two small laminate projections situated almost at right angles to each other, one projecting dorso-caudad from the horizontal dorsal margin, the other subvertical and projecting from the dorsal part of the

lateral margin, their adjacent edges approximate but not attinent. Subgenital plate and pallium as in *forcipatus*. Penis differing as follows: dorsal portion in caudal view much narrower than broad ventral portion, entire penis smaller; ventral lobes in lateral aspect taller than long, scarcely subquadrate, the fold separating their ventral portions from the dorsal projections strongly oblique, declivent caudad; dorsal projections small, forming thin, curved plates, broadly subfalcate in lateral outline, the cephalic dorsal margin strongly concave, apex narrowly rounded, caudal margin broadly convex except for a weak angulation near middle; external face of each lobe weakly concave in direction of long axis, but rather strongly convex in cephalo-caudal (dorso-ventral) direction; cephalic margins of lobes approximate, caudal margins separated by bases of exposed portions of ectoparameres, which are enclosed dorsad and laterad by the projections of the ventral lobes as in a sheath. Ectoparamere apices produced as a pair of slender flagellate processes shorter than those of *forcipatus*, each with meso-proximal margin explanate as a delicate lamination toothed near base, and connected with the narrowly down-curved meso-dorsal margin of basal portion of ectoparamere shaft; ventral margins of ectoparamere shafts visible caudo-ventrad of caudal margins of dorsal projections of ventral lobes as far as junction of those projections with ventral lobes proper. Removal of the tissues concealing the endapophyses reveals them as relatively slender, gently curved laminae, with bisinuate dorsal margins and weakly subspatulate apex directed ventro-cephalad, their breadth approximately twice as great at proximal third as at distal third.

Description of allotypic female (same data as holotype).—Scarcely distinguishable from this sex of *forcipatus*. The tegmina of the allotype (the only female known) are more sharply rounded at the apex and the prosternal spine is more sharply conical than in most females of *forcipatus*, but in view of the variation in these structures occurring in *forcipatus* it seems probable that similar differences in form will be found in *insignis*. The cerci are similar to those of *forcipatus*, though with sharper apex than in most specimens of that species. No differences in coloration can be noted, except that the bases of the caudal femora in this specimen are not infuscated. This is also probably an individual variation, as the males show this feature strongly.

No noteworthy structural variation is found in the small type series, except in the size and form of the tegmina, which evidently vary in this species in the same fashion as in *forcipatus*. In coloration the two species are practically identical, the only difference observed being mentioned in the above description of the female.

The present species is known only by the type series recorded below, which was taken by Mr. R. H. Beamer beside the East Coast Highway at a

	Measurements in millimeters				
	Length body	Length pronotum	Caudal breadth pronotum	Length tegmen	Length caudal femur
MALE					
Holotype <sup>23</sup> .....	14.1	3.1	2.3	2.7	8.8
Paratopotype .....	13.9	3.2	2.3	2.3	8.6
Paratopotype .....	13.7	3.1	2.3	2.9	8.7
Paratopotype .....	13.7	3.2	2.2	2.3	8.8
FEMALE					
Allotype <sup>23</sup> .....	20.7	4.3	3.8	3.6	11.6

point about 17 miles north of West Palm Beach and near Lighthouse, better known under the name "Jupiter." A letter from Beamer states that the collections at this locality were made in an area "with loose, deep sandy soil and sparse scrubby vegetation"—evidently a sand scrub or dune habitat. This agrees well with what is known of the habitat preferences of the geminate *forcipatus*. As mentioned in the discussion of the latter, *insignis* may be found to be a geographic race of *forcipatus*, or may have a distinct and more or less isolated geographic range. It seems unlikely that the species extends as far south as the Miami region, as the amount of collecting that has been done there should have brought it to light.

Specimens examined: 4 males, 1 female [holotype, allotype, and paratypes], all with the same data. Holotype, allotype, and one paratype in the collection of the University of Kansas; remaining paratypes in the Museum of Zoology of the University of Michigan and in the Hebard Coll.

#### REMARKS ON THE ECOLOGICAL AND GEOGRAPHICAL DISTRIBUTION OF THE SPECIES OF THE PUER GROUP

The accompanying map (Plate IV) shows the distribution of eight of the forms of the Puer Group (s.s.) and of *pygmaeus*, in relation to certain ecological and physiographic features of the peninsula of Florida which appear to have a bearing upon it.

In any attempt to explain the present distribution of a group of animals it is necessary to take into account the past history of the region which

<sup>23</sup> Additional measurements of the holotype and allotype are as follows, those of the male being given first: vertical diameter of eye 1.9, 2.1; length of infra-ocular sulcus .9, 1.3; interocular distance .20, .30; breadth of proximal antennal segment .28, .35; cephalic breadth of pronotal disk 1.6, 2.4; height of lateral pronotal lobes to shoulder, 2.0, 2.7; total height of pronotum in lateral aspect 2.4, 3.3; breadth of tegmen 1.5, 2.0; breadth of caudal femur 2.5, 3.0; length of male supra-anal plate, 1.2, proximal breadth .95; length of male cercus 1.1, breadth of proximal portion, .5; length of antenna 6.1, 7.5; combined length of head and pronotum 5.2, 6.6.

they inhabit. Florida is known to have appeared as an island off the Georgia coast in the Oligocene, its subsequent history being one of gradual elevation, enlargement, and junction with the mainland. Since the beginning this development has probably taken place by a series of oscillatory movements accompanied by transgressions and regressions of the sea, rather than by a process of steady uplift. Such oscillations may be inferred for the earlier periods; they are known to have occurred in Pleistocene times, during which a number of marginal invasions of the sea took place. Some of these Pleistocene transgressions were extensive, as shown by the deposits of sand, old beach ridges, dunes, sand bars, and other beach forms widely distributed over the surface of the state. The greatest of these floods evidently covered all but the higher parts of Florida, leaving exposed only a more or less crescentic, west-centrally situated peninsula with its southern extremity in the Tampa region, bordered to the east and south by islands of various sizes. Indeed, it has been suggested that one or more of these incursions of the sea during the Pleistocene may have completely submerged the entire peninsula,<sup>24</sup> but there is no definite geological evidence in support of this view, and zoogeographical considerations oppose it.

In an interesting paper Frank Leverett has recently traced the shore line of the latest though not the most extensive submergence in considerable detail.<sup>25</sup> The lowland area covered by this invading sea he has called the Pensacola Terrace, the extent and boundaries of which are indicated on Plate IV by the horizontal ruling and dashed line. From various considerations he fixes the time of withdrawal of this sea at no more than 25,000 and probably as little as 15,000 or 20,000 years ago, and suggests that the Pensacola shore line may be a near correlative of the shore of glacial Lake Algonquin. The significance of these facts in connection with animal distribution in this area is obvious, and some of their possible consequences in relation to distribution and speciation in the Puer Group are mentioned below.

The dotted areas shown on the map outline the predominantly sandy regions of the state which are covered for the most part with scrub oak and sand scrub vegetation. The distribution of these areas is that given on the generalized soil map of Florida, prepared by Roland M. Harper and published in 1925 by the State Geological Survey. This map was based on field surveys of the principal vegetation types occurring in the state, and is thus in effect phytogeographic, its application to soils resting upon the assumption that the vegetation is a reliable indicator of their nature.

<sup>24</sup> See page 227, in Cooke and Mossom—"Geology of Florida," *Twentieth Ann. Rept. Florida State Geol. Surv.*, 1927-1928, (1929) pp. 29-227.

<sup>25</sup> Leverett, F.—"The Pensacola Terrace and its associated beaches and bars in Florida." *Florida State Geol. Surv. Bull.* 7, (July, 1931) 44 pp., 6 figs., map.

Although Harper's map has been criticized by students of soils on the grounds that it lumps several soil types and series under one name and that it is inaccurate in detail, it is of value to the zoogeographer interested in the distribution of animal life in Florida for the comprehensive picture it gives of the extent and distribution of some of the more important plant associations of the region.

The accompanying map shows how the more or less xeric sandy areas are scattered over the state as relatively isolated patches of various forms and sizes, which, together with others too small to be separately mapped, exist as many large and small islands encompassed by pine flatwoods, swamps, and hammocks. The sand areas may be divided into two principal classes, which are not distinguished on the map.

The first and by far the most extensive type is characteristic of the interior portions of the peninsula, lying above the Pensacola Terrace. These sand areas, sometimes collectively known as the Florida "sand hills," are covered with what was originally an open forest of long-leaf pine and scrub oak, from which most of the pine has now been removed. The topography is usually rolling, the drainage good, conditions relatively xeric, and the soils are typically sands of the Norfolk series.<sup>26</sup> These soils have evidently been derived chiefly from the littoral sands and gravels of the Citronelle formation (Pliocene), or as residuals from the Hawthorne formation (Miocene calcareous sandstone) and its derived Alachua formation (Pliocene). The significance of these facts in relation to the possible duration of this habitat is mentioned below. This habitat is commonly referred to as "high pine land." Here in favorable situations the long-leaf pine reached its best development, with a robust and characteristic habitus in contrast to its more spindling growth on the flatwoods. Among the pines were scattered scrubby oaks—mostly turkey oak and blue-jack or upland willow oak. On the highest and most xeric situations the scrub oaks probably predominated even before deforestation commenced, but everywhere with the cutting off of the pine there has been an increase in the scrub oak growth. Throughout this paper this habitat has been principally referred to as "scrub oak," since that is the present aspect of the vegetation in most places. The habitat has been described by Harper<sup>27</sup> under the name "high pine land."

The second type of habitat characteristic of the sand areas is commonly called "sand scrub." It has been described by Harper in the papers just

<sup>26</sup> See Bryan, O. C.—"The Soils of Florida" (A preliminary report). *Univ. Florida Agr. Ext. Div. Bull.* 42, (1925) 21 pp., 16 figs. incl. map.

<sup>27</sup> Harper, R. M.—"Geography and Vegetation of Northern Florida." *Sixth Ann. Rept. Florida State Geol. Surv.*, (1914) pp. 163-437, figs. 40-90. "Geography of Central Florida." *Thirteenth Ann. Rept. Florida State Geol. Surv.*, (1921) pp. 71-307, figs. 2-43.

cited, and by Hubbell and Walker in the paper referred to in Footnote 22. The sand scrub is a much more xeric habitat than scrub oak-pine. It occurs on deep, light-colored sands of the St. Lucie series, which represent old dunes. These sand scrub areas are found chiefly in a belt along the east coast and as smaller areas in the interior, mostly in the vicinity of the old shore line of the Pensacola sea, as in the neighborhood of Orlando. The habitat is therefore of more recent formation than the scrub oak-pine, and the existing areas of sand scrub may have been formed in part either as offshore barrier islands or as shore dunes during the existence of the Pensacola sea.

Inspection of the map will show how closely the known distribution of the majority of the species of the Puer Group (s.s.) conforms to the distribution of the sandy areas occupied by one or the other of these two plant associations. *Pygmaeus*, *puer puer*, *adelogyrus*, *apalachicola*, *tequestae*, *forcipatus*, and *insignis* all show such a relationship (the last occurring in a sandy coastal strip too narrow to be indicated). *Pygmaeus* is known only from the isolated scrub oak area surrounding De Funiak Springs. *Adelogyrus* has as yet been taken only in the isolated (insular in Pensacola time) sandy areas east of the St. Johns River in Volusia County. *Apalachicola* is the only species of the Puer Group (s.s.) found in the small scrub oak area extending from Bristol north to Rock Bluff, on the east side of the Apalachicola River in Liberty County; it is apparently confined to this small territory, as I was unable to find it even in the adjacent patch of scrub oak on the east side of the Taluga River. *Tequestae* and *forcipatus* follow the belt of scrub oak and sand scrub which extends more or less discontinuously down the central ridge of the state from Orange County to Highlands County.

*Melanoplus puer puer*, like the above-mentioned species, occurs in scrub oak-pine and to a less extent in sand scrub habitats, in the north central parts of the state. Here the first of these habitats is more extensive than in any other part of the state, and the range of this race is correspondingly large. *Melanoplus puer seminole* and *M. puer peninsularis*, on the other hand, appear from the map to occur in other types of situations—a suggestion confirmed by reference to field notes and published observations which show that, though they commonly occupy such scrub oak and sand scrub habitats as occur in their territories, they are more widely distributed in pine flatwoods. The morphological differences separating *puer puer* and *puer seminole* are evidently paralleled by a difference in their normal habitats, or at least in their habitat ranges, since *puer puer* seldom or never occurs in poorly drained flatwoods. No definite habitat differences appear to exist between *puer seminole* and *puer peninsularis*, though the known range of the latter does (probably accidentally) nearly coincide with the

outcrop of the Miami oölitic limestone, upon the eroded surface of which a somewhat peculiar type of flatwoods is developed. More important, perhaps, is the fact that *peninsularis* occurs in the truly tropical portion of the peninsula, while *seminole* occupies the region to the north of this zone. It is evident that both *seminole* and *peninsularis* have occupied much or (in the case of the latter) all of their present ranges very recently.

It is a reasonable conclusion from the known facts that the speciation shown by the Puer Group even in so small and topographically monotonous a region as Florida, is in large part the result of geographic and ecesic (ecologic) isolation. Two instances deserve additional mention in this connection. As pointed out previously, incipient racial differentiation is found to exist between the eastern and western populations of *Melanoplus puer seminole*. Reference to the map shows that these two phases occur in territories separated by the drainage system of the Kissimmee River and Lake Okeechobee and the bordering swamps and marshes. *Melanoplus adelogyrus* replaces the closely allied *Melanoplus puer* and its races in the sand areas of Volusia County. It is interesting to note that these areas, according to Leverett, were islands in the Pensacola sea, and in post-Pensacola time a barrier has been maintained between them and the former mainland by the broad and sluggish St. Johns River and its marginal swamps, flatwoods, and hammocks.

In considering the effectiveness of the ecesic barriers isolating the sand areas from one another, it must be recognized that this isolation is by no means so complete as inspection of the map would indicate, since small sand areas often dot the intervening zones. Collecting, however, in small patches of this description shows that they are scarcely ever inhabited by any of the species under discussion. Though the distances involved are not great, these diminutive, flightless locusts of the Puer Group are not well equipped for travel, and a few score miles of grassy flatwoods or of dense hammock apparently constitute effective barriers to most of them, whereas the larger, long-winged Melanopli do not show such restriction of their ranges in this region.

Another factor which must be taken into account, if isolation affects are to be attributed to the discontinuity shown by the sand areas, is their probable duration as isolated areas of relatively fixed position and constant ecological characteristics. It appears likely that this duration, considered from both aspects, may have been long, so far as the oak-pine habitat of the Norfolk sands is concerned. These habitats of the central part of the state may in part have existed with relatively little change since Pliocene times. Due to the low elevation and to the porous nature of the soil the attacks of erosion are undoubtedly very slow, though they have probably resulted in a gradual encroachment upon the sandy uplands—very often



probably owing more to solution of the underlying limestone than to surface erosion. Reduction in the area of this habitat through replacement of the oak-pine by later successional stages has presumably also occurred, but it is difficult to estimate at what rate successional change takes place in this region and for such habitats. It also is probably very slow. The scrub oak-pine association appears to constitute a persistent subclimax, owing to the action of certain factors of climatic origin. The abundant rainfall causes a rapid leaching of sandy, well-drained soils, which consequently fail to accumulate humus; and the well-marked dry season favors the occurrence of fires, which at frequent intervals run through these habitats, destroying not only humus-forming materials but also all but the fire-resistant species of plants which dominate these areas today. Fire has probably always been a factor in preventing the spread of the climax live oak-magnolia hammock, though it has become enormously more frequent since the advent of man.

Applying to the Puer Group (s.s.) such of the criteria which have been proposed for locating centers of origin<sup>28</sup> as appear well-founded and applicable to insects, it seems that central peninsular Florida should be regarded as the probable area in which the group originated and from which it has spread. Such convergence of phylogenetic lines and continuity of variation as can be traced support this selection, this being clearest in the case of *puer puer*, *puer seminole*, *puer peninsularis*, and *adelogyrus*. The region of "least dependence upon a restricted environment," if it is to be given any weight, would also point to this same area, and indicate *puer seminole* as the most primitive stock of the particular assemblage mentioned above—a conclusion not opposed by the evidence supplied by the morphology of the genitalia.

Isolation, by means of barriers in part physical and in part ecesic, appears to have been a principal factor in the differentiation of the Puer Group (s.s.) and its subsequent speciation. It has been shown that such barriers do exist and have existed in the past; the development of the group must have taken place in relation to such barriers, and even if its evolution cannot be traced in detail, the present distribution of its species shows that the existing barriers are effective ones. The ancestral stock probably entered the developing peninsula at an early period (Miocene?), if we may judge the length of its occupancy by the degree of divergence shown in the genital structures of its descendants as compared with that found in other groups of the genus. This immigrant stock may have in the beginning been subject to more than peninsular isolation if in its early history Florida

<sup>28</sup> For an excellent discussion and evaluation of these see pages 7 to 12 in: Dunn, E. R.—*The Salamanders of the Family Plethodontidae*. (Northampton: 1926) xii + 441 pp., 86 figs., 3 pls.

experienced advances and retreats of the sea, similar to those of the Pleistocene, severing its connection with the mainland for longer or shorter periods. The subsequent evolution of the group must remain even more a matter of speculation for the present; and such interesting questions as how and why two related species such as *Melanoplus tequestae* and *Melanoplus forcipatus* have come to occupy exactly the same range and habitat must be left unanswered, though we may suspect that the clue to the solution of the problem is to be found in the varying relations of sea and land in this most recently formed portion of the continent.

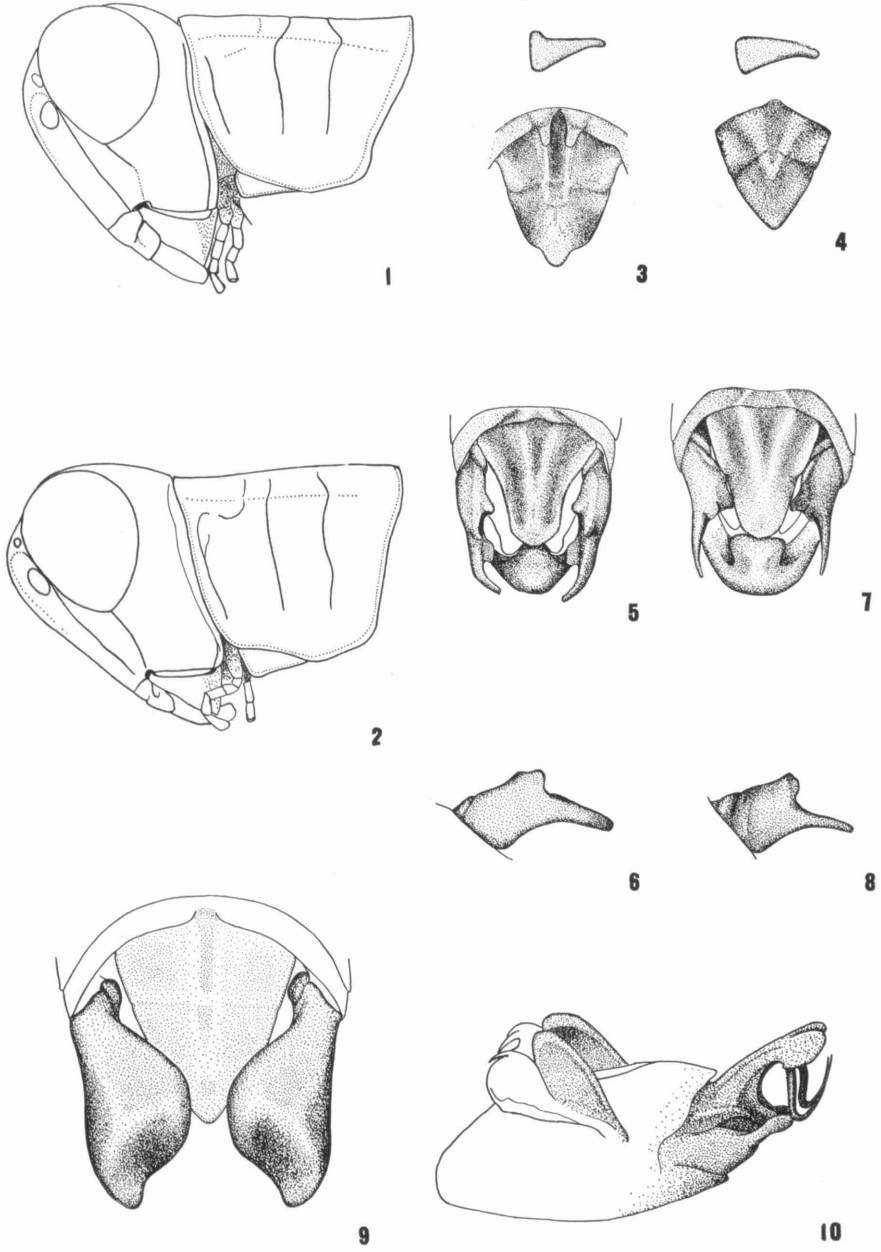


THEODORE H. HUBBELL

PLATE I

Figures 1 and 2 enlarged approximately 11 times, remainder enlarged approximately 15 times.

- FIG. 1. *Melanoplus apalachicolae* Hubbell. Outline of head and pronotum of holotypic male.
- FIG. 2. *Melanoplus tequestae* Hubbell. Outline of head and pronotum of holotypic male.
- FIG. 3. *Melanoplus apalachicolae* Hubbell. Left cercus and supra-anal plate of holotypic male.
- FIG. 4. *Melanoplus tequestae* Hubbell. Left cercus and supra-anal plate of holotypic male.
- FIG. 5. *Melanoplus forcipatus* Hubbell. Dorsal view of terminal abdominal structures of holotypic male.
- FIG. 6. *Melanoplus forcipatus* Hubbell. Lateral view of left cercus of holotypic male.
- FIG. 7. *Melanoplus insignis* Hubbell. Dorsal view of terminal abdominal structures of holotypic male.
- FIG. 8. *Melanoplus insignis* Hubbell. Lateral view of left cercus of holotypic male.
- FIG. 9. *Melanoplus tumidicercus* Hubbell. Dorsal view of supra-anal plate and cerci of holotypic male.
- FIG. 10. *Melanoplus tumidicercus* Hubbell. Lateral view of concealed genital structures of holotypic male.

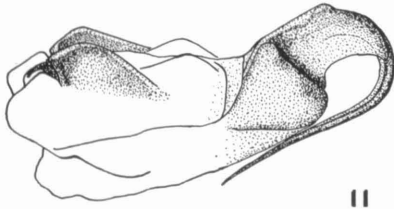


THEODORE H. HUBBELL

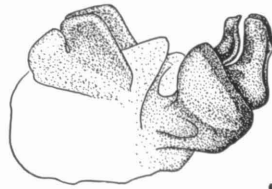
PLATE II

All figures approximately 15 times natural size.

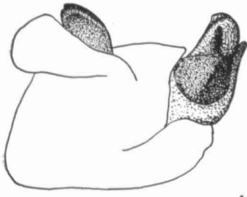
- FIG. 11. *Melanoplus strumosus* Morse. Lateral view of concealed genital structures of male—De Funiak Springs, Walton Co., Florida.
- FIG. 12. *Melanoplus foxi* Hebard. Lateral view of concealed genital structures of male—Wadley, Jefferson Co., Georgia.
- FIG. 13. *Melanoplus scapularis* Rehn and Hebard. Lateral view of concealed genital structures of male—"Camp Torreya," Liberty Co., Florida.
- FIG. 14. *Melanoplus scapularis* Rehn and Hebard. Outline of penis of above specimen in caudal view.
- FIG. 15. *Melanoplus pygmaeus* Davis. Lateral view of concealed genital structures of male—De Funiak Springs, Walton Co., Florida.
- FIG. 16. *Melanoplus pygmaeus* Davis. Outline of penis of above specimen in caudal view.
- FIG. 17. *Melanoplus rotundipennis* (Scudder). Lateral view of penis (eastern phase—Satsuma, Putnam Co., Florida).
- FIG. 18. *Melanoplus rotundipennis* (Scudder). Outline of penis of above specimen in caudal view.
- FIG. 19. *Melanoplus rotundipennis* (Scudder). Lateral view of penis (western phase—El Destino, Jefferson Co., Florida).
- FIG. 20. *Melanoplus apalachicola* Hubbell. Lateral view of concealed genital structures of holotypic male.
- FIG. 21. *Melanoplus tequestae* Hubbell. Lateral view of concealed genital structures of holotypic male.
- FIG. 22. *Melanoplus forcipatus* Hubbell. Lateral view of concealed genital structures of holotypic male, after removal of pseudosternite and tissues of genital mass, exposing the endapophyses.
- FIG. 23. *Melanoplus forcipatus* Hubbell. Outline of penis of holotype in caudal view.
- FIG. 24. *Melanoplus insignis* Hubbell. Lateral view of concealed genital structures of holotypic male, after removal of pseudosternite and tissues of genital mass, exposing the endapophyses.
- FIG. 25. *Melanoplus insignis* Hubbell. Outline of penis of holotype in caudal view.



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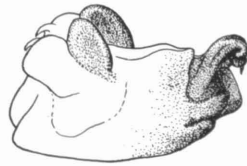
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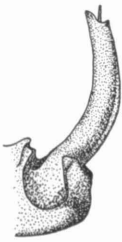
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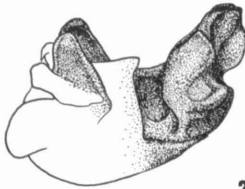
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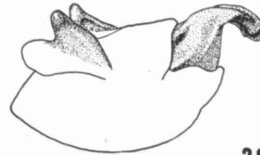
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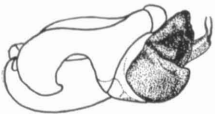
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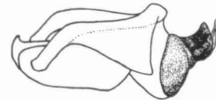
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PLATE III

All figures approximately 20 times natural size.

- FIG. 26. *Melanoplus puer puer*. (Scudder). Lateral and caudal views of concealed genital structures of male—Ocala, Marion Co., Florida.
- FIG. 27. *Melanoplus puer seminole* Hubbell. Lateral and caudal views of concealed genital structures of holotypic male—Arcadia, De Soto Co., Florida.
- FIG. 28. *Melanoplus puer seminole* Hubbell, atypical eastern phase. Lateral and caudal views of concealed genital structures of male—near Sebastian, Indian River Co., Florida.
- FIG. 29. *Melanoplus puer seminole* Hubbell, atypical. Lateral and caudal views of concealed genital structures of male—Okeechobee, Okeechobee Co., Florida.
- FIG. 30. *Melanoplus puer peninsularis* Hubbell. Lateral and caudal views of concealed genital structures of holotypic male—Near Paradise Key, Dade Co., Florida.
- FIG. 31. *Melanoplus adelogyrus* Hubbell. Lateral and caudal views of concealed genital structures of holotypic male—De Leon Springs, Volusia Co., Florida.

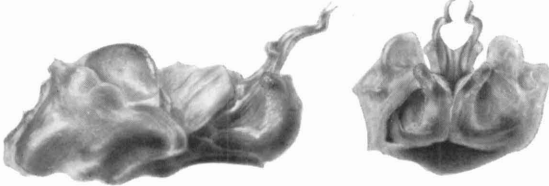




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*Grace Eager*

THEODORE H. HUBBELL

PLATE IV

Map of Florida, showing the distribution of the xeric sand areas (dotted), and the extent of the late Pleistocene invasion of the sea which formed the Pensacola terrace (horizontally ruled). The numbers indicate the localities from which the following species and races are known:

1. *Melanoplus pygmaeus* Davis.
2. *Melanoplus puer puer* (Scudder).
3. *Melanoplus puer seminole* Hubbell.
4. *Melanoplus puer peninsularis* Hubbell.
5. *Melanoplus adelogyrus* Hubbell.
6. *Melanoplus apalach'colae* Hubbell.
7. *Melanoplus tequestae* Hubbell.
8. *Melanoplus forcipatus* Hubbell.
9. *Melanoplus insignis* Hubbell.

