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KEYS FOR THE IDENTIFICATION OF COLORADO ORTHOPTERA¹

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INTRODUCTION

During recent years, the orthoptera (grasshoppers and related insects) have come to be recognized as a group of organisms peculiarly useful in studies of fundamental biological phenomena. Cytological studies in this group, particularly those of C. E. McClung and his associates, have led to some of our most valuable discoveries in connection with the chromosome mechanism of inheritance. More recently, orthoptera have furnished material for fundamental physiological investigations. In field biology, they have proved to be excellent indicators of environmental conditions and of factors governing plant and animal distribution. And of course it goes without saying that in the practice of agriculture, orthoptera, particularly certain abundant species having wide food preferences, have continually to be reckoned with. For these reasons alone, another paper on this group of insects hardly needs special justification.

Unfortunately, whereas a great deal of study is currently in progress on these insects, manuals for identification of species are not available for all sections of the country. Colorado is one such section, and this in spite of the fact that here economic problems alone are acute enough to justify such a manual. The present publication constitutes an attempt to provide this tool so necessary to critical study.

In biological investigations it is important, though unfortunately not always easy, to identify accurately the species studied. That such identification is essential should be self-evident, inasmuch as scientific findings to be valuable must be applicable to new situations and capable of repetition. Neither possi-

¹ Orthoptera in the broad sense, including the following orders recognized by Brues and Melander (11): Orthoptera (*s. str.*), Blattariae, Phasmatodea, and Mantodea.

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bility can be fulfilled unless the species studied are definitely known and named by the investigator. Whereas apparent certainty in this matter may but duplicate the errors of a taxonomist, it is at least possible to discover and correct such errors later. The present collection of keys has been brought together, therefore, to assist investigators in the identification of Colorado orthoptera. The writer hopes that it may be useful to those already studying this group, and that it may stimulate biologists to carry out additional studies of these insects.

Such keys as these are imperfect instruments. Those here presented, being designed purely for convenience, are only partially descriptive. Notes on geographic or ecological distribution are inserted frequently, however, where they may prove helpful. In all cases involving any reasonable doubt of identification, a full description of the species in question (references to the sources of such descriptions are given in the keys) should be made, or comparison made with accurately identified specimens. The former suggestion may offer no satisfactory solution, unfortunately; anyone studying early descriptions of insect species soon realizes that many such descriptions are quite inadequate if not entirely useless. In cases not settled with complete satisfaction by description or comparison, specimens should be submitted for determination to an authority on the group involved. The present keys are, furthermore, confined to species definitely known from Colorado or adjacent portions of adjoining states; and they should be used with this fact in mind. It is probable, of course, that still other species will eventually be discovered in the state. This is not likely to present a serious problem in the use of the keys, however, as the orthoptera of the state are already quite well known. The studies of Hebard, Rehn, and Hubbell, in particular, have gone far toward defining the orthopteran fauna of Colorado and adjacent states, and untangling the taxonomic confusion which has existed. The keys are, therefore, intended only as a short cut in identification. They should simplify determination for the beginner in the group, and should provide a convenient and rapid check on identification for the active investigator already moderately familiar with these insects.

The insect fauna of Colorado is primarily that of an arid, cool region. Those groups of orthoptera most abundant in the tropics are poorly represented in Colorado. Nearly three-fourths of our species are Acrididae, a family which makes up in number of species for those families less well represented. The great variety of physical conditions may be considered chiefly responsible for this relatively large number of species in one family. Five of the major western physiographic provinces as recognized by Fenneman (28) are represented in Colorado, and three of these occupy extensive areas, the Great Plains, Southern Rocky Mountains, and Colorado Plateau. The presence of such variable physio-

graphic conditions, coupled with the great range in altitude in the state—more than 10,000 feet, suggests that extensive opportunities exist for the study of the factors influencing the distribution of these insects. Although much collecting has been done in the state, most of it has been confined to rather limited regions, and the opportunities for field studies in ecology and distribution, particularly if accompanied by detailed observations of all possible environmental factors, have only been touched upon.

No keys covering the orthoptera of this state have, thus far, been published. The present arrangement is original, and, in many respects the manner of statement is new, modified, or considerably abbreviated from its source; but the keys necessarily represent, in large part, a compilation. Keys to certain groups of Kansas (8, 19) and Utah (63) orthoptera have appeared, as well as complete keys to those of Minnesota (47), Illinois (50), and North Dakota (60). General keys for the eastern states are available (9, 80). All of these, as well as other important sources (12, 16, 29, 35, 37, 40, 61, 64, 74, 75, 87, 99, 104) have been used. The authors of all of these have made use of suggestions of workers preceding them. The many devices used represent, in fact, accumulated suggestions of several generations of students of the orthoptera.

These keys include not only the Orthoptera in the limited sense (11), but, using the term in its earlier and wider sense, the Blattariae (cockroaches), Phasmatodea (walking-sticks), and Mantodea (mantids), as well. The orders, families, and subfamilies are those recognized by Brues and Melander (11), modified in accordance with certain recent suggestions of Hubbell in his model monograph of the genus *Ceuthophilus* (64). The sequence of keys does not correspond in all particulars to a natural sequence of the groups, however, but has been dictated somewhat by convenience. The nomenclature conforms to that of Hebard (42) in his paper on Colorado orthoptera, as modified by later suggestions (45, 48, 57, 60, 64, and other references). The total list of species is about the same, the present paper including seven species or subspecies not recorded by Hebard in 1929 (42), as follows: *Cyphoderris monstrosa* Uhler (3, 51), *Ceuthophilus apache* Hubbell (64), *Scudderia texensis* Saussure and Pictet (3), *Oecanthus californicus pictipennis* Hebard (57), *Leprus robustus* Hebard (53), *Trimerotropis tolteca modesta* Bruner (57), *Eremiacris acris* (Rehn and Hebard); with an eighth suggested as a possibility on the basis of a published record of *Ichnoptera*, viz., *Parcoblatta* sp. (95). The latter is treated herein as a hypothetical member of the fauna; perhaps *Eremiacris acris* should have been treated similarly. In addition, ten other species are included in the keys because of the likelihood that they may eventually be found in Colorado.

The species and subspecies included in the keys are distributed among the major

groups as follows, numbers in parenthesis being total species or subspecies included in the keys but thus far not actually recorded from the state:

| | Known from Colorado | Hypothetical |
|-----------------------|------------------------|--------------|
| Blattariae | 4 | (1) |
| Phasmatodea | 3 | |
| Mantodea | 4 | |
| Orthoptera (s. str.): | | |
| Gryllacrididae | 16 | |
| Tettigoniidae | 16 | (2) |
| Gryllidae | 9 | (1) |
| Tridactylidae | 2 | |
| Tetrigidae | 6 | |
| Acrididae: | | |
| Acridinae | 29 | (2) |
| Oedipodinae | 59 | (3) |
| Cyrtacanthacrinae | 54 | (2) |
| Totals | 202 | (11) |

A bibliography as nearly complete as possible for publications on Colorado orthoptera since 1900, and including all references in this paper, is appended to the keys. References to this throughout the paper are made by number. The only comprehensive state lists of species that have appeared are those of Gillette (32) and Hebard (42), the former list not including all families. Large numbers of Colorado species are, however, considered with those from other states in the publications of Caudell, Hebard, Rehn, Rehn and Hebard, and others. In addition to papers especially on Colorado orthoptera are included in the bibliography many publications containing descriptions, or information on the distribution of Colorado species in adjacent states. The reference to the original description of each species is not necessarily included, but references are given to one or more descriptions of each species which may be useful in checking identifications. These are suggested by numbers in parenthesis following each name in the key.

My thanks are due to Professor F. B. Isely, of Waxahachie, Texas, for advice and suggestions, and for specimens of several Colorado species not in my collection. Messrs. Morgan Hebard and J. A. G. Rehn have both been very generous with information, suggestions, determination of specimens, and specimens for examination. If errors have crept into the keys, however, the responsibility rests on the present author. I wish to thank Miss Kisa Noguchi for preparing for publication Figures 1 and 2. To the authorities of the Colorado State College of Agriculture and Mechanical Arts I wish to express my appreciation for permission to make frequent use of their large collections, including the series of specimens examined and determined by Mr. Hebard in connection with his studies previously mentioned (42).

THE USE OF THE KEYS

As suggested in the Introduction, these keys are not descriptive, but are merely short cuts to identification of species known from Colorado. The characters used in the keys are selected for convenience, and are, in most cases, easily understood after a moderate familiarity with the group has been acquired. The keys to certain groups have limitations (for example, in the use of male characters alone for the genus *Melanoplus*), but completion of such parts awaits more extensive studies than are now available. Suggestions on distribution within the state have been inserted where they may simplify the process of using the keys.

For simplicity in handling, the material has been divided into several keys rather than combined in one. A key to the orders of orthopteroid insects appears first. This is followed, in sequence, by keys to the species of Blattariae, Phasmatoidea, and Mantodea of the state. They are followed by a key to families of Orthoptera(s. str.). Keys to the families (and their subdivisions) follow in the order in which the families are named in the first key. The family of Acrididae is so large that its key is subdivided further. A key to distinguish the subfamilies appears first. This is followed by keys to the species in each subfamily, each subfamily key carrying the identification to the species except in the cases of two large genera—*Trimerotropis* and *Melanoplus*. A special key to each of these genera is given. In each case, the genus key follows that of the subfamily in which the genus belongs.

The keys are dichotomous, with succeeding subdivisions indented. The first subdivision under A is marked by B; the alternative for A is A', and that for B, B'; the first subdivision under B is C, etc. The sequence of key subdivisions is alphabetical throughout each key. The name of a species is given at the end of the sequence of key characters which is appropriate to it. Names of a few species not yet actually recorded from Colorado but likely to occur in the state are included, but the names of such are enclosed in brackets. After the name of the species and its author occurs one or more numbers in parenthesis. Such numbers correspond to titles in the Bibliography, and refer to places where descriptions of the species may be found. If such descriptions are not under the name now recognized, the synonym under which the description occurs in the reference is indicated below the name in current use.

A few good figures are, of course, better than pages of description in explaining structures used in keys, and for that reason drawings have been inserted as a substitute for a glossary. Most of the structures made use of in the keys are shown in Figure 3, which is especially appropriate to the Acrididae. Additional points, about which some uncertainty may be anticipated, are illustrated in Figures 1, 2, and 4. A rudimentary knowledge of the principles of animal

classification, and of insect structure, is assumed. Those who desire more complete information about the grasshopper, not only on external anatomy, but on internal anatomy, physiology, and ecology, can do no better than refer to Uvarov's *Locusts and Grasshoppers* (117), a thorough and clear general account, to which a very complete bibliography is appended.

Facility in using the keys, as well as familiarity with the arrangement, will be gained by tracing through from beginning to end several unrelated species already known to the worker.

KEYS

KEY TO ORDERS OF ORTHOPTERA (*s. lat.*)

The Orthoptera (*s. lat.*) are insects of moderately large to large size; they have long, often thread-like antennae; the fore-wings are usually elongate; the prothorax is large, and free from the mesothorax. Four orders are recognized: Orthoptera (*s. str.*), Phasmatodea, Blattariae, Mantodea.

A Hind legs not adapted for leaping; tarsi 5-jointed.

B Pronotum broad, shield-like, concealing most of head. (Fig. 1a)

BLATTARIAE (cockroaches)

B' Pronotum narrow, not shield-like; head free, not covered by pronotum.

C Fore-legs normal; eyes small. (Fig. 1b)

PHASMATODEA (walking-sticks)

C' Fore-legs adapted for seizing prey; eyes large. (Fig. 1c)

MANTODEA (praying mantids)

A' Hind legs adapted for leaping; tarsi with fewer than 5 joints. (Fig. 3)

ORTHOPTERA (*s. str.*)

ORDER BLATTARIAE

The cockroaches (Fig. 1a) comprise this order. Their center of abundance is in the tropics. Three of our established species are introduced. *Arenivaga erratica* Rehn, which has been recorded from Colorado only in the southwest portion, is native; one record in the literature (95, p. 447) suggests the possibility of a species of *Parcoblatta* in eastern Colorado, hence this genus is included in the following key.

A Femora of middle and hind legs armed beneath along one or both margins with distinct spines.

B Smaller, pronotum less than 7 mm. long; structure moderately delicate.

C Vento-cephalic margin of cephalic femora armed with a row of heavy proximal spines, succeeded by a row of more slender, shorter, distal spines.

[*Parcoblatta* sp.] (9, 37, 95)^a

C' Vento-cephalic margin of cephalic femora armed with a row of spines which decrease gradually in size and length distad; household pest.

Blatella germanica (Linn.) (9, 25, 37)

B' Larger, pronotum 7 mm. or over in length; structure heavily chitinous; femoral spines very heavy.

C Length 18-24 mm.; tegmina not reaching apex of abdomen in either sex; household pest.

Blatta orientalis Linn. (9, 25, 37)

^a Reported as *Ischnoptera borealis* Brunner from Fort Lupton, Colorado (95).

C' Length 27-35 mm.; tegmina extending beyond tip of abdomen in both sexes; household pest. (Fig. 1*a*)

Periplaneta americana (Linn.) (9, 25, 37)

A' Femora of middle and hind legs armed beneath only with apical or subapical spines; recorded from Durango (42).

Arenivaga erratica Rehn (37)

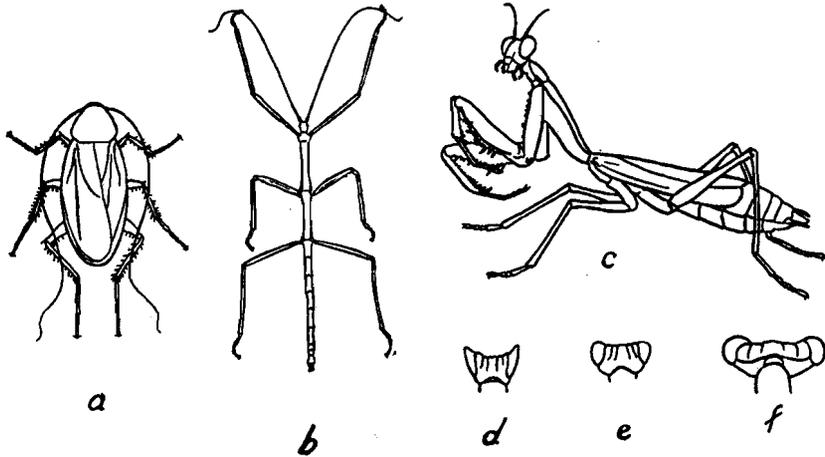


FIGURE 1. *a.* Cockroach, *Periplaneta americana* $\times \frac{3}{4}$. *b.* Walking-stick, *Diaperomera velii velii* $\times \frac{1}{2}$. *c.* Praying mantid, *Stagmomantis carolina* $\times 1$. *d-f.* Dorsal profiles of the heads of three genera of praying mantids: *d.* Yersiniops; *e.* Litaneutria; *f.* Stagmomantis; all somewhat enlarged. (*a.* redrawn after Marlatt; *d* and *e.* after Caudell.)

ORDER PHASMATODEA

Only three species of walking-sticks (Fig. 1*b*) have been recorded from Colorado, but one or more may occasionally be locally abundant. See Rodeck (101).

A Antennae not more than half as long as anterior femur; foothills.

Parabacillus coloradus (Scudder) (15, 52)

A' Antennae distinctly longer than anterior femur.

B Antennae no more, or little more, than twice as long as anterior femur; head carinate or longitudinally rugose; southwestern species, recorded from La Junta (42).

Pseudosermyle stramineae (Scudder) (15)

B' Antennae much more than twice as long as anterior femur; head smooth; eastern part of state. (Fig. 1*b*)

Diaperomera velii velii (Walsh) (9, 15)

ORDER MANTODEA

Neither individuals nor species of the family of praying mantids (Fig. 1*c*) appear to be abundant in Colorado.

A Smaller, pronotum less than 8 mm. in length; eyes more or less conical; hind femur armed externally with an apical spine.

B Eyes distinctly pointed above (Fig. 1*d*); hind femur delicately swollen basally; wingless; in foothills chiefly.

Yersiniops solitarium (Scudder) (17)

B' Eyes appearing rounded from above, but somewhat conical (Fig. 1*e*); hind femur straight; wings more or less well developed.

Litaneutria minor (Scudder) (17, 25)

A' Larger, pronotum over 10 mm. in length; eyes rounded (Fig. 1*f*); hind femur with no apical spine.

B Abdomen uniform or almost uniform in color above; eastern Colorado. (Fig. 1*c*)

Stagmomantis carolina (Johannson) (9, 17, 50)

B' Upper surface of basal three or four segments of abdomen conspicuously marked transversely with black or dark brown; western Colorado.

Stagmomantis californica Rehn and Hebard (17)

KEY TO FAMILIES OF ORTHOPTERA (*s. str.*)

A Antennae longer than body, and many jointed (exception Tridactylidae); ovipositor elongated; auditory organs, if present, on cephalic tibiae; tarsi 4- or 3-jointed, at least on mesothoracic legs.

B Tarsi 4-jointed, at least on mesothoracic legs; ovipositor sword-shaped.

C Body cricket-like in form; mostly wingless species; tarsus compressed.

GRYLLACRIDIDAE (page 136)

C' Body katydid-like in form (except in Decticinae, which are cricket-like); mostly with wings; tarsus depressed.

TETTIGONIIDAE (page 138)

B' Tarsi with 3 joints or fewer; ovipositor needle-shaped.

C Antennae long, many-jointed, tapering; hind tarsus not 1-jointed.

GRYLLIDAE (page 140)

C' Antennae short, with 12 joints or fewer; hind tarsus 1-jointed or absent; extremely small species, which live along water courses.

TRIDACTYLIDAE (page 141)

A' Antennae shorter than body, with fewer than 30 joints; ovipositor short, never elongated; auditory organs, if present, near base of abdomen; tarsi 3-jointed.

B Pronotum extending backwards, covering entire abdomen.

TETRIGIDAE (page 141)

B' Pronotum extending at most over only the basal part of the abdomen.

ACRIDIDAE (page 142)

FAMILY GRYLLACRIDIDAE

A Fastigium plane, convex, or shallowly excavate; bases of antennae widely separated.

B Fossorial legs; cephalic tibiae dorsally spinose, and without auditory foramina; pronotum dilated anteriorly; wingless. ("Jerusalem cricket," subfamily Stenopelmatinae)

Stenopelmatus fuscus Haldeman (11, 25)

B' Legs not modified for digging; cephalic tibiae not spinose dorsally, auditory foramina present; pronotum not dilated anteriorly; wings present. (Subfamily Henicinae)

Cyphoderris monstrosa Uhler (51)⁴

⁴ In my account of the collection of this species in Colorado (3), the locality was unfortunately given as "in the mountains of the Park Range, west of Crowley, Colorado." The specimens were collected in the Park Range, but west of Cowdrey, not Crowley, Colorado.

A' Fastigium grooved; bases of antennae practically continuous; wings absent. (Subfamily Rhabdophorinae)

B Fastigium biconical, deeply grooved; moveable spurs absent from dorsal side of caudal tibiae except at apex; introduced, found in greenhouses.

Tachycines asynamorus Adelung
as *Diestrammena japonica* Blatchley (9)

B' Fastigium an unpaired prominence, at most shallowly grooved medially; moveable spurs present along dorsal side of caudal tibiae, alternating with small spines.

C All tarsi 4-jointed.

D Dorsal surface of cephalic tibiae with a stout spur; plains, eastern Colorado.

Udeopsylla robusta Haldeman (9, 18)

D' Dorsal surface of cephalic tibiae unarmed except at apex.

E Dorsocaudal apical spine of caudal tibiae but little longer than last dorsal spur; dorsal margins of caudal tibiae with smaller number of denticulations, the cephalic carina with fewer than 25; recorded from Durango.

Styracosceles neomexicanus (Scudder)
as *Phrixocnemis neomexicanus* (Scudder) (18)

E' Dorsocaudal apical spine of caudal tibiae much longer than last dorsal spur; dorsal margin of caudal tibiae with larger number of denticulations, the cephalic carina usually with from 25 to 60. (Genus *Ceuthophilus*, the "cave-" or "camel-crickets," Fig. 2a)

F Ninth tergite of abdomen of male produced posteriorly (Fig. 2b). (Three species which fall into this division of the key are not here specifically included; each is known from Colorado on the basis of one specimen only, viz., *Ceuthophilus pallescens* Bruner, 1 male, no data; *C. aridus* Bruner, known only from holotypic male, collected at Grand Junction; and *C. apache* Hubbell, represented possibly by a female collected at Westcliffe by Professor T. D. A. Cockerell, the species known otherwise only from the holotypic male. See Hubbell, 64.)

G Dorsal spurs of caudal tibiae small, with very few bristles; ovipositor more than twice as long as pronotum; plains and foothills, eastern Colorado. (Fig. 2b)

Ceuthophilus utahensis Thomas (64)

G' Dorsal spurs of caudal tibiae large, outer surface densely covered with bristles; ovipositor less than twice as long as pronotum; plains, eastern Colorado.

Ceuthophilus pallidus Thomas (64)

F' Eighth tergite of abdomen of male produced posteriorly (Fig. 2c).

G Caudal tibiae straight.

H Caudal tibiae longer than femora; ventral cephalic carina of femur with 19-45 small denticulations; in grasslands and open yellow pine, pinyon, and juniper.

Ceuthophilus fusiformis Scudder (64)

H' Caudal tibiae shorter than femora; ventral cephalic carina of femur with 13-31 small denticulations; in mountains, up to 13,000 feet.

Ceuthophilus alpinus Scudder (64)

G' Caudal tibiae arched dorsally; ventral cephalic carina of femur with 4-10 strong denticulations; recorded in Colorado only from Pueblo. (Fig. 2c)

Ceuthophilus nodulosus Bruner (64)

C' Cephalic tarsi 3-jointed.

D Cephalic tarsi alone 3-jointed; others 4-jointed.

E Distoventral apices of three proximal segments of middle and caudal tarsi strongly spinose; recorded near Colorado Springs.

Daihiniodes hastiferum (Rehn) (42)

E' Distoventral apices of three proximal segments of middle and caudal tarsi prolonged but rounded at apices; mountains.

Daihiniella bellicosa (Scudder)

as *Daihiniodes bellicosum* (Scudder) (42)

D' Both cephalic and caudal tarsi 3-jointed; plains, Platte River drainage.

Daihinia brevipes Haldeman (18)

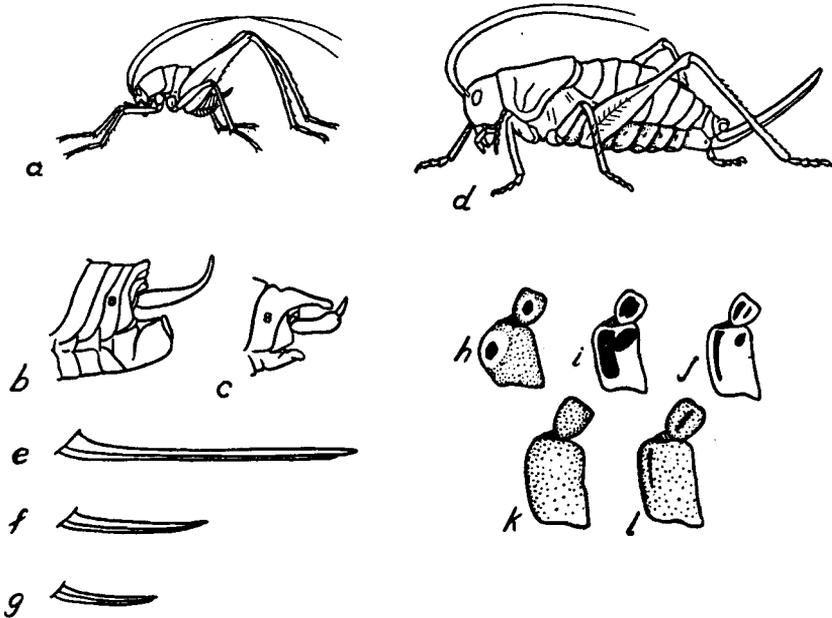


FIGURE 2. a. A cave cricket, *Ceuthophilus* $\times 1$. b-c. Lateral views of the tip of the abdomen of male cave crickets $\times 3\frac{1}{2}$ (eighth tergite numbered in each): b, *Ceuthophilus utahensis*; c, *Ceuthophilus nodulosus*. d. The "Mormon cricket," *Anabrus simplex* $\times 1$. e-g. Side views of the ovipositors of females of the genus *Conocephalus* $\times 1\frac{1}{2}$: e, *Conocephalus strictus*; f, *Conocephalus saltans*; g, *Conocephalus fasciatus fasciatus*. h-l. Ventral views of the basal antennal segments of tree crickets: h, *Oecanthus niveus*; i, *Oecanthus nigricornis argentinus*; j, *Oecanthus nigricornis quadripunctatus*; k-l, *Oecanthus californicus californicus*. (b-c, after Hubbell; d, after a drawing by SuZan N. Swain; e-g, after Rehn and Hebard; h-l, after Fulton.)

FAMILY TETTIGONIIDAE

A First and second tarsal joints smooth, not grooved on sides.

B Hind legs nearly or fully four times as long as body; hind margin of pronotum obtuse-angled; a southern species, recorded only from near Trinidad.

Arethaea gracilipes gracilipes (Thomas) (59)

B' Hind legs less than three times as long as body; hind margin of pronotum broadly rounded.

C Tegmina long, narrow, but little broader at middle than at apex.

D Yellowish line usually present along lateral carina of pronotum; notch of dorsal abdominal process of male subquadrate, with a minute median tooth; larger, body 21–28 mm.; eastern Colorado (3).

Scudderia texensis Saussure and Pictet (9, 96)

D' Pronotal disk uniform yellowish green; notch of dorsal abdominal process of male without median tooth; smaller, body 15–21 mm.; rather widely distributed, plains and foothills.

Scudderia furcata furcifera Scudder (25, 96)

C' Tegmina broad, distinctly wider at middle than at extreme apex; known from southwestern Colorado.

Microcentrum rhombifolium (Saussure) (9, 25, 50)

A' First and second tarsal joints grooved longitudinally on sides.

B Front tibiae without terminal spines above; body color greenish, body form slender.

C Front and middle femora spined beneath; body length 24 mm. or more; recorded from Julesburg.

Neoconocephalus ensiger (Harris) (97)

C' Front and middle femora unarmed beneath; body length less than 24 mm.

D Prosternal spines rather long, cylindrical, slender; tegmina fully developed; body more robust, usually over 18 mm., in length; plains, eastern Colorado.

Orchelimum concinnum delicatum Bruner (9)

D' Prosternal spines very short or wanting; tegmina usually abbreviated, shorter than abdomen in most species; body more slender, usually less than 17 mm. in length.

E Hind tibiae armed at apex with three pairs of spurs; prosternum bispinose.

F Apical portion of cerci broad and rounded; smaller, body length of female rarely over 14 mm.; ovipositor short, 7.3–9.4 mm. (Fig. 2g); recorded from eastern plains and San Luis Valley.

Conocephalus fasciatus fasciatus (DeGeer) (9, 99)

F' Apical portion of cerci narrow, acuminate; larger, female 15 mm. or more in body length; ovipositor long, 18–32 mm. (Fig. 2e); plains, eastern Colorado.

Conocephalus strictus (Scudder) (9, 50, 99)

E' Hind tibiae armed at apex with but one pair of spurs; prosternum without spines; plains, eastern Colorado. (Fig. 2f)

Conocephalus saltans (Scudder) (9, 99)

B' Front tibiae with a terminal spine above on the outer side; body color usually gray or brown (may be green in *Anabrus*); body stout, cricket-like.

C Wings fully developed; occurs in northern New Mexico.

[Capnobotes occidentalis (Thomas)] (16)

C' Wings short, rudimentary, or absent.

D Prosternum armed with a pair of distinct spines.

E Size large, pronotum 11–16 mm. long; southeastern Colorado.

Pediodectes haldemanii (Girard)

as *Stipator americanus* (Saussure) (16)

E' Size smaller, pronotum under 10 mm. long.

F Sides of abdomen and upper part of lateral lobes of pronotum usually black; pronotum 7.5–10 mm. long; to be looked for in northeastern Colorado.

[Pediodectes nigromarginata (Caudell)]

as *Stipator nigromarginata* Caudell (16)

F' No large patch of black; general color brownish; pronotum 5-7 mm., long; plains, eastern Colorado.

Pediodectes stevensonii (Thomas)

as *Stipator stevensonii* (Thomas) (16)

D' Prosternum unarmed, or armed with indistinct spines.

E Lateral carinae of anterior half of pronotum absent or indicated only by color.

F Pronotum 12 mm., or more in length; widespread, extending even above altitudes of 12,000 feet; most common in northwestern Colorado; the "Mormon cricket," a pest of great economic significance in the Great Basin. (Fig. 2d)

Anabrus simplex Haldeman (16, 113—thesis)

F' Pronotum 8 mm., or less in length; known in Colorado only from the Arkansas Valley.

Eremopedes scudderi Cockerell (16)

E' Lateral carinae of pronotum persistent except sometimes on anterior fourth.

F Caudal femora three or more times as long as pronotum; in mountains of northern Colorado.

Steiroxys trilineatus (Thomas) (16)

F' Caudal femora little if any more than twice as long as pronotum.

G Pronotal disc distinctly more than one and one-half times as long as greatest width; southwestern Colorado.

Plaglostira albonotata albonotata Scudder (16)

G' Pronotal disc not more than one and one-half times as long as greatest width; recorded from Grand Junction.

Plaglostira gillettei Caudell (16)

FAMILY GRYLLIDAE

A Body elongate or moderately so, length over 5 mm.; hind femora elongate, not exceptionally swollen; eyes large, not concealed by pronotum.

B Hind tibiae armed above with two rows of spines; tegmina always present.

C Head short, vertical or nearly so; color black or brown.

D Larger, body over 14 mm., long; widespread, the common large field cricket.

Gryllus assimilis (Fabricius) (9, 25, 100)

D' Smaller, body under 12 mm., long; the small, black, field crickets.

E Lower pair of apical spurs of hind tibiae unequal in length, the inner one much the longer; larger, 7.2-11.5 mm., long; widespread.

Nemobius fasciatus fasciatus (DeGeer) (9, 31, 50)

E' Lower pair of apical spurs of hind tibiae equal in length; smaller, 6.5-8.5 mm., long; plains of northeastern Colorado.

Nemobius carolinus brevicaudus Bruner (9, 31, 50)

C' Head elongate, horizontal; general color white or pale green.

D First two segments of antennae with one or more prominent black spots on lower surface (Fig. 2h-j).

E Only one round spot on each segment; widely distributed. (Fig. 2h)

Oecanthus niveus (DeGeer) (9, 29, 30, 50)

E' Two spots (which may, however, be confluent) on each segment.

F The spots round, large, and usually confluent (Fig. 2i); widely distributed.

Oecanthus nigricornis argentinus Saussure (29, 30, 50)

F' Two spots elongate, and distinctly separate (Fig. 2j); widely distributed.

Oecanthus nigricornis quadripunctatus Beutenmuller (9, 30, 50)

D' First two segments of antennae plain on ventral surface or marked at most with a faint streak on each (Fig. 2k-l).

E Tegmina immaculate; western Colorado.

Oecanthus californicus californicus Saussure (29, 30)

E' Tegmina with considerable green, and a color pattern of greenish and brownish suffusion along principal veins; recorded in Colorado only from Mesa Verde.

Oecanthus californicus pictipennis Hebard (57)

B' Hind tibiae armed above on both margins with minute teeth but no spines; tegmina and wings absent; plains eastern Colorado.

Cycloptilum comprehendens comprehendens Hebard (42, 44)

A' Body subspherical, wingless, less than 3 mm., long; hind tibiae ovate, very strongly swollen; eyes very small, covered by pronotum; living in ants' nests; probably in eastern or southern Colorado.

[*Myrmecophila nebrascensis* Lugger] (9, 39)

FAMILY TRIDACTYLIDAE

A Hind tibiae with four pairs of long swimming plates; hind tarsi 1-jointed; over 5.5 mm., long.

Tridactylus apicalis Say (9, 50)

A' Hind tibiae with one pair of short swimming plates; hind tarsi wanting; under 5.5 mm., long.

Tridactylus minutus Scudder (50)

FAMILY TETRIGIDAE

A Vertex extending forward beyond front of eyes, and distinctly wider than one eye, its front margin angulate or rounded, not truncate; front margin of pronotum not reaching eyes. (Fig. 4a)

B Front of vertex, from above, obtusely angulate, its median carina not projecting beyond the sides; widely distributed.

Acrydium subulatum (Linn.) (56)

as *Tettix granulatus* (Kirby) (35)

B' Front of vertex, from above, convex or rounded, its median carina distinctly projecting as a small tooth beyond the sides.

C Median carina of pronotum elevated only slightly between and before shoulders; frontal costa slightly sinuate between eyes; form more slender, caudal femora slender; northeastern Colorado.

Acrydium ornatum Say (50)

as *Tettix ornatus* (Harris) (35)

C' Median carina of pronotum obviously elevated between and before shoulders; frontal costa distinctly concave or sinuate between the eyes; form more robust, caudal femora stout.

D Sides of frontal costa gradually divergent from above downward; distributed at lower altitudes.

Acrydium acadicum acadicum (Scudder)

as *Tettix acadicus* Scudder (35)

D' Sides of frontal costa abruptly divergent near the vertex, but more or less parallel below this region; distributed at higher elevations.

Acrydium acadicum brunneri (Bolivar)

as *Tettix brunneri* Bolivar (35)

- A' Vertex not at all, or barely extending beyond front of eyes, and usually narrower than one eye, its front margin truncate or nearly so; front margin of pronotum reaching eyes. (Fig. 4b)
- B Pronotum long, usually much surpassing tips of hind femora, its median carina feebly elevated throughout its length; eastern Colorado.
- Paratettix cucullatus cucullatus** (Burmeister) (35)
- B' Pronotum usually short, not reaching tips of hind femora, its median carina distinctly elevated throughout; widespread, chiefly western.
- Paratettix cucullatus extensus** Morse (35)

KEY TO SUBFAMILIES OF ACRIDIDAE

- A Prosternum without distinct conical or cylindrical spine.
- B Vertex and front meeting at an angle, the face retreating. (This character is not always obvious, but familiarity with the genera in which the angle is not pronounced is soon acquired. See Fig. 4.).
- ACRIDINAE (Truxalinae) (page 142)
- B' Vertex and front forming a rounded surface, the face nearly or quite vertical. (Most of the grasshoppers of this subfamily have banded, colored wings.)
- OEDIPODINAE (page 147)
- A' Prosternum with a distinct conical or cylindrical spine.
- CYRTACANTHACRINAE (page 154)

SUBFAMILY ACRIDINAE

This subfamily, the Truxalinae of some authors, is well represented in Colorado. In a few genera, the face is as nearly vertical as in the Oedipodinae, but a gradually acquired familiarity with these few forms will eliminate this apparent difficulty in differentiating between these subfamilies. Facial profiles of superficially similar Acridinae and Oedipodinae are shown in Figure 4.

- A Lateral foveolae of vertex not visible from directly above (Fig. 4c).
- B Antennae strongly ensiform (lens-shaped in cross-section).
- C Tegmina with adjacent, regular, longitudinal veins in the proximal portion of marginal field; fastigium of vertex with distinct medio-longitudinal carina; may occur in north-eastern Colorado.
- [*Pseudopomala brachyptera* (Scudder)] (74, 80)
- C' Tegmina venation normal, with fewer veins in marginal field; medio-longitudinal carina of fastigium subobsolete or absent.
- D Lateral carinae of pronotum present and distinct.
- E Stout; caudal femora usually not reaching tips of tegmina; ventral margin of lateral lobes of pronotum shorter than their depth; southeastern Colorado.
- Mermiria texana** Bruner (87)
- E' More slender; caudal femora usually reaching or extending beyond tips of tegmina; ventral margin of lateral lobes of pronotum longer than their depth; eastern Colorado.
- Mermiria neo-mexicana** (Thomas) (87)
- D' Lateral carinae of pronotum absent; eastern Colorado.
- Mermiria maculipennis macclungi** Rehn (87)
- B' Antennae never decidedly ensiform, although they may be slightly flattened, or clavate.
- C Pronotum saddle-shaped, a high crest on the metazona; wings colored; plains, eastern Colorado.
- Acrolophitus hirtipes** (Say) (12, 114)

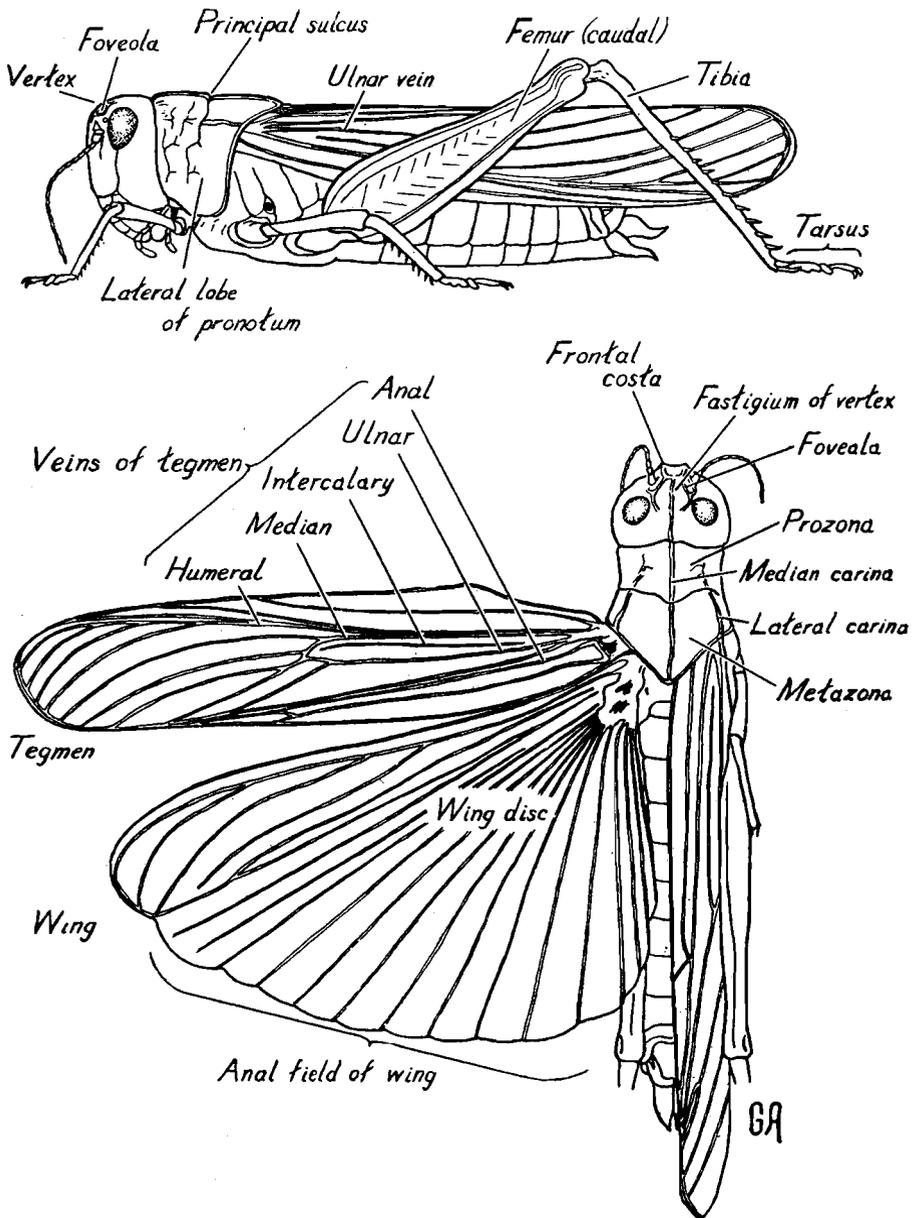


FIGURE 3. *Arphia pseudonietana pseudonietana* $\times 2\frac{1}{2}$; above, left lateral view; below, dorsal view, showing left tegmen and wing spread. The labelled structures are those most frequently mentioned in the keys to the family Acrididae. The fields or areas of the tegmen, also frequently referred to in the keys, may be located with reference to the veins labelled above, as follows: The marginal field lies anterior (ventral, in the folded wing) to the humeral vein; the discoidal area lies between the humeral and anal veins; and the anal area lies posterior (medial, in the folded wing) to the anal vein.

- C' Pronotum not saddle-shaped, no high crest; wings clear.
 D Fastigium of vertex with surface largely convex, lacking conspicuous infra-marginal impression (may have shallow impression).
 E Lateral carinae of pronotum straight, parallel, prominent and elevated; form rather slender; eastern Colorado.

Opela obscura (Thomas) (12, 74)

- E' Lateral carinae of pronotum not parallel, usually well constricted near middle.
 F Internal spurs of caudal tibiae equal in length.

G External spines of caudal tibiae 16 to 24.

- H Lateral carinae of pronotum only gently bowed inward; external spines of caudal tibiae 20-23 in the female; may occur in south-eastern Colorado.

[***Syrbula admirabilis*** Uhler] (12, 74)

- H' Lateral carinae of pronotum more decidedly to strongly bowed inward; external spines of caudal tibiae 16-18 in female; southern Colorado.

Syrbula fuscovittata Thomas (12)

as *Syrbula acuticornis* Bruner (74)

- G' External spines of caudal tibiae 12 to 15; eastern Colorado.

Amphitornus coloradus (Thomas)

as *Amphitornus bicolor* (Thomas) (74)

- F' Internal spurs of caudal tibiae decidedly unequal in length.

- G Lateral carinae of pronotum strongly constricted near middle; about twice as far apart at posterior margin as at narrowest point; eastern Colorado. (Fig. 4h)

Philbostroma quadrimaculatum (Thomas) (74)

- G' Lateral carinae of pronotum only moderately constricted, the widest part of the disc not more than half again as wide as narrowest.

- H Antennae clavate; recorded from Las Animas County.

Eritettix variabilis Bruner (74)

- H' Antennae acuminate; eastern Colorado. (Fig. 4c)

Eritettix simplex tricarinatus (Thomas) (74)

- D' Fastigium of vertex with surface deplanate or concave, or with a conspicuous infra-marginal impression.

- E Fastigium of vertex with distinct medio-longitudinal carina.

- F Tegmen of male with three distinct longitudinal veins in marginal field; tegmen of female as long as or longer than head and pronotum; northern Colorado foothills.

Chloeaithis conspersa Harris (9, 80, 90)

- F' Tegmen of male with but one distinct longitudinal vein in marginal field; tegmen of female shorter than head and pronotum; in mountains, in foothills and at moderate elevations.

Neopodismopsis abdominalis (Thomas)

as *Chrysochraon abdominalis* Thomas (90, 114)

- E' Fastigium of vertex lacking a distinct medio-longitudinal carina.

- F Only one longitudinal vein in basal part of marginal field of tegmen; lateral carinae of pronotum well indicated by color but not by structure.

- G Larger; disc of tegmen with rather small, distinct, dark spots; median carina of pronotum cut much behind the middle.

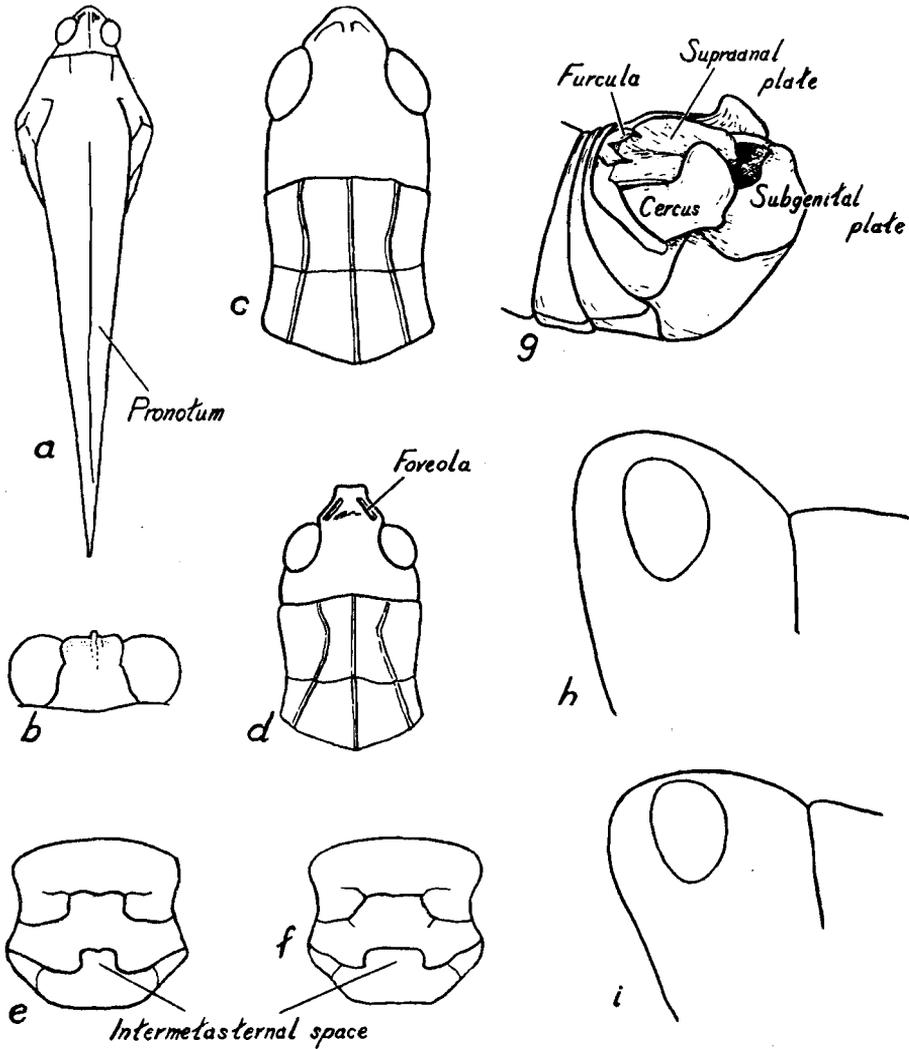


FIGURE 4. *a.* Dorsal view of the head and pronotum of *Acrydium subulatum* $\times 6$. *b.* Profile of the head of *Paratettix cucullatus cucullatus* from above, $\times 15$. (*a* and *b* after Hancock). *c.* Dorsal view of the head and pronotum of *Eritettix simplex tricarinatus* $\times 6$. *d.* Dorsal view of head and pronotum of *Aeropedellus clavatus* $\times 6$. *e-f.* Ventral views of mesosternum, metasternum, and first abdominal sternite: *e.* *Arphia pseudonietana pseudonietana* $\times 3$; *f.* *Melator pardalinus* $\times 2\frac{1}{2}$. *g.* Structures at the posterior end of the abdomen of *Melanoplus bivittatus* $\times 6$, the structures labelled being those most frequently used in the key to the genus *Melanoplus*. *h-i.* Profile views illustrating the angles of vertex and front in two species of Acridinae in which this angle is less pronounced than in most members of the subfamily: *h.* *Phlebotoma quadrimaculatum*; *i.* *Ageneotettix deorum deorum*; both $\times 7$.

- H** Posterior tibiae in part red or reddish; eastern Colorado.
Cordillacris occipitalis occipitalis (Thomas)
 as *Alpha occipitalis* (Thomas) (74)
- H'** Posterior tibiae testaceous; central Colorado.
Cordillacris occipitalis cinerea (Bruner)
 as *Alpha cinerea* (Bruner) (74)
- G'** Smaller; disc of tegmen with large dark blotches which are connected dorsally; median carina of pronotum cut very little behind the middle; western Colorado.
Cordillacris crenulata crenulata (Bruner)
 as *Alpha crenulata* (Bruner) (74)
- F'** More than one longitudinal vein in basal portion of marginal field of tegmen; lateral carinae of pronotum well indicated structurally.
- G** Fastigium bluntly rounded, anteriorly; spurious vein in ulnar area usually absent; eastern Colorado.
Orphulella speciosa (Scudder) (9, 34, 80)
- G'** Fastigium somewhat acute anteriorly; spurious vein in ulnar area usually present.
- H** Lateral carinae of pronotum usually distinctly incurved; tegmina longer, clearly exceeding hind femora; eastern Colorado.
Orphulella pelidna pelidna (Burmeister) (9, 34, 80)
- H'** Lateral carinae of pronotum not markedly incurved; tegmina shorter, little exceeding hind femora; western Colorado.
Orphulella pelidna desereta Scudder (34)
 as *Orphulella salina* Scudder (23)
- A'** Lateral foveolae of vertex visible from above (Fig. 4d).
- B** Antennae clavate; from foothills to alpine meadows. (Fig. 4d)
Aeropedellus clavatus (Thomas)
 as *Gomphocerus clavatus* Thomas (12, 74, 114)
- B'** Antennae simple.
- C** Tegmen of male with large, square, transparent cells in marginal field.
- D** Form moderately slender; face and eyes oblique; internal spurs of caudal tibiae equal; in damp meadows, edge of plains to over 10,000 feet.
Chorthippus longicornis (Latreille) (60)
 as *Chorthippus curtispennis* (Harris) (80)
- D'** Form moderately robust; face rounded and moderately oblique, eyes almost vertical; internal spurs of caudal tibiae moderately unequal; central mountains of the state, North Park south to Creede.
Bruneria brunnea (Thomas)
 as *Stenobothrus brunneus* Thomas (74)
- C'** Tegmen of male without large, square, transparent cells in marginal field.
- D** Median carina of pronotum continuous and distinct, cut only by the principal sulcus.
- E** Size small, females less than 22 mm.; lateral foveolae of vertex distinct.
- F** Disc of pronotum with prozona longer than metazona.
- G** Caudal tibiae red or reddish.
- H** Tegmina at least half as long as abdomen; widespread and abundant. (Fig. 4i)
Ageneotettix deorum deorum (Scudder) (9)

- H'** Tegmina greatly abbreviated, about one-third as long as abdomen; southwestern Colorado.
Ageneotettix deorum curtispennis Bruner (12)
- G'** Caudal tibiae glaucous; eastern Colorado.
Drepanopterna femoratum (Scudder)
 as *Aulocara femoratum* Scudder (12, 23)
- F'** Disc of pronotum with prozona shorter than metazona; caudal tibiae pale; pink or buffy.
G Larger; median carina distinct on summit of head, and accompanied by two supplementary carinae; southeastern Colorado.
Psoloessa texana texana Scudder (12)
 as *Psoloessa maculipennis* Scudder (74)
- G'** Smaller; median carina on head not distinct; eastern Colorado.
Psoloessa delicatula delicatula (Scudder)
 as *Stirapleura decussata* Scudder (12, 74)
- E'** Size large, males more than 24 mm. long; lateral foveolae of vertex subobsolete to weakly indicated.
F Tegmina of female the length of head and pronotum, of male falling short of end of abdomen; males black, form robust; eastern Colorado, chiefly southeastern.
Boopedon nubilum (Say) (74)
- F'** Tegmina of female one and one-half times length of head and pronotum, of males extending well beyond end of abdomen; males greenish-yellow to light brown; form slender; central Colorado mountains.
Stethophyma gracile (Scudder)
 as *Mecostethus gracilis* (Scudder) (74)
- D'** Median carina of pronotum obsolete in caudal portion of prozona; caudal tibiae glaucous, usually of a deep shade; widespread and common.
Aulocara elliotti (Thomas) (12, 23)

SUBFAMILY OEDIPODINAE

The Oedipodinae seem to be most abundant, both in species and individuals, in arid or semi-arid regions. It is consequently not surprising that Colorado has some sixty species in her fauna. Most of them have rather brightly colored wings, and many produce a loud clacking or crackling noise when in flight.

One Colorado species which falls into the subfamily Oedipodinae is placed by many authors in the *Batrachotetrigininae*, a subfamily not recognized by Brues and Melander (11). This species, *Brachystola magna* (Girard), is the large lubber grasshopper. It may be distinguished from all other Colorado orthoptera by its size. It is thick-bodied and large, the pronotum being over twelve millimeters long. Its wings are vestigial. From other Oedipodinae it may be distinguished also by the presence of an outer apical spine next the spurs of the hind tibiae, this being absent in the others of the subfamily.

- A** Intermetasternal space linear in males, and narrower than the intermesosternal space (and not transverse) in females. (Fig. 4e)
- B** Wings brightly colored: red, orange, or yellow.
- C** General coloration yellow-brown or reddish-brown; widespread.

Arphia conspersa Scudder (61)
 as *Arphia frigida* Scudder (63)

- C' General coloration black or blackish brown.
 D Abdomen yellowish to wood-brown below; western Colorado.
Arphia canora Rehn (63)
- D' Abdomen black or very dark brown below; widespread, late summer and fall.
 (This is the species illustrated in Figs. 3 and 4e)
Arphia pseudonietana pseudonietana (Thomas) (8, 9, 63)
- B' Wings pellucid or only faintly colored.
 C Distinct fasciations absent from tegmina; eastern Colorado, spring.
Chortophaga viridifasciata (DeGeer) (8, 9, 80)
- C' Distinct fasciations present on tegmina.
 D Intercalary vein usually curved, distinctly nearer median than ulnar vein; widespread, late summer and fall.
Encoptolophus sordidus costalis (Scudder) (8, 9, 80)
- D' Intercalary vein usually straight, approximately midway between ulnar and median veins; may occur in southeastern Colorado.
Encoptolophus pallidus subgracilis Caudell
 as *Encoptolophus texensis* Bruner (8)
- A' Intermetasternal space quadrate in males, at least as wide as long; in females, transverse (Fig. 4f) (*Brachystola magna*, the lubber grasshopper, falls in this portion of the key. It has been described in the second paragraph at the beginning of the keys to this subfamily.)
- B Lateral carinae of pronotum not transversely intersected by the principal sulcus; principal sulcus obsolete or indistinct on the lateral lobes.
 C Median carina of pronotum conspicuous; distal half of tegmina membranous and with quadrate cells.
 D Wings clear, and without fuscous transverse band; pronotum not rugose; widespread in open portions of mountains.
Camnulla pellucida Scudder (9, 80, 82)
- D' Wings colored, red or yellow, and with fuscous transverse band; pronotum rugose.
 E Sides of frontal costa parallel throughout; eastern Colorado.
Hippiscus rugosus (Scudder) (8, 9, 80)
- E' Sides of frontal costa considerably narrowed at upper extremity.
 F Single cleft in median carina of pronotum, the carina of approximately uniform height throughout.
 G Anterior extremity of fastigium of vertex prolonged well beyond the eyes, narrowing gradually; inner surface of hind femora yellow, or yellow with prussian-blue base, and with one to three black spots or bars; eastern Colorado.
Pardalophora apiculata (Harris) (80)
 as *Hippiscus apiculatus* (Harris) (9)
- G' Anterior extremity of fastigium of vertex not prolonged, narrowing rapidly in front of eyes; inner surface of hind femora buff to coral red ("deep pink"—Hebard; "vermillion"—Beamer); eastern Colorado.
Pardalophora haldemani (Scudder)
 as *Hippiscus haldemani* (Scudder) (8, 9)
- F' Two clefts in median carina of pronotum; or, if these do not show distinctly, carina is somewhat interrupted or crenulated near middle of pronotum.
 G Pronotal median carina depressed between the two transverse incisions or mid-portion of carina depressed if the two incisions are not clear.

- H Fastigium of vertex deep and moderately narrow; tegminal markings not very sharply defined, rather large pale areas between them; eastern Colorado, in sandy areas.

Xanthippus montanus (Thomas) (8)

- H' Fastigium of vertex broad and rather shallow; tegminal markings sharply defined, rather small pale areas between them.

Xanthippus corallipes 4 ssp. (8, 102, 105)

The four subspecies known from this state are distinguished by average differences, and the group has been sufficiently confused in the past to make it undesirable to attempt a key. However, in general the first subspecies listed below averages larger than the second, the latter larger than the third, and *altivolus*, smallest of all. Females of the last named subspecies are also distinctly brachypterous. *Xanthippus corallipes pantherinus* (Scudder) occurs in the Arkansas Valley, *X. c. latefasciatus* Scudder, on the plains farther north; *X. c. leprosus* Saussure, in the mountain foot-hills, and *X. c. altivolus* Scudder, at higher elevations. The lengths in the table below are from typical specimens in my collection, from the states indicated:

| | Length in millimeters | |
|---|-----------------------|--------|
| | Male | Female |
| <i>X. c. pantherinus</i> (Texas) | 36 | 47 |
| <i>X. c. latefasciatus</i> (South Dakota) | 27 | 40 |
| <i>X. c. leprosus</i> (Colorado) | 24 | 38 |
| <i>X. c. altivolus</i> (Colorado) | 22 | 32 |

- G' Pronotal carina not depressed between the two transverse incisions; tegminal markings not clearly defined; widespread in mountains.

Cratypedes neglectus (Thomas)

as *Hippiscus neglectus* (Thomas) (63)

- C' Median carina of pronotum slight; only distal one-fourth of tegmina membranous.

- D Wing disc light caerulean blue; caudal tibiae deep blue; southern Colorado.

Leprus cyaneus Cockerell (53)

- D' Wing disc usually yellowish-green to greenish-blue; caudal tibiae pale glaucous; males distinctly broader, more robust than in *L. cyaneus*. (Atypical material recorded from Cedar Creek, Montrose County, by Hebard.)

Leprus robustus Hebard (53)

- B' Lateral carinae of pronotum transversely intersected by the principal sulcus, which is distinct on the lateral lobes.

- C Median carina of pronotum well marked, in some very high, with not more than one transverse incision.

- D Pronotal carina very high and arched, with no transverse incision; general color green, wing disc orange; plains, eastern Colorado, rare as far north as Boulder.

Tropidolophus formosus (Say) (114)

- D' Pronotal carina with one deep transverse incision.

- E Wings without complete median transverse fuscous band.

- F Tegmina almost uniform, fasciations not prominent; inner margin of wing all black; widespread. (The "road-duster".)

Dissosteira carolina (Linnaeus) (8, 9, 80)

F' Tegmina with prominent fasciations in spots or blotches; inner margin of wing pale yellow, surrounded by a broad black band which does not reach posterior margin of wing; eastern Colorado, chiefly southeastern. (Periodically, one of the most serious agricultural pests in Colorado.)

Dissosteira longipennis (Thomas) (8)

E' Wings with median transverse fuscous band, extending entirely across the wing.

F Hind tibiae without a distinct dark ring at the proximal end.

G Hind tibiae rich (rarely) to pallid orange; pronotal carina well marked but not high; eastern Colorado.

Spharagemon equale (Say) (61, 76)

G' Hind tibiae rich pink; pronotal carina usually strikingly elevated; widespread.

Spharagemon collare (Scudder) (61, 76, 80)

F' Hind tibiae with a distinct dark ring at the proximal end.

G A subobsolete to distinct suffusion succeeding proximal ring; southeastern Colorado, rare.

Spharagemon bolli inornatum Morse (61, 76)

G' A heavy extensive dark brown ring succeeding proximal ring; recorded in Colorado only from near Colorado Springs.

Spharagemon bolli bolli Scudder (9, 61, 76, 80)

C' Median carina of pronotum not high, with two transverse incisions.

D Most of the cells of the distal half of the tegmina regularly quadrilateral, and arranged in rows on either side of spurious veins; inner edge of transverse fuscous band, if present, usually nearer base than apex of wing.

E Metazona at least one and one-half times as long as prozona, often more than twice as long.

F Tegmina fasciate on costal margin only; posterior margin of lateral lobes of pronotum parallel with anterior margin; western Colorado—a Great Basin genus.

Conozoa sulcifrons acuminata Scudder (63)

F' Fasciations crossing the tegmina, fading in some cases at the posterior border; posterior margin of lateral lobes of pronotum somewhat oblique and only subparallel with anterior margin (this latter character of somewhat doubtful value).

G Radiate veins of anal field of wing not distinctly swollen.

TRIMEROTROPIS (A special key to this genus follows this section. See page 152.)

G' Radiate veins of anal field of wing distinctly swollen.

H Swollen veins prominent only in anterior half or two-thirds of anal field; wing disc yellowish.

I Wing bar broken, weakly defined, incomplete.

J Averaging smaller; from altitudes chiefly above 9,000 feet.

Circotettix rabula altior Rehn (89)

J' Averaging larger; mountain foothills.

Circotettix rabula rabula Rehn and Hebard (89)

as *Circotettix undulatus* Thomas (8)

I' Dark wing bar, usually complete and solid; plains area of eastern Colorado, on ledges and bluffs.

Circotettix rabula nigrafasciatus Beamer (8, 89)

H' Swollen veins prominent in entire anal field; wing disc colorless or blackish.

I Tegmina shorter, in males averaging under 29 mm., in females averaging under 31 mm.; eastern Colorado, plains into mountains.

Aerochoreutes carlinianus carlinianus (Thomas) (89)

I' Tegmina longer, in males averaging over 30 mm., in females averaging over 32 mm.; western Colorado.

Aerochoreutes carlinianus strepitus Rehn (89)

E' Metazona not much longer than prozona, never one and one-half times as long, though sometimes appearing so in *Trachyrhachis*.

F Distal end of intercalary vein much nearer the median than the ulnar, not more than one full row of cells on either side; larger, over 28 mm. long; plains and mountains, northern and central Colorado. (Fig. 4f)

Metator pardalinus (Saussure) (8, 63)

F' Distal end of intercalary vein ordinarily not nearer the median than the ulnar, more than a single row of cells on the posterior side; smaller, under 28 mm. long.

G Anterior and posterior margins of lateral lobes of pronotum nearly or quite parallel, hind angle rectangulate.

H Lateral foveolae of head small, margins rounded.

I Fasciations of tegmina extending from anterior margin to posterior ulnar vein; pronotal carina not elevated as a crest between sulci; southeastern Colorado.

Rehnita capito (Stål)

as *Conozoa melleola* Scudder (110)

I' Fasciations of tegmina extending from anterior margin no farther than ulnar vein; pronotal carina elevated as a crest between sulci.

J Wing disc usually pink; eastern Colorado, plains and mountains

Mestobregma plattai plattai (Thomas) (8)

J' Wing disc usually yellow; southern Colorado (recorded from Mancos)

Mestobregma plattai corrugata (Scudder)

as *Conozoa corrugata* Scudder (110)

H' Lateral foveolae of head large, margins rather straight.

I Tegmina irregularly marked and blotched with fuscous; not more than two or three large patches, and these in the distal half.

J Wing disc colorless, some veins alone black; widespread.

Trachyrhachis kiowa kiowa (Thomas) (12, 63)

J' Wing disc some shade of yellow or red; eastern foothills.

Trachyrhachis aspera Scudder (12)

I' Tegmina regularly and evenly marked through entire length with large dark patches; wing disc pale yellow; mountains of central and southern Colorado.

Trachyrhachis coronata Scudder (12)

G' Anterior and posterior margins of lateral lobes of pronotum not parallel, hind angle rounded.

H Eyes prominent and globose; plains, eastern Colorado.

Derotnema haydenii haydenii (Thomas) (63, 88)

H' Eyes subprominent, not globose; western Colorado.

Derotnema haydenii rileyianum Saussure (63, 88)

D' Fewer than half of the cells of the distal half of the tegmina regularly quadrilateral; inner edge of fuscous transverse band of wings, if present, nearer apex than base of wing.

E Transverse fuscous band of wings present; eastern Colorado, into foothills.

Hadrotettix trifasciatus (Say) (8, 63)

E' Wings clear; widespread, but most common in southeastern part of state. (This genus superficially resembles *Aulocara*, and is therefore quite unlike the other members of the subfamily in Colorado.)

Hellaula rufa (Scudder)

as *Aulocara rufum* Scudder (108)

GENUS TRIMEROTROPIS

A Two black bands across the face, one above, one below the basal joints of the antennae; at moderate elevations in the mountains, forested areas.

Trimerotropis cincta (Thomas) (75)

A' Two black bands not present on the face.

B Hind tibiae red or reddish; or, if not, tip of wing is clear, not clouded.

C Tegmina with transverse bands, conspicuous or only fairly well developed.

D Tegminal bands sharply defined.

E Tegmina light in color; general body color gray; western Colorado.

Trimerotropis strenua McNeill (75)

E' Tegmina dark in color; general body color brown.

F Males over 30 mm. long; probably to be found in southeastern Colorado.

Trimerotropis magnifica Rehn (8)

F' Males less than 30 mm. long.

G Width of eye in male about width of fastigium of vertex as seen from above; less than fastigium in female; plains, eastern Colorado.

Trimerotropis pistrinaria Saussure
as *Trimerotropis bruneri* McNeill (8, 42, 75)

G' Width of eye in male greater than width of fastigium of vertex as seen from above; about same width in female; foothills, mountains at moderate elevations.

Trimerotropis humile (Morse) (42)

as *Spharagemon humile* Morse (76)

D' Tegminal bands present, but not sharply defined.

E Dark band of wing no wider than approximately one-third the length of the wing.

F Posterior femora with reddish on inner surface.

G Color dark brown; hind tibiae coral red; recorded by Hebard (57) from southwestern Colorado.

Trimerotropis tolteca modesta Bruner (63, 75)

G' Color grayish brown; hind tibiae orange yellow; widespread in mountains at moderate elevations.

Trimerotropis campestris McNeill (75)

as *Trimerotropis citrina* Scudder (8, 63, 75)

F' Posterior femora with yellow on inner surface.

G Median carina absent from fastigium of vertex; median carina of metazona elevated and distinct; western Colorado.

Trimerotropis latifasciata Scudder (8, 63, 75)

G' Median carina of fastigium of vertex distinct; median carina of metazona faint; eastern Colorado.

Trimerotropis laticincta Saussure (63, 75)

E' Dark band of wing very wide, two-thirds as wide as length of wing; southeastern Colorado.

Trimerotropis melanoptera McNeill (75)

C' Tegmina plain but for a few scattered spots; in sandy areas, eastern Colorado and San Luis Valley.

Trimerotropis agrestis McNeill (8, 75)

B' Hind tibiae not red or reddish; or, if so, the tip of the wing is clouded.

C Hind tibiae yellow or brownish.

D Cross band of wing indistinct and narrow, or absent.

E Wing disc faintly greenish yellow; in sage brush areas.

Trimerotropis gracilis gracilis (Thomas) (63, 75)

E' Wing disc clear or tinged with blue or greenish; western Colorado.

Trimerotropis sparsa (Thomas)

as *Trimerotropis azureus* Bruner (75)

D' Cross band of wing distinct.

E Color dull or pale yellowish brown.

F Median carina on prozona distinctly elevated; recorded in Colorado only from the type locality, Antlers, Mesa County.

Trimerotropis bilobata Rehn and Hebard (92)

F' Median carina on prozona not distinctly elevated; river valleys of western Colorado.

Trimerotropis inconspicua Bruner (13)

E' Color brown or dark brown.

F Cross band of wing narrow, interrupted; size small, male under 20 mm., long; at moderate elevations in mountains.

Trimerotropis fratercula McNeill (75)

F' Cross band of wing not interrupted; size large, male over 20 mm. long.

G Cross band outside center of wing, narrow but not broken, its spur extending over one-half the distance to the base; widespread at low and moderate elevations.

Trimerotropis pallidipennis pallidipennis (Burmeister) (75, 91)

G' Cross band in center of wing, in width equal to one-third length of wing, its spur extending less than one-half the distance to the base; alkali areas in eastern Colorado.

Trimerotropis pallidipennis salina McNeill (60, 75)

C' Hind tibiae bluish or blackish, occasionally pinkish.

D Well defined bands on tegmina; wing apex clear; should be found in forested sections of northwestern Colorado.

[*Trimerotropis fontana* Thomas]

as *Trimerotropis juliana* Scudder (63, 75)

and *Trimerotropis ferruginea* McNeill (75)

D' Poorly defined bands on tegmina; wing apex clouded; in open forest, at moderate elevations in the mountains.

Trimerotropis suffusa Scudder (42)

as *Circotettix suffusus* (Scudder) (63)

SUBFAMILY CYRTACANTHACRINAE

The "spine-breasted" grasshoppers are, in numbers of individuals, our most abundant orthoptera. The more familiar species belong to the genus *Melanoplus* of this subfamily; and most serious agricultural pests are members of this same genus. Ecologically the genus *Melanoplus* is of considerable interest, since its species are adapted to a great variety of environmental conditions. Some species occur even in the small, xeric, plant communities among the sand dunes of the San Luis Valley; others are found in sphagnum bogs near timber-line; and every intermediate condition of moisture and vegetation seems characterized by species of *Melanoplus*.

The following keys are based chiefly on characteristics of the male; it is not possible at present to prepare a key which will be equally satisfactory for specimens of both sexes. In practice, however, it is in most cases possible to associate the sexes of the same species by matching them in color and size, especially if it is known that they have been found under similar ecological conditions. (For important key characters see Figure 4g.)

- A Face very oblique, slanting backward; antennae more or less ensiform; form very slender.
- B Tegmina abbreviate, not reaching the end of the abdomen; subgenital plate of male about twice the length of preceding sternite; tips of ovipositor valves not darker nor more chitinous than the remainder of the valves; plains, eastern Colorado.
- Paropomala wyomingensis*** (Thomas) (42)
as *Mesops wyomingensis* (Thomas) (114)
- B' Tegmina of normal length, reaching or exceeding the end of the abdomen; subgenital plate of male short, approximately the length of the preceding sternite; tips of ovipositor valves more chitinous and usually darker than the remainder of the valves.
- C Head moderately produced; size smaller, male 17 mm. long, female 24 mm.; south-eastern Colorado.
- Eremiacris virgata*** (Scudder) (94)
- C' Head strongly produced; size larger, male 19 mm. long, female 27 mm.; recorded from Roggen as *E. pallida* (Bruner) (3).
- Eremiacris acris*** (Rehn and Hebard)⁶ (94)
- A' Face nearly vertical, antennae filiform; form not extremely slender.
- B Lobes of mesosternum longer than broad, their inner margins more or less straight; size larger, tegmina usually over 30 mm.; subgenital plate of male deeply notched at apex.
- C Caudal femora banded; caudal tibiae purplish; plains, eastern Colorado.
- Schistocerca lineata*** Scudder (107)
- C' Caudal femora lacking any trace of bands; caudal tibiae red; western Colorado.
- Schistocerca*** sp.
This species, referred to by Hebard (42) is near *S. venusta* Scudder and *S. shoshone* (Thomas) (107)
- B' Lobes of mesosternum not longer than broad, their inner margins usually rounded; size smaller, tegmina in largest females under 30 mm.; subgenital plate of male not deeply notched at apex.

⁶ The specimens upon which the inclusion of this species is based were originally reported as *Eremiacris pallida* (Bruner) (3), but Mr. Rehn informed me later that the species represented was *E. acris* (Rehn and Hebard). In a recent paper, Mr. Hebard includes Roggen, Colorado in the range of *E. virgata* (Scudder), but it seems likely that his statement is based upon the same specimens here referred to *E. acris*. My own specimens from the original Roggen series average considerably smaller in size than *E. acris*; they may well be *E. virgata*. If so, *E. virgata* is the only species of the genus known from Colorado.

C Lateral margins of subgenital plate of male, as seen from the side, straight or only slightly convex, never suddenly amplified at the base.

D Furcula of male projecting cylindrical fingers; color pale greenish-gray; plains and foothills on "white sage."

Hypochlora alba (Dodge) (19, 104)

D' Furcula of male slight, scarcely projecting lobes; color not pale greenish-gray.

E Color in general greenish-brown; southeastern Colorado.

Campylacantha olivacea vivax (Scudder) (19, 104)

E' Color markings bizarre—orange and dark blue predominant; plains, eastern Colorado.

Dactylotum pictum (Thomas)

as *Pezotettix picta* Thomas (114)

C' Lateral margins of subgenital plate of male suddenly amplified at base, or entire margin strongly convex.

D Subgenital plate of male with distinct *subapical* tubercle; cerci of male always slender, never broad and flattened.

E General color green; body relatively slender; furcula present as distinctly projecting lobes.

F Pronotum mostly smooth, may be punctate on metazona.

G Tegmina fully developed, or at least twice the length of pronotum, overlapping above.

H Transverse sulci of pronotum marked in black; plains and foothills, eastern Colorado.

Hesperotettix viridis viridis (Thomas) (19, 104)

H' Transverse sulci of pronotum not marked in black.

I Anal area similar in color to rest of tegmen; western Colorado, and San Luis Valley.

Hesperotettix viridis nevadensis Morse (77)

as *Hesperotettix gillettei* Bruner (13)

I' Anal area of tegmen reddish-purple; plains and foothills, eastern Colorado.

Hesperotettix viridis pratensis (Scudder) (19, 104)

G' Tegmina not longer than pronotum, not touching above.

Hesperotettix curtippennis Scudder (104)

F' Pronotum rugose on both prozona and metazona.

Hesperotettix speciosus (Scudder) (19, 104)

E' General color olivaceous or brownish; body relatively short and stout; furcula scarcely or not apparent.

F Tegmina about twice as long as pronotum, or longer.

G Cerci of male tapering only in basal half; mountains, front range.

Aeoloplus turnbulli turnbulli (Thomas) (57, 104)

G' Cerci of male tapering almost uniformly through basal three-fourths.

H The tegmina almost as long as abdomen; caudal tibiae pale glaucous; plains, eastern Colorado.

Aeoloplus turnbulli bruneri Caudell (57)

H' Tegmina one-half to three-fourths as long as abdomen; caudal tibiae pinkish or pale purplish; western Colorado.

Aeoloplus minor Bruner (13)

F' Tegmina shorter than pronotum; western Colorado.

Aeoloplus chenopodii (Bruner) (104)

D' Subgenital plate of male without distinct subapical tubercle. (If a minute tubercle is present, the cerci are broad and flattened.)

E Head not large nor prominent in comparison with pronotum—not so wide as pronotum; cerci of male variable, in most species not substyliform.

MELANOPLUS (A special key to this genus follows this section.)

E' Head large and prominent in comparison with pronotum—wider, even excluding the eyes, than the pronotum; cerci of male substyliform; eastern Colorado, plains and lower foothills.

Phoetaliotes nebrascensis (Thomas) (19, 104)

GENUS MELANOPLUS

A Tegmina short, never so long as abdomen. (Occasional long-winged individuals among these species occur, but they are rare.)

B₁ Cerci of male broad, expanding from the base, or, if apparently tapering slightly in the basal half, much less than twice as long as the breadth in the middle.

C Cerci swollen from base, with finger-like projection directed upward and inward; eastern Colorado, plains.

Melanoplus lakinus (Scudder) (19, 104)

C' Cerci not as described in C.

D Color predominantly brownish yellow; southeastern Colorado.

Melanoplus discolor (Scudder) (19, 104)

D' Color predominantly reddish-brown or gray; western Colorado.

Melanoplus occidentalis brevipennis Bruner (13)

B' Cerci not expanding from base, at least twice as long as the breadth in the middle.

C Cerci beyond middle either equal or tapering.

D Cerci long and slender, substyliform.

E Furcula two short diverging fingers; southwestern Colorado.

Melanoplus tristis Bruner (13)

E' Furcula two short parallel fingers or cones.

F Tegmina hardly longer than pronotum; size small. (*M. dodgei* ssp.)⁴

G Smallest subspecies, male about 14.5 mm. long; female about 21 mm.; high altitudes, main range of Rocky Mountains.

Melanoplus dodgei dodgei (Thomas)

as *Podisma dodgei* (Thomas) (104)

G' Size moderately small, male about 18.5 mm. long, female about 25 mm.; eastern foothills of northern Colorado.

Melanoplus dodgei incultus Scudder (106)

F' Tegmina attaining middle of hind femora; size larger, males about 20 mm. long, females about 28 mm.; mountains of southern Colorado.

Melanoplus bohemani (Stål)

as *Melanoplus altitudinum* Scudder (104)

⁴ Hebard (60) does not recognize *Melanoplus dodgei dodgei* and *M. d. incultus* as geographic races, on the grounds that the latter (found at lower altitudes) intergrades gradually with the former (at high altitudes). The writer believes, however, that geographic races may be as clearly related to altitudinal differences as to others of a geographic nature, and hence retains the nomenclature of Hebard's earlier papers.

- D' Cerci not slender.
 E Cerci small; abdomen bright yellow below, striped above; foothills, front range.
 Melanoplus dawsoni (Scudder) (104)
- E' Cerci long and somewhat spatulate; abdomen not conspicuously marked.
 F Tegmina half as long as abdomen; mountains of southern Colorado.
 Melanoplus borealis stupefactus (Scudder)
 as *Podisma stupefacta* Scudder (104)
- F' Tegmina about length of pronotum; mountains at fairly high elevations.
 Melanoplus oregonensis marshallii (Thomas)
 as *Melanoplus gillettei* Scudder (104)
- C' Cerci beyond middle broader at some point than at middle.
 D Cerci about four times as long as the breadth at the middle; foothills to timber-line.
 Melanoplus fasciatus (F. Walker) (104)
- D' Cerci about twice as long as the breadth at the middle; high elevations, mountains of central Colorado.
 Melanoplus kennicotti nubicola (Scudder)
 as *Podisma nubicola* Scudder (104)
- A' Tegmina about as long as abdomen, or longer.
- B Cerci of male equal or tapering beyond middle, never bifurcate.
- C Cerci of male expanding from the base outward; chiefly on plains, but found even above timber-line.
 Melanoplus occidentalis occidentalis (Thomas) (19, 104)
- C' Cerci of male tapering in basal half, sometimes throughout.
- D Furcula relatively prominent, at least one-third as long as supra-anal plate.
- E Cerci of male elongate, finger-like.
- F General color grayish-brown.
 G Larger, male 23 mm. long; plains, eastern Colorado.
 Melanoplus bowditchi bowditchi Scudder (19, 42, 104)
- G' Smaller, male 20 mm. long; in sage-brush, northern Colorado.
 Melanoplus bowditchi canus Hebard (39, 42)
- F' Color not grayish-brown.
 G General color greenish-yellow; smaller, male 21 mm. long; plains, eastern Colorado, chiefly northern part.
 Melanoplus flavidus flavidus Scudder (19, 42, 104)
- G' General color warm brown, or reddish-brown; larger, male 29 mm. long; may occur in southeastern Colorado.
 [Melanoplus flavidus elongatus Scudder] (42, 104)
- E' Cerci of male broad, not finger-like.
 F Subgenital plate very long, prolonged at apex; in the mountains, at moderate elevations.
 Melanoplus bruneri Scudder (42, 104)
- F' Subgenital plate not prolonged at apex, but ending apically in a prominent horse-shoe shaped ridge.
 G Plates of furcula divergent; widely distributed.
 Melanoplus femur-rubrum femur-rubrum (DeGeer) (19, 104)
- G' Plates of furcula parallel; recorded from Pikes Peak and Sierra Blanca.
 Melanoplus borealis monticola Scudder (104)
- D' Furcula very short, less than one-fourth as long as supra-anal plate.

E Cerci of male elongate, finger-like; plains and foothills.

Melanoplus regalis (Dodge) (19)
as *Aeoloplus regalis* (Dodge) (104)

E' Cerci of male broad, not finger-like.

F Subgenital plate of male deeply grooved vertically at apex.

G Smaller, male 21.5 mm. long; a widespread and abundant form today, and a serious agricultural pest.

Melanoplus mexicanus mexicanus (Saussure)
as *Melanoplus allanis* (Riley) (19, 104)

G' Larger, male 25 mm. long; now extinct. This was the devastating "Rocky Mountain locust" of the 1870's; it is now generally considered a migratory phase of the preceding.

Melanoplus mexicanus spretus (Walsh) (19, 104)

F' Subgenital plate of male rounded posteriorly.

G Cerci of male not markedly broad, about four times as long as broad; widespread.

Melanoplus gladstoni Scudder (104)

G' Cerci of male obviously broad, about twice as long as broad; south-eastern Colorado.

Melanoplus glaucipes (Scudder) (104)

B' Cerci of male expanding beyond the middle, or bifurcate.

C Cerci boot-shaped, or distinctly bifurcate.

D Cerci boot-shaped, the "heel" varying in prominence.

E Larger species; males over 27 mm., females over 35 mm. long.

F General color above uniform brownish; rarely, a dark phase, which is greenish-black; reported as common at lowest elevations in state, where it may be destructive; not generally common in Colorado.

Melanoplus differentialis (Thomas) (104)

F' General color above brownish, with a yellow-buff stripe on each side extending from behind the eye, along margins of pronotum and converging on tegmina; widely distributed; our common large grasshopper, and a serious agricultural pest. (Fig. 4g)

Melanoplus bivittatus (Say) (104)

E' Smaller species, male 25 mm., female 29 mm. long; known only from Grand Junction in Colorado.

Melanoplus yarrowii
as *Melanoplus olivaceus* Scudder (104)

D' Cerci distinctly bifurcate.

E Smaller branch of cercus on dorsal side.

F Smaller, male 15.5 mm., female 20 mm. long; foothills, eastern Colorado.

Melanoplus infantilis Scudder (104)

F' Larger, male 22 mm., female 24 mm. long; mountains, at moderate elevations.

Melanoplus alpinus Scudder (104)

E' Smaller branch of cercus on ventral side of cercus; plains, and lower foothills, eastern Colorado; a late summer species.

Melanoplus keeleri luridus (Dodge) (19, 104)

C' Cerci not boot-shaped or distinctly bifurcate.

D Cerci twisted inward at apex, and grooved externally; eastern Colorado, an early season species.

Melanoplus confusus Scudder (104)

- D' Cerci not as described in D.
- E Furcula less than half as long as supra-anal plate, not extremely broad at base.
- F Subgenital plate of male broadly rounded posteriorly.
- G Darker, pronotum with longitudinal dark band in center and another behind eye on lateral lobe; plains, eastern Colorado; an agricultural pest.
Melanoplus packardii Scudder (19, 45, 104)
- G' Coloration lighter, dark bands indicated in G absent. (Both subspecies under this division of the key are found in eastern Colorado, *M. foedus foedus* Scudder, characteristic of plains areas, and *M. foedus fluviatilis* Bruner, of river bottoms.)
Melanoplus foedus ssp. (19, 45, 48)
- F' Subgenital plate of male elongate posteriorly, narrowed, not broadly rounded.
- G Subgenital plate of male with a prominent vertical groove in the apex; plains and foothills, eastern Colorado.
Melanoplus angustipennis (Dodge) (19, 104)
- G' Subgenital plate of male without a vertical groove in the apex; plains, eastern Colorado, chiefly southeastern.
Melanoplus arizonae Scudder (104)
also as *Melanoplus palmeri* Scudder (104)
- E' Furcula well over half as long as the supra-anal plate, broad at base and tapering rather abruptly; should occur in northwestern Colorado, in sage brush.
[**Melanoplus complanatus canonicus** Scudder] (42, 104)

BIBLIOGRAPHY OF COLORADO ORTHOPTERA

An attempt has been made to make the following list of references complete for all papers published since 1900 which discuss taxonomic, faunal, and ecological problems involving Colorado orthoptera. References to a great many papers actually based on studies in nearby states, rather than Colorado, have, therefore, been included. The literature of economic entomology as it bears upon orthoptera has not been included in its entirety, but the two bulletins by Corkins (22) and Parker (83) have been included as sources of information on grasshopper control. Additional references are cited by Langford (73). The bibliography in Scudder's index (109) extends the literature list prior to 1900 in all aspects of the study of orthoptera.

Included in this list are references to general works which contain useful descriptions of Colorado species, as well as shorter papers in which original descriptions of Colorado species occur, but no attempt has been made to refer to all original descriptions of Colorado species. Where it is believed that illustrations in the reference cited may be of value in determining Colorado species, the abbreviation "ill.", appears in the citation; the omission of the abbreviation, however, does not necessarily mean that the reference is not illustrated.

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