THE AND OTHER ORTHOPTERA OF ARIZONA

BY

E. D. BALL, E. R. TINKHAM,
ROBERT FLOCK, AND C. T. VORHIES

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THE GRASSHOPPERS AND OTHER ORTHOPTERA
OF ARIZONA

BY E. D. BALL, E. R. TINKHAM, ROBERT FLOCK, AND C. T. VORHIES

INTRODUCTION

The grasshoppers and other insects such as the crickets and cockroaches belong to one of the most destructive groups of insects, the order Orthoptera. The problem of control is especially difficult in Arizona, where many species and a variety of habitats must be considered. Because of their large size, conspicuous habits, and the noises they make, the Orthoptera attract a great deal of attention and are the subject of many inquiries at the University.

In no other state are there to be found so many species of this order as in Arizona. For example, in the lists which have been published Alberta, Canada, has eighty-two kinds; Montana and Minnesota, 125; Kansas, 185; Colorado, 195; while this paper includes 282 species and varieties. The number of species in any single locality, however, is much smaller, and attention to the distribution of the various species will aid in identification.

Most of the serious damage is done by a few species, and in control work it is important to be able to identify these. Many of the less common species may occasionally become important, and there should be some easy means of identifying them. One of the most important and least known groups of economic species in this state is that which feeds on important range plants. This injury may be due either to feeding on forage plants in direct competition with grazing animals or to reduction of ground cover and consequent increase of soil erosion. This problem of the relation of grasshoppers to the range is so complex that one of the chief contributions of this bulletin will be in presenting the species so that workers doing research on the range will be able to identify them easily. Some species of Orthoptera may be beneficial because of feeding on injurious weeds, as in the case of the burroweed grasshopper; or feeding on injurious insects such as grasshoppers, as in the case of the praying mantis. A very large majority of the species, however, are of but little economic importance because of their restricted food habits or their limited distribution.

While considerable taxonomic work has been done on the Orthoptera of Arizona, most of it is too technical, or otherwise not available, for the general worker or the layman. The primary purpose of this bulletin is to list the Arizona Orthoptera with condensed data designed to enable anyone to identify the more important species and learn their relative importance.
AUTHORSHIP AND ACKNOWLEDGMENTS

For a number of years the University of Arizona has carried on research on the Orthoptera of the state. Dr. E. D. Ball was the first to take up this subject as a major project working primarily on the range grasshoppers but also carrying on a survey of the biology and importance of all other Orthoptera. For approximately 1 year following Dr. Ball's retirement Dr. E. R. Tinkham carried on the work, and he is directly responsible for many of the excellent drawings with which this bulletin is illustrated. Robert A. Flock, a graduate student in the department, then took up the task of preparing the manuscript, supplementing Dr. Ball's notes with his own knowledge and observations. Dr. C. T. Vorhies is responsible for the final revision and editing of the material. Inevitably, much of value in the notes, and in the mind of the original investigator, has been lost through the necessity of others taking up and completing the work. J. A. G. Rehn and Morgan Hebard, of the Philadelphia Academy of Sciences, have for many years done much of the outstanding taxonomic work on the Orthoptera of this region, and they have cooperated throughout with a continuance of this phase of the work, which is much appreciated.

ORTHOPTERA AND LIFE ZONES

Since insects are largely restricted in habitat not only by climatic conditions as are plants but also directly in their turn by dependence upon those plants, it need occasion no surprise that the Orthoptera of Arizona are distributed according to the so-called Life Zones. In the west these Life Zones are conspicuous in the floral landscape wherever one gains or loses altitude rapidly and hence are briefly characterized by a few well-known major plants.

Some of the most distinctive Orthoptera are found in the Lower Sonoran Zone. This zone covers those portions of the western and southern part of the state which are below about 4,000 to 4,500 feet in elevation. Typical plants are the creosote bush \((\text{Larrea divaricata})\), palo verde \((\text{Cercidium microphyllum})\), mesquite \((\text{Prosopis juliflora})\), and the desert grassland grasses. This zone includes most of the irrigated region and the grazing land of southern Arizona.

The Upper Sonoran Zone is the richest in respect to the number of kinds of Orthoptera. This zone lies between altitudes of about 4,500 and 6,500 feet. Live oak, piñon pine \((\text{Pinus edulis})\), juniper, and sagebrush \((\text{Artemisia tridentata})\) are typical plants, and the chaparral and northern short grassland are important plant associations in this zone, which contains a large percentage of Arizona range land.

The Transition Zone occupies a considerable portion of the state. Its characteristic plants are yellow pine \((\text{Pinus ponderosa})\), Chihuahua pine \((\text{Pinus leiophylla})\), and Gambel oak \((\text{Quercus gambelii})\). It lies between elevations of about 6,500 and 8,000 feet.
The Canadian Zone, 8,000 to 9,500 feet, is of less importance in this state. Typical plants are white fir (Abies concolor), Douglas fir (Pseudotsuga taxifolia), Mexican white pine (Pinus strobi-formis), and aspen. The Hudsonian Zone is very poorly represented in Arizona. It is characterized by Englemann spruce (Picea engelmannii) and bristle cone pine (Pinus aristata). These last two zones are of little importance because of their limited extent.

THE STUDY OF ORTHOPTERA

COLLECTING AND MOUNTING

Most Orthoptera are large and conspicuous and may be collected with a minimum of equipment. Some of the most interesting kinds may be found in such unusual places as the sand at the edge of permanent water, in pack rat dens, caves, under rocks, in rotten logs, in decaying plant material, and on certain plants. By the use of a stout net made of heavy material many species may be swept from thick vegetation, while others are rapid flyers and are more readily collected with a butterfly net. At night many kinds may be collected at lights, by looking for them with a lantern, or by listening for their calls and stalking them. Several rare species may be trapped with a bottle sunk to the edge in the ground and containing a small amount of molasses or other attractive bait.

Specimens may be killed in a cyanide killing bottle or in a bottle containing carbon tetrachloride. The cyanide bottle is made by putting a small amount of cyanide at the bottom of a bottle and covering it with cotton or plaster of Paris and blotting paper. The fumes are deadly poisonous. The carbon tetrachloride bottle is perfectly harmless. This is made by putting cotton and blotting paper in the bottom of any tight bottle. This material is kept damp with the killing agent.

After killing, the specimens may be pinned through the base of the right wing. A piece of blotting paper may be pinned underneath, and the legs and antennae arranged in the desired position and allowed to dry. The left wing is often spread to show color. Specimens may be pinned in a box lined with cork, balsa wood, or soft corrugated paper; or they may be kept in mounts made by packing a shallow paper box with cotton, placing the specimen on the cotton and then covering with glass or heavy cellophane and sealing the edge with gummed paper; or ready-made Riker mounts may be purchased. Moth balls or paradichlorobenzene should be kept in the boxes to keep out museum pests. All specimens should be labeled with the place and date of capture and other important information.

Most species can be named by the keys, illustrations, descriptions, or data on distribution and habits in this bulletin. In case of doubt, specimens may be sent to the Department of Entomology, University of Arizona, where a final determination can be made.
Although many scientific terms are used to describe structures of the various species of Orthoptera, these technical terms have been reduced to a minimum in this bulletin so that it may be easily used by as many people as possible.

The Orthoptera, like other insects, are made up of three body regions: the head, thorax, and abdomen. Attached to the head are the long feelers or antennae, the large compound eyes, the small eyes or ocelli, and the mouth parts (Fig. 1). The broad portion of the head back of the eyes is known as the occiput, the narrower portion between the eyes the vertex. The central portion of the vertex, known as the disc,\(^1\) is often depressed or separated from the remainder of the head by lateral carinae or keels, or divided into two parts by a median carina. On the margins of the vertex near the front borders of the eyes are small pits or concavities bounded by elevated ridges called the lateral foveolae. The apex of the vertex is often called the fastigium. The long frontal portion of the head from the vertex to the basal segment of the mouth parts is called the front or face. On the face is a ridge extending along the median line, called the frontal costa. Its edges or carinae may be parallel, diverging, or converging.

Figure 1.—Diagrams of the head of a grasshopper showing parts referred to in text: A, front view; B, side view.

The thorax is the middle part of the insect to which the legs and wings are attached. Most of the top and sides of the thorax are covered by the large hood-shaped pronotum. Its upper surface is called the disc, and its sides the lateral lobes. Ridges

\(^1\)Disc is used for both head and pronotal areas and also for the major area of the hind wing. The context will indicate which use is intended in a given place.
called the lateral carinae usually separate the disc from the lateral lobes. A third ridge, the median carina, divides the disc lengthwise through the middle. The median carina is usually cut by one or more sulci or grooves which cross the disc and extend down the sides. On the under or ventral side of the front part of the thorax is the narrow, somewhat movable piece called the prosternum, bearing in its center a tooth or spine which is used to distinguish one important group of grasshoppers.

The wings, if present, arise just behind the pronotum. The front wings are rather thick and not especially adapted for flight and are called the tegmina. The hind or true wings are very large and thin, often brilliantly colored, and are much used in classification.

Young Orthoptera and adults of certain species are wingless or have only small pads. In young grasshoppers, called nymphs, the wing pads are inverted so that the narrow tegminal pad is below the wing pad.

The legs consist of five segments: the small coxa, next to the body; the small trochanter; the large femur with the principal jumping and running muscles; the long, slender tibia; and the tarsus. The tarsus usually consists of from three to five joints with claws at the end and is the part which might be called the foot (Fig. 2).

The abdomen, or hind portion of the body, of the grasshopper is composed of ten complete segments. The abdomen of the female grasshopper ends in a double pair of short, curved, horny plates known as the valves of the ovipositor. In the other groups of Orthoptera the ovipositor varies greatly in form and size but is usually long and slender. Beneath the end of the abdomen of the male grasshopper is a large upcurved spoon-shaped piece known as the subgenital plate. At the sides of the next to the last segment are two appendages known as cerci. In the male grasshopper these are unjointed and afford valuable characters for classification (Figs. 9, 10).

The cockroaches which live in houses are well known, but some of the outdoor species are very seldom seen. The praying mantids are all predacious and may be considered beneficial. The walking-sticks feed on plants but are usually rare and seldom observed.

The cricket family includes the destructive field cricket and the tree crickets, which are quite important. The katydids or long-horned grasshoppers are interesting singers but are rather uncommon in this region; the larger species may sometimes injure cultivated shrubs and trees. By far the most important group of the order is the family of locusts, or short-horned grasshoppers.

The last three families are "jumping Orthoptera," a well-known and readily recognizable type, but not always correctly placed in their respective groups by the observer. Unfortunately so much confusion has arisen in the use of the common terms "grasshopper" and "locust" that to attempt to define them acceptably to all is hopeless. Even entomological authorities differ in their
choice of usages, so that no matter what choice is made for this bulletin some authorities will be found to differ with it.

First, it may be stated emphatically that the buzzing, raucous, loud-voiced insect so widely known as the "17-year locust" (and related species, the loudest of all insect "singers") is not a locust. These insects are cicadas. They belong to an order of insects having piercing mouth parts for sucking plant juices and are totally unrelated to grasshoppers. Grasshoppers and locusts have chewing mouth parts with which they consume plant tissues.

The principal confusion within the order Orthoptera has arisen in the two families which are designated herein as the Acrididae and the Tettigoniidae. The name Locustidae (locusts), now abandoned, has been used for each of these families, thus adding to the confusion of names. Most of the species which occur in the destructive hordes popularly known as locusts belong in the family Acrididae. The great majority of species of this family, however, are either harmless or sometimes injurious but not migratory in great swarms. Many of these are common enough to be well known and in nearly every such case are popularly called simply "grasshoppers."

In the Tettigoniidae are found several species which are more truly grass-loving and grass-inhabiting forms, more addicted to green and succulent grasses and other vegetation than are many of the Acrididae. Often grass green or grass gray in color, they are likely to be less conspicuous than Acridids, and the term "grasshopper" seems a particularly apt one for them. After all is said, however, probably katydid is the best known common name for many of these. Since the terms grasshopper and locust have been so long used for various species of both these families,
GRASSHOPPERS AND OTHER ORTHOPTERA

no attempt will be made to restrict its use to either group.

There is an easy distinction between these families which, if it were more widely understood, might tend to reduce the existing confusion. All species of Acrididae have relatively short antennae (horns) and have been by some authorities designated as "short-horned grasshoppers"; these include the "true" locusts, which are short horned. They are in general coarser, heavier bodied, with thicker wing covers, and more heavily or brilliantly colored than grasshoppers of the family Tettigonidae. The latter have more slender antennae, usually longer than the body, and may well be known as the "long-horned grasshoppers," a term used by some authorities. They are in general more delicately built, with thinner wing covers than Acrididae, and are often delicate green, tan, or nearly white in color. The flat, usually rather long ovipositor of the female Tettigoniid contrasts strongly with the short, stiff, four-piece ovipositor of the female Acridid.

There are many wingless forms in both groups. Some of these in the family Tettigoniidae tend to resemble crickets and are so-called, which does not lessen the confusion since true crickets constitute a third family, the Gryllidae.

Finally to illustrate the difficulties, the so-called "Mormon cricket," the villain of the early Mormon settlement in Utah, is in appearance cricketlike (wingless, brown); in activities locust-like (migratory in devouring hordes); and actually a katydid, or long-horned grasshopper (family Tettigonidae). So in this bulletin some Acrididae will be called locusts, while many others will have grasshopper as part of the common name; but in no case will any Tettigoniid be called a "locust," since none of them has ever earned such a term of opprobrium, save only the "Mormon cricket," and it was not called a locust to begin with!

The order Orthoptera contains a number of distinct families which are easier to characterize singly than collectively. Most of the species are fairly large. All have biting mouth parts, and most feed upon plant material. The fore wings, when present, are leathery; and the hind wings are thin, with numerous veins and longitudinal folds. The young, or nymphs, closely resemble the adults except for the absence of wings.

KEY TO THE FAMILIES OF ORTHOPTERA

A. Hind legs enlarged for jumping
   B. Antennae usually much shorter than body; tarsi 3-segmented; ovipositor short, composed of four separate parts. Short-horned grasshoppers or locusts. ACRIDIDAE (p. 274)

BB. Antennae much longer than body
   C. Tarsi 4-segmented; wings, when present, sloping at sides of body; ovipositor a long, compact blade. Long-horned grasshoppers or katydids. TETTIGONIIDAE (p. 346)

CC. Tarsi 3-segmented, or less; wings when present horizontal in greater part. Crickets GRYLLIDAE (p. 362)
AA. Legs nearly equal in size, the hind legs not adapted for jumping

B. Front legs not highly specialized for grasping

C. Body flat, broad, often more or less oval when viewed from above. Cockroaches

CC. Body elongate and slender. Walkingsticks.

BB. Front legs highly specialized for grasping. Praying mantids.

FAMILY BLATTIDAE. THE COCKROACHES

The cockroaches are essentially insects of warm climates and are very plentiful in Arizona (Hebard, 1917). Seventeen kinds have been reported from the state, of which seven are native species, rarely seen in houses; two are domestic pests in other regions but are not well established here; two have been taken in bananas from the tropics; and one introduced species is found chiefly in the field. The following four are important household pests: the large American roach, *Periplaneta americana*; the medium-sized Oriental roach, *Blatta orientalis*; the small German roach, *Blattella germanica*, with black stripes on the thorax; and the small brown-banded roach, *Supella supellectilium*.

Most roach infestations may be controlled by the use of roach powders such as sodium fluoride or borax. The powder may either be distributed where the roaches will walk on it or mixed with food such as flour or chocolate so that the roaches will eat it. The brown-banded roach is most easily controlled with phosphorus paste, which is also effective against the American roach. Fumigation with cyanide and dusting or spraying with mixtures of pyrethrum are also effective.

The house should be tightly built so that new infestations are not continually being started by migrating roaches, and it is particularly important to have plumbing of a sort that will not allow roaches to enter from the sewer or cesspool. It is important also to watch carefully all packages and furniture which are brought into the building. The brown-banded roach is especially likely to be thus introduced because it prefers to hide and attach its egg cases in such places.

Roaches are a nuisance because of their odor and unpleasant appearance but are much more important for other reasons. Much food and other material, such as book bindings, are destroyed or disfigured. The relationship to spread of disease is not very well understood but must be of considerable importance. The American roach, which breeds in tremendous numbers in the sewers and migrates to stores and residences, would appear to be especially adapted for spreading intestinal diseases. The brown-banded roach is not so restricted to the kitchen, and because of its habit of feeding on such material as soiled handkerchiefs, pepper-

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*Borax 1 part; cocoa 3 parts.*
mints, mucilage on stamps, and similar material, as well as food, may well be important in the spread of respiratory diseases.

**SUBFAMILY BLATTINAE**

*Latiblattella lucifrons* Hebard. Length: male, % in.; female, % in. A light brown woodland roach.

This species is very similar in appearance and closely related to the brown-banded roach, a household pest, though this species has never been reported as a domestic pest. Most commonly seen feeding on pollen and dead insects on the flower stalks of *Yucca elata* in June in the Santa Rita Mountains.

Upper Sonoran Zone in the Santa Rita (type), Huachuca, and Baboquivari mountains.

*Supella supellectilium* (Serville). Brown-banded roach. Length: male, % in.; female, % in. A reddish brown roach with two cross bands of light yellow color. The female is broader and shorter-winged than the male.

This is one of the most important household roaches in the warmer parts of the state. It was introduced into the state in 1933 and has since spread westward into California. Phosphorus paste is the most satisfactory control. The egg parasite, *Anastatus blattidarum* Ferrère, is quite important in the control of this roach where established.

*Blattella vaga* Hebard. Field roach. Length: ½ in.; closely resembles the German roach except for more olive color and black face.

This roach is not typically found in houses, but during very dry weather it may become a nuisance, especially around plumbing fixtures. It is a common species in the irrigated areas of the southern part of the state. No damage has been reported in the field, but it may occasionally damage seedlings. Control is effected by the removal of vegetation about the house.

Phoenix (type), Mesa, Tucson, Somerton, and Yuma.

*Blattella germanica* (Linn.). German roach. Length: % in.; two conspicuous dark stripes on pronotum.

This roach, probably the most important one in the United States, is also of considerable importance in Arizona. It is especially common in commercial establishments.

Yuma, Tucson, Nogales (and probably other cities).

*Parcoblatta notha* (Rehn and Hebard), Wood roach. Length: male, % in.; brown, unbanded.

This species is of little importance but may occasionally be a nuisance in houses. It is found in the Upper Sonoran Zone from Prescott south to the Baboquivari and Huachuca mountains, and Safford.

*P. americana* Scudder. This California and Nevada species was reported from Ehrenberg, Arizona, by Hebard (1917, p. 87).

*Neostylopyga rhombifolia* (Stoll). Length: 1 in.; brownish black, marbled with yellowish buff; wings reduced to pads.

This is a very distinctive, large species. It is an important
household roach in Asia and the west coast of Mexico. (Nogales, Hebard, 1917, p. 172.) It was found by Ball in 1930 in Nogales and Tucson but does not appear to have become established. 

Blatta orientalis Linnaeus. Oriental roach. Length: 1 in. or less; blackish brown; male, wings shorter than abdomen; female, wing pads only.

This is a cosmopolitan household pest, most common in the central latitudes of the United States, and widely distributed in this state. A slow-moving roach found most often in very damp places.

Douglas, Nogales, Tucson, and Phoenix.

Periplaneta americana (Linn.)- American roach. Length: 1½ to 2 in.; reddish brown.

This, the largest Arizona species, is probably the most important and widely distributed roach in this region. While it is mainly a household pest, it wanders freely from place to place. It is especially common in the sewers of southern Arizona from which it spreads to near-by buildings. Although long known in the state, T. B. Hall (Indian agent, Sells) states that some of the older Papago Indians can remember a time when they did not have this roach. The eggs are commonly parasitized by Evania appendigastor, the ensign fly.

Cities and towns of the Gila and Salt River valleys.

Periplaneta australasiae (Fabr.). Australian roach. Length: 1% to 1% in.; reddish brown, with clear-cut markings on pronotum, and a yellow band on outer edge of fore wings.

One record, Benson, Arizona, in a dwelling (Flock). Cosmopolitan in distribution.

SUBFAMILY NYCTIBORINAE

Nyctibora sp. A large round, brown, wingless form.

This roach was taken from fruit from the American tropics. It does not become established this far north.

SUBFAMILY PANCHLORINAE

Panchlora cubensis Saussure. This is a beautiful long-winged, green species taken at Tucson (L. P. Wehrle) and Cornville (R. B. Streets), transported from the tropics in fruit.

SUBFAMILY CORYDIINAE

Holocompsa azteca (Saussure). Length: less than ¼ in.; marked with black, yellow, and orange; ocelli present.

This Mexican household pest has been taken at Nogales, but does not appear to be established there.

Compsodes schwarzi (Caudell). Length: % in. (with wings).

A very rare species of which only the winged male is known. Taken by Owen Bryant in an ant nest in the Santa Rita Mountains. Catalina and Santa Rita (type) mountains of southern Arizona, to Texas, Sinaloa, and Lower California.
The roaches of this group are commonly found in the dens of rodents or other animals and apparently take the place of our domestic roaches with these animals. The males are long-winged, buff with brown markings, and are often seen because they are attracted to lights in large numbers. The females are round and wingless, and resemble sow bugs. The femora are without stout spines beneath, (Hebard, 1920b.)

KEY TO GENERA

la. Middle and hind femora with dorsal genicular spine at apex.  
   Arenivaga

1b. Middle and hind femora without dorsal genicular spine at apex.  
   Eremoblatta

Arenivaga grata Hebard. The largest native roach in Arizona, the female being over % inch long and the male larger because of the long wings; apparently spends the winter mainly in the nymphal stage.

The males have been taken at light in the Baboquivari Mountains (Lutz and Rehn). A female and many nymphs were taken by Flock in the guano in a bat cave in the Tucson Mountains.

Southern Arizona to Mexico.

Arenivaga erratica (Rehn). Length: male, % in., winged; female, less than % in.

This is the most common and widespread species of the group. Most commonly found in wood rat and ground squirrel dens in the desert regions. Most abundant in the Lower Sonoran Zone but occurs in the Upper Sonoran Zone in southern California, Utah, Colorado, Arizona, Texas, and Mexico.

Arenivaga apache (Saussure). Similar in appearance to erratica but less common. Found in the mountains of southern Arizona north to Prescott; California; and Mexico.

Arenivaga genitalis Caudell. A rare roach occurring from southern Arizona to California.

Eremoblatta subdiaphana (Scudder). Length: male, % in. or more, winged; female, % in.; small, hairy, with big spiny legs.

Southern California to southwestern Texas.

FAMILY MANTIDAE. THE PRAYING MANTIDS

There are many curious and striking forms of insects, but the praying mantids are among the weirdest, both in habits and structure. The spiny tibiae and femora of the greatly enlarged forelegs close together on their prey like the jaws of a trap. The common name comes from the way in which the forelegs are held. However, the name could better be "preying" mantids because the insects hold their legs in this attitude so as to be ready to grasp any prey which may come along. This family is entirely predacious and hence, chiefly beneficial. Many kinds of insects are eaten, including injurious grasshoppers. An individual mantis
often takes two grasshoppers at a time, grabbing one in each spiny arm and carefully turning them around so that their legs are away from its body so that they cannot kick or scratch. It then eats its prey alive, usually starting at the base of the head. Eggs are deposited on plants in conspicuous masses imbedded in a thick mucus which dries and becomes very tough (PL I B).

**KEY TO THE SUBFAMILIES OF MANTIDAE**

A. Head unarmed.

B. Form rather stout; inner margin of upper surface of fore coxae not conspicuously dilated apically.

C. Size small; less than 1¾ in. long; pronotum slightly longer than fore coxae; eyes more or less conical; hind femora armed exteriorly with an apical spine.

Ground mantids—**AMELINAe** (p. 268)

CC. Size large; more than 2 in. long; pronotum much longer than fore coxae; eyes round; hind femora with no apical spine.

Common mantids—**MANTINAe** (p. 270)

BB. Form very slender; inner margin of upper surface of fore coxae abruptly and considerably dilated at apex.

Stick mantids—**OLIGONICINAE** (p. 270)

AA. Middle of head with an erect process longer than the rest of the head.

Unicorn mantids—**VATINAe** (p. 271)

**SUBFAMILY AMELINAe. GROUND MANTIDS**

This group contains three species of ground-inhabiting forms. While rather common, they are not often seen because of their small size and dull colors.

**KEY TO GENERA**

la. Eyes distinctly pointed above; hind femora of female nearly twice as long as pronotum; wings short in both sexes; cerci long, distinctly surpassing the infragenital plate.

Horned ground mantis—**Yersiniops**

1b. Eyes scarcely pointed above; hind femora of male little longer than pronotum; wings of male long, of female short; cerci short, scarcely or not surpassing the infragenital plate.

Ground mantis—**Litaneutria**

**Yersiniopssolitarius** (Scudder). Horned ground mantis. This species is readily distinguished by the remarkable eyes, which extend out from the sides of the head as curved horns. The hind legs are better adapted for jumping than in most of the mantids, and the wings are lacking. Adults, July to October.

This mantis feeds on various small insects on the ground and occurs in rather bare, rocky places. When captured, copious quantities of a brown liquid are exuded from the mouth.

Upper Sonoran and Lower Transition zones in southeastern Arizona, north to the White Mountains and Springerville, and west to the Baboquivari Mountains; New Mexico and Colorado.

**Yersiniops sophronicum** (Rehn and Hebard). Long-horned ground mantis. Very similar to the preceding species except for the "smaller size, and the more compressed head with strongly
Plate I.—A, *Pseudovates arizonae*, Arizona mantis, natural size; B, egg masses of three species of mantids, about natural size; C, *Diapheromera arizonensis*, Arizona walkingstick, on creosote bush, one half natural size. (A and B by Vorhies; C by Tinkham.)
acute mammiform eyes which are hardly at all divergent and in
the shorter cephalic limbs" (Rehn and Hebard, 1908, p. 369).
Rocky areas in the giant cactus-palo verde belt of the Lower
Sonoran Zone of southern Arizona from Tucson (type) to Sacaton.

*Mantana minor* Scudder. Ground mantis. This small gray
ground-living species is the most common mantis in the state. The
females are always short-winged, and the males are usually long
 winged. The winged male has a characteristic large black spot
in the center of the hind wing. Adults, April to November.
Most of Arizona, north to Washington and Montana, and south
into Mexico.

**SUBFAMILY OLIGONICINAE. STICK MANTIDS**

*Oligonicella mexicana* Saussure and Zehntner. Stick mantis. Length: male, 1½ in., winged; female, 1% in., wingless; extremely
slender pronotum, % to ½ in.
A rather rare species which is most commonly seen when at-
tracted to lights. Found waiting for prey on flowers such as the
composite, *Gymnolomia annua*. Nymphs of various stages of de-
velopment taken from April to October. Many nymphs over-
winter and mature in early summer. The adults are most common
in June and July. As with many other tropical species there is
not a very definite seasonal development.
Huachuca, Tumacacori, and Catalina mountains; Nogales and
Patagonia to Tucson and Phoenix; southern Arizona to Mexico
and Guatemala.

**SUBFAMILY MANTINAE. COMMON MANTIDS**

This subfamily includes those most commonly seen and called
mantids or *campomoche*. They are considerably larger than the
ground mantids and are more apt to be found on bushes and
plants, where they are more noticeable. There exists in the
Southwest a belief that it is fatal for a horse or cow to eat one
or to drink from a trough in which a *campomoche* has drowned.
This is only superstition. Professors Stanley and Ball fed many,
both dead and alive, to a cow with no ill result. The praying
mantis is one of the most beneficial insects on the range because
of the large number of grasshoppers and other insects which it
eats. The large brown egg masses, 1% to 2 inches long, are very
common on trees and shrubs (PL I B).

*Stagmomantis limbata* (Hahn). Bordered mantis. Wings lemon
yellow, those of male with opaque costal area; no dark markings
on upper side of abdomen. Overwinters in egg; adults, August
to November.
One of two common large green, yellow, or brownish colored
mantids. Found on many plants but especially common on low
brush and blooming plants. Grasshoppers are extensively eaten,
and flies are one of the principal foods. The food is caught chiefly
by waiting at a suitable place, such as a flower, for the prey to
wander within reach. The egg masses are commonly parasitized
by *Podagrion mantis* Ashm., and occasionally by *Eupelmus alini* (determined by Gahan). Roberts also reports *Podagrion cras-
siclava* Cahan and *Eupelmus brevicauda* Cwfd. from Arizona egg cases.

Lower and Upper Sonoran zones. Southeastern Arizona west to Quinlan and Baboquivari mountains, and north to Cornville, Yavapai County; Arizona, New Mexico, Texas, and Mexico.

*Stagmomantis californica* Rehn and Hebard. California mantis. Wing of female dark or marked with ashy blotches; first four segments of male broadly edged with seal brown. Slightly smaller, more slender, and with broader head than *limbata*, and usually darker in color. Some specimens taken by Ball in northwestern Arizona are almost black. Adults, June to December.

Probably the more common of the two large green, yellow, or brownish mantids in Arizona. Habits quite similar to *limbata*. Widely distributed in the Lower and Upper Sonoran zones of southern and western Arizona north to Littlefield (Ball). Arizona to California, Nevada, and Texas.

*Stagmomantis gracilipes* Rehn. A rare mantis, closely resem-
bbling others of the genus. Female usually yellow or golden; male brown or green. It is best distinguished by the long, slender legs and pronotum: male, body, 58 mm.; pronotum, 19.5 mm.; front femur, 13.1 mm.; hind femur, 16.5 mm. Female, body, 61 mm.; pronotum, 21 mm.; front femur, 17 mm.; hind femur, 19 mm. Adults, early, June 12 to July 17.

Desert grasslands of Sonoran zones of southern Arizona north to the Pinal Mountains (Flock); Huachuca, Tumacacori, and Baboquivari mountains (Ball); Tucson, Benson, and Santa Rita Mountains (Flock).

**SUBFAMILY VATINAE. UNICORN MANTIDS**

*Pseudovates arizonae* Hebard. Arizona mantis (Hebard, 1935b, p. 116). Length: male, 2½ in.; female, 3 in.; wings long; fore wings bright yellowish green with two large transverse bands of dark brown; hind wings brown at tip, costal margin greenish buff; disc dark brown with yellow veinlets.

One of the rarest and most remarkable of Arizona Orthoptera. Its most distinctive character is a long erect process or double "horn," about % inch long, in the middle of the head (PL I A). Found in very dense shaded vegetation near water. Probably goes over winter as a nymph.

South central Arizona. Recorded from Baboquivari Mountains (type), Nogales, Catalina Springs, and Ocotillo; Santa Cruz River at Tumacacori Mission; Patagonia (Ball); Benson (Flock); Santa Rita Mountains (Mrs. R. A. Darrow); Tucson (Vorhies); and Sabino Canyon (Tinkham).

**FAMILY PHASMIDAE. THE WALKINGSTICKS**

The walkingsticks are remarkable for their resemblance to twigs of different plants or to dead grass. The habit of moving
very slowly and deliberately and of remaining motionless for long periods of time also makes them very hard to find. Even the eggs of most species closely resemble plant seeds and are usually dropped at random on the ground. All of the walkingsticks feed on the leaves of plants. None of the species is very important in Arizona from an economic standpoint.

KEY TO THE SUBFAMILIES OF PHASMIDAE

A. Antennae very short, shorter than femora of forelegs. Short-horned walkingsticks.
   *Pachymorphinae* (p. 272)

AA. Antennae much longer than femora of forelegs.

B. Size large; form slender; legs widely spaced; tarsi 5-jointed. Long-horned walkingsticks.
   *Heteronemiinae* (p. 272)

BB. Size small, \(\frac{1}{2}\) to \(\frac{3}{4}\) in. long; form stout; mesothorax little longer than prothorax; legs relatively close together.
   *Timeminae* (p. 274)

SUBFAMILY PACHYMORPHINAE. SHORT-HORNED WALKINGSTICKS

The two species of this subfamily in Arizona live largely on range grasses and are usually the same color as the dead grass. They are not confined to grasses but are also found on other plants such as burroweed (*Haplopappus*) and *Sphaeralcea* spp. The eggs are long and slender and are apparently pushed down inside the sheaths of grass leaves rather than dropped on the ground. Only about eight eggs are laid at a time (Hebard, 1934a).

*Parabacillus hesperus* Hebard. Length, \(2\frac{1}{2}\) to \(3\frac{1}{2}\) in.

This is the commonest walkingstick in Arizona. It occurs over most of the state west of the Huachuca Mountains.

Arizona to Utah, California, Nevada, and Oregon.

*Parabacillus coloradus* (Scudder). Very similar to *hesperus*, except next to the last (9th) abdominal segment of the male is twice as long as wide. In *hesperus* the length and width are about equal.

Eastern Arizona west to Osborn, the edge of the Mogollon Plateau, and the Hualapai Mountains. Utah, Wyoming, South Dakota, Kansas, Oklahoma, and Texas.

SUBFAMILY HETERONEMIINAE. LONG-HORNED WALKINGSTICKS

KEY TO GENERA

1a. Middle legs of male slender; hind femora unarmed beneath near apex.
   *Pseudosermyle*

1b. Middle legs with greatly enlarged femora, especially in male; hind femora armed with spine near apex.
   *Diapheromera*

*Pseudosermyle straminea* Scudder. Gray walkingstick. Length about 3 in.; color usually gray but may be pink or yellow; texture of surface rough.
Next to the short-horned walkingsticks, this is the most common species in the state. It is occasionally found feeding on grass but more often on shrubs and perennial plants. It has been taken most commonly on burroweed (*Haplopappus tenuisectus*), rabbit brush (*Chrysothamnus* sp.), sagebrush (*Artemisia tridentata*), bur sage (*Franseria deltoidea*), *Ephedra*, *Atriplex polycarpa*, *Hymenodea salsola*, *H. monogyra*, and skunk brush (*Ptelea trifoliata*).

Found over most of both Lower and Upper Sonoran zones in Arizona, and occasionally higher. Southern Arizona up to 7,800 feet in Santa Rita and Chiricahua mountains; west to Tinajas Altas; north to Boulder Dam, Littlefield, and the painted desert.

Arizona to Texas, Colorado, and California.

*Diapheromera femorata* Say. This species closely resembles the common Arizona walkingstick but is rare in Arizona. Both species are about 4 inches long, with long antennae. This one may be distinguished from *arizonensis* by uniform brown or green color; arcuate operculum in female; minute serrations on inner ventrolateral carinae of hind femora; and seventh segment of abdomen distinctly longer than ninth.

In the eastern part of the United States this species is very common and at times extremely destructive to shade trees. The chief food plant is oak.

Hebard (1935c, p. 278) records it from Naco, Paradise, and Grand Canyon, Arizona.

*Diapheromera arizonensis* Caudell. Arizona walkingstick. Length: male, 3\% in.; female, 3\% in.; antennae, 3 in.; brown or green, except underside with shining black marks on meso- and metathorax.

This is the common large walkingstick in Arizona, and is most abundant on spiny shrubs and trees such as mesquite (*Prosopis velutina*), and *Acacia constricta*. It is sometimes found in numbers in all stages on other plants, including bear grass (*Nolina microcarpa*).

Lower Sonoran Zone, and lower edge of the oaks; southeastern Arizona, west to the Baboquivari Mountains, and north to Castle Hot Springs (type) and Beaver Dam.

*Diapheromera covilleae* Rehn and Hebard. Creosote bush walkingstick. Length: male, 3\% in.; female, 4\% in. This is the largest walkingstick in the state and is found almost entirely on the creosote bush, *Larrea (Covillea) divaricata* (PL 1C). It resembles the preceding species but can be easily distinguished by the presence of two small horns on the head just behind the antennae. The female is dark brown or gray, and the male is usually light brown or green.

Eggs are oblong and bigger at one end than the other, with a side knob. They resemble seeds and are dropped on the ground under the bushes. One female depositing eggs contained forty-five fully developed eggs, twenty-three soft ones, and several sets of smaller ones.

Probably occurs over most of southern Arizona but is rather
rare. The most northern records are Hayden, the Catalina Mountains, and Paradise Valley (Maricopa County).

Arizona to Texas and Mexico.

SUBFAMILY TIMEMINAE

This subfamily is very rare, being known only from the single Arizona species (new) below and from three other uncommon species in the coastal mountains of California. They feed on various shrubs and trees, including conifers.

*Timema ritensis* Hebard. This is a small insect about % to % inch long, and relatively broader than the true walkingsticks. The metathorax is but little longer than the prothorax, so the legs are close together as in most other Orthoptera. All the Arizona specimens are brown in color, but in California pink and green individuals are found in similar species.

This species is known from one specimen collected at 9,432 feet on Mt. Wrightson in the Santa Rita Mountains, July 7, 1936, by R. A. Flock (Hebard, 1937b, p. 347), and a pair since taken by Owen Bryant at 9,000 feet in the Santa Catalina Mountains, June, 1940.

FAMILY ACRIDIDAE. SHORT-HORNED GRASSHOPPERS

The short-horned grasshoppers constitute the most important family of the Orthoptera, both as to economic importance and number of species. These grasshoppers have jumping hind legs; short, round, or slightly flattened antennae; 3-jointed tarsi; and an ovipositor consisting of four short valves projecting from the tip of the abdomen. The fore wings are usually dull colored and thickened, and the hind wings are thin, fan-shaped, and may be brightly colored.

Grasshoppers all feed on plant material and often are the most important insect pests in large areas in Arizona. Most of the damage is done by a small number of species, but many others may do some damage at times.

EGG LAYING HABITS

The number of eggs laid by a given species may determine its economic importance, and a knowledge of the egg laying habits is important in control. If the egg laying sites are known, the eggs and newly hatched nymphs may be more easily destroyed.

Grasshopper eggs are deposited in the ground in conspicuous pods. With her ovipositor the female first digs a hole in the soil which is larger at the bottom than at the top. The eggs are then deposited at the bottom of the hole in a mass of frothy, glutinous material which hardens and binds the eggs into an oval mass, the hole above the eggs being filled with the same fluid mixed with dirt, forming a protective cap. Egg masses can be readily found with the aid of a shovel, and the number per unit area may be used to estimate the following year's outbreak. Sites are chosen
for egg laying according to the character of the soil, type and
density of plant cover, and nearness to the favorite food plants.

The eggs of most species are deposited in the summer and fall
and remain dormant over winter, though in some cases they hatch
in the fall or at some other time of the year. Weather influences
the time of hatching. While the eggs, egg pods, and nymphs may
have good characters for determination, it is usually easier to
associate the eggs with adults in economic work.

FOOD PLANTS

Food plant preferences determine the economic importance of
glasshoppers. Most of those important on economic crops are
rather omnivorous. However, even in case of these species, cer-
tain crops and crop strains are preferred, and others may be left
entirely alone. Others of the grasshoppers are so specialized that
they will die if specific plants are not available. *Clematodes
larreae* and *Booettix punctatus*, for example, are entirely con-
 fined to the creosote bush, *Larrea divaricata*.

In still other cases a grasshopper species feeds and reproduces
largely on certain plants but may spread to other near-by plants. *Melanoplus
herbaceus*, for example, feeds and reproduces in
great numbers on arrowweed (*Pluchea sericea*) in the Salt River
Valley but never becomes very abundant on the near-by culti-
vated crops. In other cases the grasshopper feeds on several
species of a certain type of plant. The green streak (*Hespero-
tettix viridis*), a common grasshopper on the ranges, feeds on
range weeds such as snakeweed (*Gutierrezia*), burroweed (*Hap-
lopappus*), and rabbit brush (*Chrysothamnus*).

NATURAL CONTROL

Grasshoppers are controlled by many natural factors. They are
eaten by predacious insects, spiders, mammals, and birds, and
attacked by a number of internal parasites and diseases. A
number of insects and other animals search out the egg pods and
destroy them, and these factors must be taken into account in
making grasshopper counts for predicting outbreaks. Immature
and adult grasshoppers commonly contain large parasitic fly
maggots, which develop inside the grasshopper and greatly re-
duce its egg laying capacity. Many egg pods are destroyed by
larvae of *beetles*, blister beetles, and ground beetles.

A certain disease is at times one of the most important factors
in reducing the numbers of grasshoppers. Infected grasshoppers
crawl to the tops of plants to die. Virulence of the disease is or-
dinarly dependent upon humid weather, but it occurs quite reg-
ularly in certain damp situations such as the fields and under-
brush along the Santa Cruz River near Tumacacori. Infected
grasshoppers from southern Arizona, Springerville, Arizona, and
Colorado have been studied by Dr. Kofoid of the University of
California. An outstanding example of control by this means took
place in the Sulphur Springs Valley in the late summer of 1931.
Grasshopper counts showed a reduction of 65 per cent in a few days. Several species of range grasshoppers were killed, and egg laying was stopped to such an extent that few grasshoppers hatched the following year.

Birds often destroy large numbers of grasshoppers. Flocks of Swainson hawks and white-necked ravens have destroyed outbreaks of range grasshoppers in the Baboquivari Mountains region and Sulphur Springs Valley of southern Arizona (Ball, 1938, pp. 908-9). Many of the smaller birds also eat quantities of immature grasshoppers. Coyotes may feed exclusively on grasshoppers for a time, when they are abundant. Skunks devour large numbers.

Weather is very important in determining the abundance of grasshoppers. The number of eggs hatching and the survival of the newly emerged nymphs depend to a large extent on the temperature and humidity at that time. Low temperatures in the spring may greatly delay or prevent hatching or prevent feeding of nymphs that have just hatched out. Unfavorable temperatures in the egg laying season may reduce that activity and consequently decrease the next year's population. Humid weather in the summer may encourage the development of disease and cause a great reduction in numbers.

THE MOST IMPORTANT CROP PEST SPECIES

A comparatively small number of grasshoppers causes most of the serious damage on cultivated crops. In southern Arizona by far the most damage is done by the migratory and the differential grasshoppers. Some of the most important species are listed below. Others may be important at times, especially in isolated areas of cultivation.

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Poisoning is the standard method of control of grasshoppers on cultivated lands and is usually confined to the genera *Melanoplus* and *Schistocerca*. Formulas for a large number of poison baits are available. The following is the bait recommended by J. R. Parker (1939) of the United States Bureau of Entomology. Well-aged sawdust or other substitutes, such as cottonseed meal, are used to cut the cost of the bait.

- Mill run bran, mixed feed or shorts: 25 lbs.
- Sawdust (3 times bulk of mill run bran): 3½ bu.
- Liquid sodium arsenite: 1/2 gal.
- Water: 10 to 12 gal.

Another bait in common use, which may be used against other pests such as cutworms and crickets, is the following:

- Bran: 100 lbs.
- White arsenic, Paris green, or sodium fluosilicate: 4 lbs.
- Water: 12 to 16 gal.
- Molasses (not necessary): 1½ gal.

Molasses and ground lemons or oranges may be added to make the bait more attractive.

Mixing of the bait may be done better and more cheaply at central mixing stations under the general supervision of county agricultural agents. It may also be done by individuals, by hand on a tight floor or flat container, or in power mixers. The bran and poison may be mixed dry if done in the open, and the water poured into the mixture, or the poison may be put into the water first. The bait should be worked until the poison is well distributed, all lumps are broken up, and the moisture is evenly distributed. When damp enough only a small amount of water should drip when a handful of the bait is squeezed.

*Care must be used in handling this bait, as it is very poisonous and irritating to the skin.*

**DISTRIBUTION OF POISON BAIT**

Grasshopper bait is usually spread by hand but may be spread by an end-gate seeder or other mechanical device, or it may be sown from a car or airplane. The bait should be thrown so that it falls apart into flakes. Ten to 15 pounds should cover an acre.

There is little danger of poisoning of livestock if no lumps are distributed. However, in irrigated fields bait should not be distributed before irrigation. Sodium fluosilicate is much less poisonous to livestock and may be used if desired. Arsenic is not poisonous to poultry or birds.

**WHERE TO POISON**

Most efficient poisoning of grasshoppers is done on the egg-laying sites soon after the hoppers have hatched. The grasshoppers most common in cultivated areas lay very few eggs in clean-cultivated crops, bare ditch bank or other dry areas, or
even in good thick clean stands of alfalfa. Eggs are often concentrated around the edges of weed patches (such as Johnson grass, Bermuda grass, or mustard), in alfalfa fields and idle land, which are also breeding places for other serious pests, such as sugar beet leafhopper, Lygus, and several other plant bugs injurious to alfalfa and cotton.

In the north the eggs of the migratory grasshopper are deposited in dry, light soil with sparse vegetation, but in the south they are deposited in damper, more thickly covered areas. The differential and two-striped grasshoppers commonly lay their eggs along fence rows and overgrown ditch banks and waste places. Time used in determining the egg-laying sites will be well spent. Adult grasshoppers which are widely distributed in the field are more difficult to control.

**TIME OF SPREADING BAIT**

Bait should be put out early in the day before the temperature reaches 70 to 80 degrees F. Most of the feeding is done at this time, and the bait will not have time to become too dry. In alfalfa the grasshoppers often feed high in the plants and do not reach the bait which is on the ground. Baiting in alfalfa should be done immediately after cutting.

**CULTIVATION**

The eggs, especially of the migratory grasshopper, may be destroyed by plowing in the winter. Badly infested fields, or fields with scattered weed patches, should be treated in this way.

"**HOPPER DOZERS**"

In alfalfa fields or when the grasshoppers are desired for poultry food, "hopper dozers" may be used for control. A balloon type dozer was used in the Salt River Valley which was effective when used during the hours when grasshoppers were less active. The dozer is pulled by horses or truck and consists of a frontal shield and a cloth balloon into which the grasshoppers are knocked and confined.

**POULTRY**

Turkeys and chickens eat tremendous numbers of grasshoppers and might profitably be grown for this purpose.

**CONTROL OF RANGE GRASSHOPPERS**

Control of grasshoppers on the range is necessarily different from the control practiced in cultivated areas. The cost per unit area must be much lower to be practical economically. The problem may be partially solved by using some of the cheaper bait combinations and by use of cheap large-scale methods of distribution, such as the airplane. Baiting must be timed in such a way that a large percentage of the grasshoppers may be killed.
with a single application. This involves knowledge of the life histories of grasshoppers, especially in regard to egg-laying sites and hatching dates.

Very little experimental work has been done on the actual control of range grasshoppers in Arizona. Ball worked out a control program for the Carlos Ronstadt Ranch or the Santa Rita Experimental Range but was unable to do the final experimental work because of illness. Funds have not been available for this type of experimental work. In the 1941 Sulphur Springs Valley outbreak, for example, no money could be obtained for poison bait, although grasshopper outbreaks in that region have been studied for a number of years by University of Arizona and Department of Agriculture entomologists. The ranchers have yet to be convinced that grasshopper control might be a profitable part of range management.

A grazing range is a more or less balanced ecological unit. Great increase in the numbers of grasshoppers results in a decrease in the carrying capacity of the range for cattle. Prediction of such an increase in the grasshopper population would enable ranchers to adjust the number of livestock on their range. Likewise a change in the plant cover on the range, whether caused by drouth, overgrazing, livestock, grasshoppers, or some other factor, will result in changes in the grasshopper population.

Overgrazing or drouth may result in increased numbers of grasshoppers when the range is least able to withstand the effects of their feeding; and their feeding in turn tends to prevent revegetation of the range and to preserve the overgrazed condition. Grasshopper eggs usually hatch about the time that plants are germinating, when the young plants are most easily killed. Also, grasshoppers destroy many immature seed heads, thus preventing natural reseeding of the range, even when they are not abundant enough to cause noticeable damage to the rest of the plant.

Certain species of grasshoppers which are not abundant on ranges with good stands of grass become very abundant when the stand is destroyed by overgrazing or drouth. Some of these species are typical of bare areas and are important in preventing revegetation of depleted range land. Treherne and Buckell (1924, p. 35) suggested that control of a grasshopper of this type (Camnula pellucida) would depend upon range management which would allow for re-establishment of the range grasses. Reduction of the grazing load of the range together with reseeding projects should be carried on in addition to poison campaigns for most rapid revegetation of the range. Other species of grasshoppers increase in numbers on depleted ranges because of the increase in numbers of specific food plants. Some of these species such as the "green streak," Hesperotettix viridis, which feeds on burroweed (Haplopappus sp.) and snakeweed (Gutierrezia sp.), attack range weeds which prevent the growth of more palatable food, and should be considered beneficial.
ORGANIZATION OF CONTROL

Regular uniform grasshopper surveys are necessary for grasshopper control. These surveys should be at least supervised by trained entomologists who are acquainted with local conditions. Surveys should be conducted according to the methods of Shotwell (1935) and other workers of the Division of Cereal and Forage Insect Investigations of the Bureau of Entomology. The results of this survey should be used to determine when applications of bait or some other control are practical and to secure necessary support for such control. Actual mixing and spreading of bait should be under the direction of the County Agricultural Agent. Community action is frequently necessary in controlling grasshoppers, especially in irrigated regions where grasshoppers move from one farm to another in large numbers.

PRINCIPAL RANGE GRASSHOPPERS

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KEY TO THE SUBFAMILIES OF ACRIDIDAE

A. Pronotum extending over all or nearly all of abdomen; fore wings small; hind wings fully developed.
   Pygmy grasshoppers—Tetriginae (p. 281)

AA. Pronotum short, not covering abdomen; fore and hind wings nearly equal in length.
   B. Antennae shorter than front femora.
      Monkey grasshoppers—Eumastacinae (p. 282)
   BB. Antennae longer than front femora.
      C. Outer apical spine of hind tibiae present.
         Lubber grasshoppers—Romaleinae (p. 319)
   CC. Outer spine of hind tibiae located before apex.
      D. Prosternum between front legs armed with tubercle or lamellate swelling.
         Spine-breasted grasshoppers—Cyrtacanthacrinae (p. 321)
   DD. Prosternum flat.
      E. Median carina of pronotum threadlike; face often slanting and forming an angle with the vertex; hind wings not brightly colored; wings often short.
         Slant-faced grasshoppers—Acridinae (p. 282)
      EE. Median carina of pronotum somewhat raised or crestlike; face nearly vertical and rounded at meeting with vertex; hind wings usually brightly colored and with a black band; wings long.
         Band-winged grasshoppers—Oedipodinae (p. 298)
SUBFAMILY TETRIGINAE. PYGMY GRASSHOPPERS

The grouse locusts or pygmy grasshoppers are dark in color and only \( \frac{3}{8} \) to \( \frac{1}{2} \) inch in length. They are characterized by a long tapering pronotum which reaches to or beyond the tip of the abdomen, having the appearance of tegmina. However, there are no tegmina or front wings. The length of the pronotum is not specific, and individuals with both long and short pronotums may be found in the same species.

Grouse locusts are common in damp places in washes, and along streams and other bodies of water. They feed upon algae, lichens, mosses, tender sprouting seeds, sedges, and other tender plants and debris. The winter is spent in either the immature or adult stage.

*Tetrix subulatum* (Linnaeus). Easily recognized by the length of the vertex which is markedly produced beyond the eyes. Occurs at high elevations (Transition and probably Canadian zones) in the east central part of the state. Usually found along the margins of ponds, streams, and meadows but occasionally in wooded areas and even in cultivated fields. This is a holarctic species of much of the Canadian and Transition zones of the United States and Canada.

McNary; Greer (8,000 ft.); West Fork of Black River (7,800 ft.); Springerville.

Genus *Paratettix* Bolivar. Vertex not prolonged before the eyes; femora of middle legs only moderately flattened. The two species included in this genus are very common and would be most apt to be taken by the general collector.

*Paratettix azteca*us Saussure. Slender; pronotum usually prolonged considerably beyond abdomen; femora of middle legs slender, only slightly compressed at margins; frontal costa of head nearly parallel, close together.

A moderately common species of Upper and Lower Sonoran zones, southern Arizona. Huachuca, Baboquivari, Santa Rita, and Catalina mountains to Bill Williams Fork.

Arizona to California, Mexico, and Cuba.

*Paratettix cucullatus* extensus Morse. Broad; pronotum usually short, only to tip of abdomen; femora of middle legs broader, more compressed at margins, lower margin strongly lobed behind the middle; branches of frontal costa more strongly diverged.

This species is extremely abundant in suitable habitats over most of the state in the Lower and Upper Sonoran and Transition zones; from Santa Cruz Valley on southern boundary of the state to Bill Williams Fork, Prescott, Granite Dells, and Springerville.

*Clupeotettix schochii* (Bolivar). Although superficially resembling the last species, this rare grouse locust is readily distinguished by the much broader femora of the middle legs.

This is a southern species taken in the Baboquivari Mountains by Snow and Ball, Ball's specimens were taken on the sand of a
wash below a deep pool about a mile above the dam in Brown Canyon, on the east side of Baboquivari Peak, at about 5,500 feet. Arizona to Nicaragua, Guatemala, and Venezuela.

SUBFAMILY EUMASTACINAE  MONKEY GRASSHOPPERS

The two species in this group are small, wingless grasshoppers with antennae shorter than the femora of the front legs. They have very long, slender, hooked legs for climbing in bushes and trees.

_Eumorsea balli_ Hebard. Piñon pine grasshopper. Length: male, % in.; female, % in.; eggs, July; nymphs, June to August.

This was called a "monkey grasshopper" by Dr. Ball from its acrobatic ability in a pine tree. It is one of the most unique new species turned up by him in this study and is also a new genus (Hebard, 1935b, p. 119). It is uncommon and has been found in only three of the southern mountain ranges. It was at first thought to be confined to the Mexican piñon pine (Pinus cembroides). However, specimens have also been taken on low weeds, herbs, and bushes at some distance from pines.

Huachuca Mountains, Ramsey Canyon (Ball), Carr Canyon (Beamer), 5,000 to 6,000 feet; Pinaleno Mountains, east slope (Ball), 7,500 to 9,300 feet; Santa Rita Mountains (Flock), 9,000 feet.

_Morsea californica dumicola_ Rehn and Hebard. Chaparral grasshopper. Length: male, % in.; female, % in.; similar to piñon pine grasshopper but smaller; nymphs, July; adults, August and September.

Found on northern Arizona chaparral, this grasshopper appears to be most abundant on buckbrush (_Ceanothus_ sp.) but is also common on other plants such as cliff rose (_Cowania mexicana_), mountain mahogany (_Cercocarpus_), and sometimes manzanita (_Arctostaphylos_) and other associated shrubs.

Glenn Oaks, Ashfork, Yarnell Heights, Prescott (type), on the Mogollon Plateau; at 5,000 feet near Utah line; Littlefield; and Big Springs on the Kaibab Plateau.

SUBFAMILY ACRIDINAE. SLANT-FACED GRASSHOPPERS

The slant-faced grasshoppers are so-called because many of the species have the face very oblique, meeting the vertex at an acute angle. Unfortunately for ease of identification, this character is even more strikingly developed in some of the Arizona spine-breasted grasshoppers (_Cyrtacanthacrinae_), while many species of this group do not show this slant-faced character to any great extent and may be separated from the band-winged grasshoppers (_Oedipodinae_) only on the basis of the color of the hind wings and the feebly developed median carina or keel of the pronotum. In some of the most important species the wings are short.

This group is predominantly grass feeding and many of the species are so shaped and colored as to be less conspicuous in the
Figure 3. — Female slant-faced grasshoppers (x1½): A. Opeia obscura; B. Psoloessa texana pusilla; C. Amphitornus coloradus ornatus; D. Eritettix variabilis; E. Ageneotettix deorum.
grass. The very slender genera such as *Mermiria* and *Achurum* are usually found clinging to the stalks of tall grasses. Many of the more robust species are found at the bases of dense stands of grass. A few of the robust species are very similar to the band-winged grasshoppers (Oedipodinae) both as to appearance and habitat. *Heliaula*, for example, has been changed from one sub-family to the other several times. It is found on bare, rocky soils and is rather omnivorous in food habits, as is the case with many of the Oedipodinae. Other genera which might be confused are *Zapata*, *Aulocara*, *Drepanopterna*, and *Ligurotettix*.

This family contains a number of the most important range grasshoppers in Arizona. Since many of the important species are rather local in distribution, they had not been extensively studied previous to the inauguration of work on range grasshoppers at the University of Arizona.

**KEY TO THE GENERA OF ACRIDINAE**

1. Face usually strongly slanting, forming angle with vertex; lateral foveolae or pits of vertex forming right angle or acute angle with plane of fastigium and invisible from above. ...............2

   Face usually vertical and rounded at meeting with vertex; lateral foveolae of vertex forming obtuse angle with plane of fastigium and visible from above. ...........................................14

2. Antennae strongly sword-shaped; lateral carinae of pronotum straight. ..................................................3

   Antennae round or slightly flattened; lateral carinae of pronotum curved. .............................................5

3. Antennae very long, flattened entire length; form slender; size large, 1 to 1 1/2 inches long. ................................4

   Antennae shorter, apical half flattened only slightly; form more robust; size small, % to 1 inch long (Fig. 3 A).  

   *Opeia* (p. 290)

4. Fore wings pointed at apex (Fig. 4 B).  

   *Achurum* (p. 286)

   Fore wings broadly rounded at apex (Fig. 4 E).  

   *Mermiria* (p. 286)

5. Pronotum normal; head not distinctly elevated above pronotum; common species. .................................................................7

   Pronotum saddle-shaped, head distinctly elevated above pronotum; rare. .................................................................................6

6. Green with white and brown markings; hind wings colorless; lives on creosote bush.  

   *Bootettix* (p. 289)

   Brown or green; hind wings marked with black; lives on ground or on low plants.  

   *Pedioscirteutes* (p. 289)

7. Wings short, not extending past end of abdomen; distribution northern (lateral foveolae of vertex very shallow). ........8

   Wings longer than abdomen; distribution general. ..................9
8. Form robust; face rounded and nearly vertical; fore wings greenish, marked with four dark patches.

   *Philobostroma* (p. 291)

   Form slender; fore wings brown; face slanting.

   *Neopodismopsis* (p. 293)

9. Fastigium of vertex with surface largely convex, lacking a conspicuous impression, median carina distinct.

   Fastigium of vertex with surface flat or concave, with a conspicuous impression, median carina very indistinct.

   10. Antennae slightly flattened and slightly broader near apex; internal apical spurs of hind tibiae unequal (Fig. 3 D).

       *Eritettix* (p. 291)

   Antennae round or tapering gradually to apex; internal apical spurs of hind tibiae equal.

   11. Hind tibiae with 15 to 24 external spines; female large and robust, male small and slender (Fig. 4 C).

       *Syrbula* (p. 289)

   Hind tibiae with 12 to 15 external spines, form slender.

   12. Lateral carinae of pronotum indistinct and curved; color brown striped with cream; common (Fig. 3 C).

       *Amphitornus* (p. 291)

   Lateral carinae of pronotum distinct and nearly straight; color brown; rare.

   *Amblytropidia* (p. 290)

13. Antennae slightly sword-shaped; lateral carinae of pronotum indistinct except in color; color brown (Fig. 4 A).

       *Cordillacris* (p. 291)

   Antennae round; lateral carinae of pronotum distinct; color brown or green.

   *Orphulella* (p. 292)

14. Pronotum normal, lateral carinae present; costal field of fore wing normal; ground inhabiting.

   Pronotum saddle-shaped; lateral carinae absent; costal field of fore wing expanded; bush inhabiting.

   *Ligurotettix* (p. 298)

15. Antennae simple; common.

   Antennae flattened; rare.


   Antennae club shaped.

   *Aeropedellus* (p. 293)

17. Antennae very long; lateral carinae of pronotum curved; side of pronotum with narrow brown stripe.

   *Acantherus* (p. 293)

   Antennae of normal length; lateral carinae of pronotum angularly constricted; sides of pronotum brown with pale stripe on the lower border.

   *Horesidotes* (p. 293)

18. Face slanting, meeting the vertex at an angle; inner apical spurs of hind tibiae nearly equal in length; wings shorter than abdomen.

   *Chorthippus* (p. 293)

   Face nearly vertical and rounded at meeting with vertex; wings long or short.
19. Median carinae of pronotum distinct.................................20
   Median carinae of pronotum obsolete for most of its length.
   Heliaula (p. 297)

20. Hind tibiae blue; median carinae of pronotum low on posterior part
    of prozona and cut by two sulci........................................21
   Hind tibiae red or tan; median carinae percurrent and cut by one
   sulcus...................................................................................22

21. Wings shorter than abdomen; marked with distinct dark markings
    (Fig. 5 C, D).
   Drepanopterna (p. 295)
   Wings longer than abdomen; dark markings indistinct (Fig. 4 D).
   Aulocara (p. 295)

22. Size large; lateral foveolae or pits of vertex indistinct........23
   Size small; lateral foveolae of vertex well marked...............25

23. Hind tibiae brown; wings longer than abdomen.
   Rhammatocerus (p. 294)
   Hind tibiae red or black; wings shorter than abdomen............24

24. Hind femora conspicuously banded; lateral carinae present on vertex
    (Fig. 5 E, F).
   Morsetella (p. 297)
   Hind femora with pale bands; vertex evenly rounded (Fig. 5 A, B).
   Boopedon (p. 297)

25. Hind tibiae buff or pink in color; lateral carinae of pronotum per-
    current and sharply constricted in middle; prozona shorter than me-
    tazona (Fig. 3 B).
   Psoloessa (p. 294)

26. Hind tibiae red; lateral carina obsolete on prozona; prozona longer
    than metazona........................................................................27

27. Apex of fastigium subacute; rare.
   Zapata (p. 295)
   Apex of fastigium rounded; common (Fig. 3 E).
   Ageneotettix (p. 294)

Achurum sumichrasti Saussure. Length: male, 1½ in.; female, 
1% in.; face extremely slanting; head projecting before the eyes
the length of the eyes; form slender; yellow or greenish brown
with reddish brown lateral stripes on head and pronotum; fore
wings long, pointed; antennae sword-shaped, tapering toward
apex (Fig. 4 B); twenty eggs per pod in summer, hatching in fall;
nymphs overwinter; adults June and July.

Found clinging to stalks of coarse grasses on rocky slopes in
desert grassland of the Lower and Upper Sonoran zones of south-
eastern Arizona. Most commonly taken on Andropogon sp., A.
barbinodis, Muhlenbergia emersleyi, Eragrostis sp., and Spor-
obolus sp.

Southeastern Arizona west to the Baboquivari and Quinlan
mountains; north to the Catalina and Pinaleno mountains.

Arizona to southwestern Texas, and south to Mexico and
Guatemala.

Genus Mermiria Stal. This comparatively common genus is
rather similar in appearance to Achurum. Form, slender; brown
Figure 4.—Female slant-faced grasshoppers (x 2): A, Cordillaceris crenulata pima; B, Achurum sumachrasti; C, Syrbusa fuscovittata; D, Aulocara elliotti; E, Mermiria texana.
and yellow-striped; antennae sword-shaped; face strongly slanting; end of fore wings rounded (Rehn, 1919a).

*Mermiria texana* Bruner. Length: male, 1¾ in.; female, 1¾ in. Readily distinguished by sharply contrasting dark brown and light yellow dorsal and lateral stripes on pronotum and head; dorsal stripe on fore wings prominent; small, distinct, lateral carinae on pronotum (Fig. 4 E). Overwinters in egg, sixteen to twenty-four per pod; nymphs, May to July; adults, June to November.

A rather uncommon species found on rocky slopes from the upper edge of the Lower Sonoran Zone through the Upper Sonoran Zone into the margin of the Transition Zone. It is almost always found feeding on grass under the protection of brush; never taken in open grasslands. In Texas it is found in association with creosote bushes in desert areas (Tinkham), but in Arizona it is more common about the junction of the Upper Sonoran and Transition zones.

Mountains of southeastern Arizona north to Springerville, Showlow, Pleasant Valley, and Glenn Oaks in Yavapai County. Arizona to Colorado, Texas, and Mexico.

*Mermiria maculipennis* Bruner. Length: male, 1½ in.; female, 2 in.; pale brown; dorsal stripe absent on head and pronotum; lateral stripes present; no lateral carinae on pronotum. Overwinters in egg, sixteen to twenty-four per pod, mostly August and September; nymphs, June, July, a few to November; adults, June to November.

This is the most widespread and abundant species of the genus in the state and is at times very important on the range and even in cultivated areas. It is most common in the desert grassland of the Lower and Upper Sonoran zones but is also common in the northern grassland of the Upper Sonoran Zone. Particularly abundant in sacaton grass (*Sporobolus wrightii*) but also found in other rank grasses such as wheat, oats, rye, wild rye (*Elymus* sp.), Johnson grass (*Sorghum halepense*), *Andropogon* sp., and various range grasses including dense stands of grama grass (*Bouteloua* spp.). It is very active and hard to catch, jumping, flying, and dodging from one grass stalk to another.

Southeastern Arizona and the Mogollon Plateau west to Baboquivari Mountains (Pima County), Williamson Valley and Glenn Oaks (Yavapai County), and northeastward to St. Johns (Apache County).

Arizona to Texas, Montana, and Mexico.

*Mermiria neomexicana* (Thomas). Length: male, 1% in.; female; 2 in.; pale brown; dorsal stripe on head and pronotum usually present; lateral carinae of pronotum not diverging behind. Overwinters in egg; eggs twenty-four to thirty per pod, mostly October and November; nymphs, July to September; adults, July to November.

A rather uncommon species in the state except in the tall grasses of the desert grassland of the Baboquivari and Tumacacori
mountains, southern Arizona. Especially common in dense stands of *Bouteloua curtipendula* and *Muhlenbergia emersleyi*. Ranges from the desert grassland of the Lower Sonoran Zone up to the lower edge of the Transition Zone. Baboquivari, Tumacacori, and Chiricahua mountains, Tucson, and north in White Mountains to Springerville.

Arizona to Texas, Colorado, Montana, and Illinois.

*Bootettix punctatus* Scudder. Creosote bush grasshopper. Length: male, % in.; female, 1 in.; rich green, marked with silvery white, brown, and black; fore wings with small black dots; pronotum saddle-shaped; antennae short; head moderately ascending; nymphs, March to August; adults, May to November.

Confined to the creosote bush (*Larrea divaricata*), on which plant its peculiar markings, similar to those of the creosote bush katydid (*Insara covilleae*), make it very hard to see. Reported from southeastern Arizona as *B. argentatus* according to Hebard (1935c, p. 280).

Southern and western Arizona to California.

Genus *Pedioscirtetes* Thomas. This rather rare genus is easily recognized by the high fastigium of the head, the long red antennae, and the saddle-shaped pronotum.

*Pedioscirtetes nevadensis* Thomas. Nevada grasshopper. Length: male, 1 in.; female, 1% in.; distinctive bright green; underwings yellow, banded with black. Eggs, six to eight per pod; nymphs, June; adults, July and August.

One of the rarest of North American grasshoppers, taken in Arizona near Springerville and Flagstaff (Ball). Found closely associated with the Colorado rubber plant, *Actinia richardsoni*. It was also taken feeding on *Artemisia frigida*, *Gutierrezia*, and grama grass (*Bouteloua sp.*).

Northern Arizona, Nevada, Idaho.

*Pedioscirtetes maculipennis* (Scudder). Texas grasshopper. Length: male, 1 in.; female, 1% in.; conspicuously banded and marked with brownish white on a dark gray background; underwings jet black. Eggs, eleven to sixteen per set; nymphs, May to August; adults, June to September.

Occurs in low, rocky hills of the Lower Sonoran Zone. Found feeding on the gray, matlike plant, *Caldenia canescens*, in areas where Chihuahua desert plants such as blackbrush (*Flourensia cernua*) occur in Cochise County, Arizona, west to Tombstone and north to Dos Cabezas.

Texas and Mexico.

*Syrbula fuscovittata* Thomas. Length: male, 1 in.; female, 1½ in. The female is not only much larger but also different in appearance from the male," being green, while the male is dark brown with a yellowish white stripe on the edge of the wing, and the lateral lobe of the pronotum. On the disc of the pronotum of the female is a central light brown band bordered by darker brown; underwings of both sexes are black. The male antennae are slender and slightly thickened at the apex (Fig. 4 C). Eggs,
overwinter, forty-five per set; nymphs, spring to August or even October, adults, June to October.

While the females are rather slow, the males are very active, and stridulate loudly, making a sound described by Tinkham as tsck-a-tsck-a-tsck. Most common in tall grass of the desert grassland but also in denser growth of northern grassland; often found in grass growing among shrubs on steep, rocky hillsides. Since the food consists almost entirely of grasses, damage to range is sometimes considerable.

Lower and Upper Sonoran zones from 2,000 to 6,800 feet; southeastern Arizona north to Springerville and Coconino County, south of the Grand Canyon.

Arizona to Texas and southern Colorado.

Genus *Opeia* McNeill. Antennae flattened, sword-shaped; but not so much so as in *Mermiria*; wings reduced, much shorter than abdomen in female, and not exceeding it in male; lateral carinae on pronotum parallel.

*Opeia obscura* (Thomas). (Hebard, 1937b, places *O. testacea* under this species.) Length: male, % in.; female, 1 in.; light green; wings somewhat reduced; caudal tibial spurs very unequal; postocular band on side of head and pronotum brown, bordered on top with yellow; often quite narrow (Fig. 3 A). Eggs, overwinter, twenty per set; nymphs, March to October; adults, April to October.

A very common and sometimes destructive grasshopper in alfalfa, grains, and Bermuda grass in cultivated areas, especially in the Yuma and Salt River districts. Also common in thicker stands of grass in the Lower Sonoran Zone and in sparse, short grasses of the Upper Sonoran and lower Transition zones. An important range grasshopper in the northern short grassland and great plains. Feeds on a wide variety of grasses, especially of the genera *Bouteloua*, *Sporobolus*, *Distichlis*, and *Muhlenbergia*.

Found in all Arizona, except highest elevations; north to Montana.

*Opeia atascosa* Hebard. Caudal tibial spurs nearly equal. A rare species known only from a limited area in extreme southern Arizona (Hebard, 1937b, p. 354). The types were taken by Hebard at Atascosa Peak and north of Montana Peak in the Tumacacori Mountains, in the oak belt of the Upper Sonoran Zone, in September. Occurs quite widely in this region, from 4,500 to 6,500 feet, from May through October. One specimen from the Santa Rita Mountains (Flock). Feeds on tall range grasses such as *Elyonurus barbiculmis* and *Bouteloua curtipendula*.

*Amblytropidia mysteca* Saussure. Length, about 1 in.; brown or grayish; outer wings uniformly brown; underwings amber; sides of head and pronotum very dark brown; top of head, pronotum, and wings, light brown. Adults, in winter.

Probably feeds on grasses, but there is one record (Ball) from the composite *Trixis californica*. A rare and wary species found only in the oak belt of the Upper Sonoran Zone from the Babo-
quivari, Tumacacori, and Santa Rita mountains, Arizona, to southwest Texas.

Orizaba, Sinaloa, Jalisco, Vera Cruz, and Morelos, Mexico.

*Amphitornus coloradus ornatus* McNeill. Length: male, % in.; female, 1 in.; dull brown; antennae slightly flattened; fine yellow bars on sides of pronotum; hind femora with two black bars; head and pronotum with or without dorsal light stripe (Fig. 3 C). Adults, July to September.

Widely distributed in Upper Sonoran grasslands and Transition Zone. Recorded also from Lower Sonoran Zone (Phoenix) by Hebard. Feeds primarily on grass and is at times very abundant on the range, especially in the northern grasslands.

Southeastern Arizona and the Plateau region north to Ashfork and Aubrey Valley; north to Canada, east to Texas.

*Amphitornus coloradus saltator* Hebard. Similar to *A. coloradus ornatus* but with short wings, leaving end of abdomen exposed (Hebard, 1937b, p. 357). A race of high elevations, taken in the Transition Zone of San Francisco Mountain, September 8, 1932, by Ball; and in the juniper-piñon association of the Upper Sonoran Zone of the Kaibab Plateau by Rehn and Hebard.

Arizona to Utah and Nevada.

*Eritettix variabilis* Bruner. Length: male, % in.; female, % in.; small; brown; light central line on head; pronotum with dark brown bands, constricted at center of the pronotum (Fig. 3, D).

Feeds on many grasses, including *Muhlenbergia emersleyi*, *M. torreyi*, *Hilaria belangeri*, and *Bouteloua* spp. Widespread but rarely abundant in the desert grassland and northern grassland of the Upper Sonoran and lower Transition zones.

Arizona and New Mexico to southwestern Texas.

*Phlibostroma quadrimaculatum* (Thomas). Length: male, \( \frac{1}{2} \) in.; female, 1 in.; greenish, with yellow and black markings; wings reduced; four crenulate markings on fore wings are distinctive; head large and nearly vertical. Eggs, about twelve per pod; adults, July to September.

A fairly important range grasshopper of the dry, short grass areas in the Upper Sonoran and Transition zones of northern Arizona; Yavapai, Coconino, Navajo, and Apache counties.

Prairie provinces of Canada south to Mexico east of the Rockies.

Genus *Cordillacris*. Small, slender, buff colored, with brown markings; wings reaching to end of abdomen; head slanting; antennae slightly flattened.

1a. Outer wings with dark brown center, with about seven scallops or crenulate markings; cheeks less inflated; smaller.

*Cordillacris crenulata pima*

1b. Outer wings without solid brown center and scallops; cheeks more inflated; larger.

*Cordillacris occipitalis* (Thomas) (S. W. phase). Length: male, % in.; female, % in. Eggs, overwinter, four to six per set; adults, June to August.
Occurs on shallow, sandy or gravelly soil covered with scanty growth of short grasses and weeds, in the Upper Sonoran and Transition zones at elevations from 4,000 to 9,000 feet. Most common on Mogollon Plateau, but found south to Naco, on the Mexican boundary.

Arizona to the Great Basin.

*Cordillarcris crenulata pima* Rehn. Length: male, 9/16 in.; female, % in. (Fig. 4 A). Eggs, four per pod; adults, May to September. (Rehn, 1907, p. 69.)

One of the most common grasshoppers in dryer areas where soil is thinner and grass more parched. Usually in dryer situations and at lower elevations than *C. occipitalis*. It is especially common on grama grass (*Bouteloua*) range. One of the important grasshoppers in preventing reseeding of grass on the range.

Upper Sonoran Zone and fringe of Transition Zone of southeastern Arizona, north to Yavapai, Coconino (Grand Canyon), and Apache counties. The type locality of this form is the Baboquivari Mountains.

Widely distributed in the west.

Genus *Orphulella* Gigliotos. Length: male, % in.; female, 1 in.; beautiful green and brown; wings longer than abdomen, with brown stripe; from compound eye along head and lateral carinae of pronotum a narrow dark stripe bordered inside with light yellow; antennae not flattened as in the similar species *Opeia obscura*. (Gurney, 1940.)

*Orphulella compta* Scudder. Green desert grasshopper. Eggs overwinter, average fourteen per pod; adults, from May 20 to November 14.

This is a common species in Arizona in the Lower Sonoran valleys, especially in irrigated areas. Very abundant in Bermuda grass and alfalfa, and occasionally in barley and other field crops. May be considered a fairly important economic species in both the cultivated areas and lower grazing lands; not important in the higher desert grassland, however. In the desert it is usually found to be locally abundant in moist areas, especially along streams and near waterholes; on grasses such as *Distichlis* and *Sporobolus*.

From sea level to 4,000 feet in southern California, Arizona, Utah, and Nevada. Littlefield is the most northern record for the state.

*Orphulella pelidna desereta* Scudder. The wings are shorter, extending to the tips of the hind femora.

On the northern short grassland often in areas of thin soil and sparse grass, but more often in light soil where the grass is thicker, or in salt grass (*Distichlis*). One of the important range grasshoppers in some areas. St. Johns, Springerville, and Lupton, Arizona (Ball).

Northeastern Arizona and northwestern Texas, north to western Montana, and west to the Pacific.
Neopodismopsis abdominalis (Thomas). Length: male, \( \frac{3}{4} \text{ in.} \), wings, \( \frac{1}{2} \text{ in.} \), but not exceeding abdomen; female, about 1 in., wings, \( \frac{1}{2} \text{ in.} \); antennae not thickened at end; lateral foveolae not well marked. Eggs, eight per set.

A rare grasshopper found at the highest elevations of the Canadian and Hudsonian zones of the Mogollon Plateau, in mountain meadows and lush grasses. San Francisco Mountain (Ball), Alpine, and 19 miles west of Springerville (Tinkham). Widespread in the northwestern United States.

Acantherus piperatus Scudder. Length: male, \( \frac{3}{4} \text{ in.} \); female, 1 1/8 in.; dark brownish gray; sides of head and pronotum yellow; antennae long, flattened, black with yellow tips. Adults, June to October.

Rocky hillsides and ridges, from 2,000 to 4,500 feet. Tall grasses under spiny shrubs and trees from saguaro-palo verde to lower live oak associations in the Sonoran zones. Southeastern Arizona west to Ajo (Hebard) and northwest to Yarnell Heights, Yavapai County (Tinkham).

Horesidotes cinereus Scudder. Length: male, \( \frac{3}{4} \text{ in.} \); female, 1 in.; similar in appearance to Acantherus piperatus, but light-colored antennae shorter, less flattened; lateral lobes of pronotum at dorsal edge of a length equal to depth; lateral carinae of pronotum often with white line and more constricted, showing angulation; internal spurs of hind tibiae decidedly unequal. Nymphs, March to July; adults, June to October.

Occurs on grass under shrubs on rocky hillsides, though feeding to some extent on plants other than grasses, such as Callianandra and Haplopappus.

Lower Sonoran Zone desert up to lower edge of oak belt, southern Arizona to southern California; north to Bradshaw Mountains in Yavapai County.

Chorthippus longicornis Latreille. Length: male, \( \frac{5}{8} \text{ in.} \); female, \( \frac{7}{8} \text{ in.} \); antennae simple; a short-winged grasshopper resembling Neopodismopsis abdominalis, but with lateral foveolae sharply outlined by a ridge above. Eight eggs per pod; adults, July to October in Chiricahua Mountains; August and September in north.

Found injurious in a hay meadow at Nutrioso (Tinkham), but usually in mountain meadows of grass or iris (Iris missouriensis). A high mountain species of the Canadian and Hudsonian zones in the Chiricahua, San Francisco, Blue Ridge, and White mountains at elevations above 9,000 feet.

Widespread in the northern part of North America and Europe.

Aeropedellus clavatus (Thomas). Length: male, \( \frac{5}{8} \text{ in.} \); female, \( \frac{7}{8} \text{ in.} \); distinguished by club-shaped antennae; female very short-winged. Adults, June to September.

Found in mountain meadows, apparently feeding on a large number of herbs, sedges, and grasses. Canadian Zone and higher, at 9,000 to 10,500 feet on the Mogollon Plateau, Arizona, to great plains and north to Alaska.
Genus *Psoloessa* Scudder. Small; brown and buff; head vertical; hind tibiae pale in color. Common on sparsely covered range land in the early season.

1a. Small; lower half of pronotal lobe light colored; costa on face shallowly grooved. Common, *Psoloessa texana pusilla*

1b. Larger species; lower half of side of pronotum not contrastingly marked; costa distinctly grooved. Less common, *Psoloessa delicatula*

*Psoloessa texana pusilla* Scudder. Length: male, % in.; female, % in. (Fig. 3 B). Nymphs overwinter or hatch mainly during fall and winter; adults, April to September.

One of the most widespread and abundant grasshoppers in the state. It never reaches such great numbers locally as some other species, but is very important on the range because it feeds to a large extent on germinating seeds and thus prevents revegetation of the range.

Found in dry, parched, or overgrazed areas of short grass. Most common in desert grasslands of Lower Sonoran and Upper Sonoran zones south of the Mogollon Plateau; 2,000 to 8,000 feet. North of the Mogollon Plateau and in the Transition Zone, this species is rather rare.

*Psoloessa delicatula* Scudder. Length: male, 11/16 in.; female, % in.

This early season grasshopper is found in greatest abundance in short grasslands, usually where the growth is sparse and the soil thin. Found at higher elevations and in more northern locations than is *Psoloessa texana*; grasslands of Upper Sonoran, Transition, and Canadian zones from 4,000 to 9,500 feet, over all of Arizona.

A Great Plains species found north to Canada and east to Nebraska, South Dakota, and Kansas.

*Rhammatoecerus viatoria* Saussure. Length: male, 1 1/4 in.; female, 1% in.; large, graceful, long-winged; head with conspicuous yellow center stripe continued along pronotum and wings. Eggs, thirty to fifty-eight per set, June and July, hatching in summer; adults may be found from early October through winter, spring, and summer, into August.

Most common in Upper Sonoran Zone grasslands at from 4,000 to 5,500 feet, but also occurs on small, desert hills to about 2,100 feet elevation.

Southeastern Arizona west to the Catalina and Baboquivari mountains. Most abundant in the Baboquivari, Santa Rita, and Tumacacori mountains.

East to Texas (Tinkham), and south to Mexico, Honduras, Guatemala, and Costa Rica.

*Ageneotettix deorum* Scudder. “White whiskers.” Length: male, % in.; female, % in.; antennae conspicuously white or light colored; hind tibiae bright red; markings on pronotum variable (Fig. 3 E). Eggs overwinter, eight to nineteen per pod, hatch April; adults, June to November.
This species, one of the most important range and grassland grasshoppers, is widely distributed, though seldom extremely abundant, in the short grass grasslands, especially in the Upper Sonoran Zone. It appears to feed on low plants other than grasses to some extent, unlike many other species of this subfamily.

Lower Sonoran (desert grassland), Upper Sonoran and Transition zones. Eastern Arizona west to Baboquivari and Quinlan mountains, north to Yavapai and Coconino counties.

Arizona to Texas, Canada, the plains and north central states. *Ageneotettix deorum curtipennis* Bruner. Adults, June 29 to September 11.

A short-winged race found at higher elevations in many localities in the Upper Sonoran and Transition zones on the Mogollon Plateau, in Yavapai County, and in the Huachuca Mountains of southern Arizona. Usually in grasses such as *Bouteloua, Hilaria,* and *Hordeum.*

Arizona and southwestern Colorado.

*Zapata salutaris* Rehn. Length: male, % in.; female, % in.; posterior margin of pronotum subtruncate; apex of front not rounded but subacute; hind tibiae dull pink. Nymphs, August; adults, August and September. (Rehn, 1927, p. 221.)

A small, rare grasshopper, very hard to catch. Taken in the saguaro-palo verde association among grasses on bare, rocky slopes in Lower Sonoran Zone.

Catalina Mountains, Tucson Mountains at Tumamoc Hill (type); west to the Ajo (Rehn) and Saucedas mountains (Tinkham).

*Drepanopterna femoratum* (Scudder). White cross grasshopper. Length: male, % in. (Fig. 5 C); female, 1 in. (Fig. 5 D); marked with contrasting areas of black; tibiae blue; posterior margin of eighth ventral abdominal segment of female strongly bisinuate. Two white diagonal marks on pronotum suggest the name. Eggs overwinter, six to nineteen per pod; nymphs, June to August; adults, June to October.

One of the three most important range grasshoppers in Arizona. Typically a desert grassland and Upper Sonoran Zone species at 3,500 to 6,800 feet.

Widely distributed in Arizona, and on the plains from Canada to Durango, Mexico.

*Aulocara elliotti* Thomas. Elliott grasshopper. Length: male, % in.; female, 1½ in.; similar to *Drepanopterna,* but colors less contrasted; sternum of eighth abdominal segment of female only weakly bisinuate; hind tibiae blue (Fig. 4 D). Eggs overwinter, average eight per pod; nymphs, late March to July; adults, May through September.

At times one of the most injurious range grasshoppers in Arizona, most common in short grass. It has been especially serious in the region of Bonita, Graham County, where the grama grass was almost destroyed; also important on the Mogollon Plateau. Desert grasslands of the Lower and Upper Sonoran zones, and
less commonly in Transition and Canadian zones. A very common species in Arizona and on the prairies north to Canada.

_Heliaula rufa_ (Scudder). Length: male, \( \frac{5}{8} \) in.; female, 1 in.; cream or reddish, with small, brown markings; hind tibiae pink. Adults, June to October.

Usually on slopes or small hills with thin, rocky, or gravelly soils. Rather uncommon and not apt to be of any economic importance. Upper part of the desert and Upper Sonoran Zone in southeastern Arizona, at 2,000 to 7,000 feet; west to Baboquivari, Quinlan, and Cobabi mountains (Tinkham), and north to Springerville.

_Widespread on western plains and in Southwest._

_Morseiella flaviventris_ (Bruner). "Whoopee." Length: male, 7/8 in. (Fig. 5 E); female, 1% in. (Fig. 5 F); tibiae bright red, with black and yellow rings at the base; disc of vertex outlined by carinae; sexes alike in color. Adults, August to October; nymphs, July to September; sixteen to forty-five eggs per pod.

Where found, this species is the most important range grasshopper next to _Boopedon_, to which it is similar in many respects. At times it is the most abundant species and has been especially destructive on the fine range land of the Ronstadt ranch near the Baboquivari Mountains.

This species is especially common in _Aristida_, grama grass (_Boutelouaasp._), and _Andropogon scoparius_ in swales in the desert grassland but is sometimes found in dense growths of sacaton grass (_Sporobolus wrightii_) or Bermuda grass (_Cynodon dactylon_). At Arlvaca one infestation was found to average two adults per square foot.

Southeastern Arizona west to the Quinlan, Baboquivari, and Catalina mountains, and north to the Dragoon Mountains.

_Arizona and Mexico._

_Boopedon nubilum_ (Say). "Boopee." Length: male, 1 in. (Fig. 5 B); female, 1% in. (Fig. 5 A). Male small, shining black, with bluish clear wings; female typically green and brown (rarely black), large, short-winged; hind tibiae rose-colored. Eggs, fourteen to fifty-two per pod; adults, August through October.

One of the most common and conspicuous of Arizona grassland species, this is probably the most important range grasshopper in southern Arizona. The small, black males are very active and conspicuous, while the larger females, unable to fly, remain in the grass and are not readily seen.

More common in areas of _Andropogon_, _Aristida_, and other tall grasses, than in areas of curly mesquite (_Hilaria_) and _Bouteloua_. Also found in cultivated areas on corn, sorghum, and wheat, and grass weeds such as Johnson grass (_Sorghum halepense_) and _Echinochloa_. Common in southeastern Arizona west to the Quinlan Mountains at from 2,200 to 5,500 feet.

North to Montana, South Dakota, and Nebraska, and east to Texas.
Ligurotettix coquilletti kunzei Caudell. Desert clicker. Length: male, ¾ in.; female, 1 in.; costal area of the wing greatly dilated, especially in males. Eggs, twelve per pod; adults, June to October.

A slender, long-winged, ordinary looking, gray grasshopper, much resembling some of the Oedipodinae. Found in the desert on such plants as creosote bush (Larrea divaricata), Lycium, mesquite (Prosopis), Atriplex, bur sage (Franseria deltoidea), and Franseria dumosa. It is secretive and hard to find, though the sound of its stridulation is one of the most familiar daytime noises on the desert. The sound is as loud and sustained as in some of the cicadas and has a ventriloquistic quality. The adults are usually found on creosote bush, but the eggs are laid with no particular reference to this plant, and the young nymphs feed to a large extent on spring and summer annuals.

Southern Arizona north to near Kingman. Type locality, Phoenix.

Ligurotettix coquilletti McNeill. Taken by Ball at Littlefield, and recorded by Rehn (1923) south to Kingman. Usually found above the creosote belt on Franseria dumosa. Smaller than L. coquilletti kunzei.

Mohave Desert of Arizona, Nevada, and California.

SUBFAMILY OEDIPODINAE. BAND-WINGED GRASSHOPPERS

Many species of this subfamily have bright red, orange, yellow, yellow-green, or black bands on the hind wings. The wings are always long, and there is no spine between the front legs. The face is nearly vertical and rounded at its junction with the vertex. The median carina or keel of the pronotum is raised into a sharp ridge or crest and is usually cut by one or more grooves. When in flight these are very conspicuous insects, but at rest with the wings closed the usual brown or gray color harmonizes closely with the rocky soil upon which they are usually found. Some of species are made still more conspicuous by the harsh crackling or rattling noise made while on the wing by the males, or, in a few cases, by the females. A few make sounds when at rest by rubbing the hind legs against the outer wings.

The group occurs over most of the world but the largest number of species is found in the more arid parts of the west. Many are found on the desert, others in stony arroyo beds, in grasslands, and in forested areas, but the usual habitat is stony soil with sparse vegetation. Very few are of any great importance as pests of cultivated crops but are more important on the range. Since many of the species are abundant on very sparsely vegetated land, they may be of major importance in preventing revegetation of overgrazed land.
KEY TO ARIZONA GENERA OF OEDIPODINAE (SEE FIG. 6)

1. Median carina of pronotum distinct; cut by one sulcus or appearing entire. .......................... 2
   Median carina of pronotum indistinct in middle portion or cut by two sulci ........................................ 12
2. Hind wings nearly transparent; size small ................................................................. 3
   Hind wings colored ...................................................................................................... 4
3. Fore wings marked with three dark bands; lateral carinae of pronotum not continuous; widespread.
   Encoptolophus (p. 303)
   Fore wings irregularly marked; lateral carinae of pronotum continuous; northern.
   Camnula (p. 303)
4. Disc of hind wing black.
   Dissosteira (p. 307)
   Disc of hind wing not black .......................................................................................... 5
5. Body color dark; wing disc bright red to yellow; interspace between metasternal foramina narrow,
   Arphia (p. 301)
   Body color lighter and usually mottled; wing disc orange red to yellow; interspace between foramina broad ............................................................. 6
6. Disc of hind wing yellow ............................................................................................... 7
   Disc of hind wing orange or orange red ........................................................................ 10
7. Hind tibiae red.
   Spharagemon (p. 308)
   Hind tibiae not red ...................................................................................................... 8
8. Vertex rounded; form robust.
   Hippiscus (p. 305)
   Vertex with a definite depression; form slender .................................................................. 9
9. Median carina of pronotum high; sulcus distinct.
   Lactista (p. 308)
   Median carina of pronotum low; sulcus shallow.
   Platylactista (p. 308)
10. Median carina of pronotum arcuate and toothed.
    Tropidolophus (p. 307)
    Median carina of pronotum cut by one sulcus .................................................................. 11
11. Color brown; size large.
    Tomonotus (p. 309)
    Color green with black spots; size small.
    Scirtetica (p. 308)
12. Posterior margin of pronotum broadly rounded or slightly angulate; median carina obsolete on central portion; black band lacking on hind wings ................................................................. 24
    Posterior margin of pronotum angulate; median carina distinct; black band present on hind wing ........................................................................................................... 13
13. Size large; form robust; median carina of pronotum cut by two sulci, the anterior one of which is shallow, lateral carinae long and cut by the posterior sulcus ........................................................................................................ 14
    Size small; form slender; median carinae cut by two nearly equal sulci; lateral carinae of pronotum indistinct or not cut by the posterior sulci ........................................................................ 16
14. Wing disc yellow; median carina of pronotum distinct.................15
   Wing disc yellowish green or blue; median carina of pronotum slight.  
   *Lepus* (p. 306)
15. Fore and hind margins of lateral lobes of pronotum nearly parallel. 
   *Xanthippus* (p. 305)
   Hind margin of lateral lobe of pronotum slightly produced below.   
   *Cratypedes* (p. 306)
16. Posterior angle of lateral lobe of pronotum rounded; with or without 
   a tooth.................................................................17
   Posterior angle of lateral lobe acutely produced.............................26
17. Posterior angle of lateral lobe of pronotum with a tooth..............18
   Posterior angle of lateral lobe without tooth.................................20
18. Disc of hind wing rose red; lateral elevations present adjacent to the 
   median carina of the pronotum.                                       
   *Trepidulus* (p. 309)
   Disc of hind wing not red; lateral elevations of pronotum not 
   present...........................................................................19
19. Median carina on the posterior portion of pronotum elevated.       
   *Conozoa* (p. 312)
   Median carina on metastoma very low.                                 
   *Trimerotropis* (p. 312)
20. Metazona rugose-tuberculate; lateral prominences present near median 
   carina of pronotum.                                                 
   *Derotmema* (p. 309)
   Pronotum smooth or with scattered granulations.                     
21. Median carina of pronotum cut nearly in the middle by posterior 
   sulcus; sides of pronotum marked with black.                       
   *Mestobregma* (p. 311)
   Median carina of pronotum cut considerably before the middle by 
   posterior sulcus..........................................................22
22. Form robust; antennae long; inner face of hind femora bluish black. 
   *Hadrotettix* (p. 317)
   Form slender; antennae of normal length; inner face of hind femora 
   not bluish..................................................................23
   *Trimerotropis* (p. 312)
   Anal veins of hind wings strongly reinforced; hind margin of wing 
   not evenly rounded.                                                
   *Circotettix* (p. 317)
24. Median carina of pronotum very low; pronotum slightly saddle-shaped. 
   *Rehnita* (p. 310)
   Median carina of pronotum strongly carinate..................................25
25. Size larger; median carina of pronotum high; inner face of hind femora 
   marked with blue; northern.                                        
   *Metator* (p. 311)
   Size medium; median carina of pronotum moderately high; no blue 
   present on hind femora; widespread.                               
   *Trachyrhachis* (p. 310)
26. Posterior margin of pronotum rounded.....................................27
   Posterior margin of pronotum angulate......................................29
27. Size large, over ½ inch; internal calcariae of hind tibiae subequal. *Anconia* (p. 318)

Size small, less than ½ inch; internal calcariae of hind tibiae very long, about twice the length of the outer calcariae. 28

28. Posterior angles of lateral lobes of pronotum broadly rounded. *Xeracris* (p. 319)

Posterior angles of lateral lobes of pronotum produced. *Coniana* (p. 318)

29. Disc of hind wings rose red; fore wings marked with dark band at base. *Heliastus* (p. 318)

Disc of hind wings pale yellow; fore wings marked with small dark spots. *Cibolacris* (p. 318)

Genus *Arphia* Stal. Underwings yellow or red, bordered with black; median carina of pronotum slightly notched near the middle; interspace between metasternal lobes longer than wide.

*Arphia aberrans* Bruner. Length: male, 1 in.; female, 1½ in.; grayish brown, mottled with dark brown and black; fore wings with pale dorsal stripe; hind wings yellow, red, or pale yellowish green with black outer band; tibiae of hind legs pale blue, with white basal annulus. Eggs, about twenty-four per pod, hatch in fall; nymphs overwinter; adults, May and June, but taken from March 21 to November 17.

Typical of limestone hills and rocky hillsides. Most common in the Upper Sonoran Zone but taken* from 258 feet to 9,200 feet elevation. Southern Arizona west to Wellton and north to Prescott, Williamson Valley, and the Pinal Mountains. Type locality, Huachuca Mountains.

Arizona to Texas.

*Arphia conspersa* Scudder. Length: male, 1 in.; female, 1½ in.; dark grayish brown; fore wings with pale dorsal stripe; hind wings bright yellow, with outer black band; pronotum rather long, finely rugose, median carina moderately elevated; tibiae of hind legs pale yellowish white with bluish tint in northeastern specimens. Eggs, thirteen to twenty per pod, early summer; nymphs overwinter; adults, May and June. Some old adults may be found as late as August.

Open grasslands and meadows of Canadian and upper Transition zones, south to the Chiricahua Mountains, and north to the Lukachukai Mountains, Ashfork, and the Kaibab Plateau.

Arizona to Canada and Alaska.

*Arphia pseudoneitana crassa* Bruner. Length: male, 1½ in.; female, 1¾ in.; black or dark brown; hind wings bright red, with black outer band; femora of hind legs black; form robust. A clicking noise is made in flight. Overwinters in egg, about forty per pod; nymphs, July to September; adults, June 20 to December 7, commonest in September.

One of the more common and most conspicuous grasshoppers in the Arizona grasslands; a fairly important range grasshopper,
Figure 6.—Heads and pronotums of band-winged grasshoppers, drawn to same scale: 1, Hippiscus rugosus; 2, Pedioscirtetes nevadensis; 3, Leprus cyaneus; 4, Hadrotettix trifasciatus; 5, Cibolacris parviceps gridus; 6, Tomonotus ferruginosus; 7, Arphia pseudonietana crassa; 8, Metator pardalinus; 9, Mestobregma plattei, rubripenne; 10, Trachyrhachis mexicana; 11, Trepidulus rosaceus; 12, Spharagemon collare; 13, Scirtetica ritensis; 14, Deromema haydenii laticinctum; 15, Xeracris minimus; 16, Camnula pellucida; 17, Rehnita gracilipes; 18, Platylactista aztecus; 19, Lactista oslari; 20, Conozoa carinala; 21, Heliastus benjamini; 22, Phrynotettix tschivavensis; 23, Coniana snowii; 24, Anconia integra; 25, Thyithotyle maculata.
feeding largely on grass. Most common in southern Arizona desert grassland of the Lower Sonoran Zone but extending through the Upper Sonoran into the Transition Zone.

Arizona to Texas and Mexico.


Arizona to northern prairie states, Canada, and Mexico.

Genus _Encoptolophus_ Scudder. Small brownish species; fore wings with three dark bands on a lighter background; underwings nearly transparent, smoky near the edge; median carina of pronotum with a notch cutting it nearly in the middle.

*Encoptolophus pallidus pallidus* Bruner. A pale form with slender hind femora recorded from the desert at Quitobaquita and Wellton by Hebard.

Arizona to California and Nevada.

*Encoptolophus pallidus subgracilis* Caudell. (Fig. 7 C.) Length: male, \( \frac{7}{8} \) in.; female, 1 in.; overwinters to some extent in all stages; eggs deposited in pods of fourteen to eighteen over a long season; adults, March to December, commonest in August.

A very common species in cultivated fields in the irrigated regions of southern Arizona and in damper areas on the desert and into the desert grassland. Feeds mostly on grasses but causes some damage to crops, especially alfalfa and truck crops.

*Encoptolophus sordidus costalis* Scudder. Length: male, \( \frac{7}{8} \) in.; female, 1 in.; darker than *Encoptolophus pallidus*; body more compressed and deeper through thorax; median carina of pronotum well developed. Adults, August to October.

A common species in the grasslands of Arizona from Douglas to Ashfork and Lupton. Upper and Lower Sonoran zones. Feeds to a large extent on range grasses but is also important at times in cultivated areas, especially in alfalfa fields.

Arizona to Texas and Canada.

_Camnula pellucida_ (Scudder). Clear-winged grasshopper. Length: male, \( \% \) in.; female, 1 in.; pale brown with darker brown markings; hind tibiae yellow; fore wings with irregular markings; hind wings transparent; pronotum with distinct median and lateral carinae; median carina slightly notched before middle; lateral lobe of pronotum with large black spot in front. Overwinters in egg stage; pods of ten to twenty-five eggs, short, stout, slightly curved, often concentrated in favorable dry areas with scanty vegetation, may be laid in matted roots of grasses. Nymphs dark with white stripes on sides of head and lateral lobes of pronotum, not common after mid-July; adults, June 6 to September 9.

A very important range grasshopper in limited areas. The nymphs may migrate in swarms for which reason the species is often called the "warrior grasshopper." The adults may take flight in swarms but do not migrate for great distances. The species may move into cultivated areas and cause very serious damage to vegetables and other crops, particularly grain. Range
grasses are the most important food, but barren or overgrazed land is preferred for egg deposition. Control consists of finding the egg laying sites and poisoning the nymphs before they have become dispersed.

High elevations, usually above 7,500 feet, in the Transition and Canadian zones. Northern Arizona south to Springerville and the
White Mountains. Most common in mountain meadows of the Canadian Zone, but extending into alkali areas in the Upper Sonoran Zone.

Arizona to California and southern Canada.

*Hippiscus rugosus* (Scudder). Length: male, 1% in.; female, 2 in.; large; robust; a low broad median carina; light to dark brown; fore wing slightly shorter than abdomen in female, straw colored with dark brown markings; hind wing with pale yellow disc, a black band, and transparent apex; hind tibiae yellow; vertex convex; disc poorly defined. Overwinters in egg or adult stage; eggs deposited September to April, commonest September to November.

Feeds on range grasses almost entirely but is not abundant enough to be very important. Upper Sonoran Zone in the live oak association in tall grass on rather dry hillsides. Taken in Arizona only from Patagonia and Nogales to the Tumacacori Mountains and Canelo Hills.

Arizona to Montana and the Atlantic Coast.

Genus *Xanthippus* Saussure. Large robust grasshoppers; light and dark brown in color; fore wings marked with fuscous; hind wings with yellow disc, black band, and transparent apex; hind tibiae coral red; head blue at base beneath edge of pronotum. An important group of range grasshoppers.

*Xanthippus corallipes* corallipes (Haldeman). "Red shanks." (Fig. 7 D.) Length: male, 1% in.; female, 2 in.; fore wings longer than body, well defined markings full length but narrowed at anal vein. Nymphs overwinter; eggs, six to eighty-four in large pods in bare or exposed areas; adults, April to September, most common early in season.

A very common and destructive range grasshopper in the desert grassland of southern Arizona but also widely distributed in the state. Nymphs most common in exposed and overgrazed areas, but adults may move into gram fields and tall grass; in swales and low flats of Sacaton grass (*Sporobolus wrightii*). Lower Sonoran Zone above 3,500 feet and Upper Sonoran Zone.

Arizona to Utah, New Mexico, and Mexico.

*Xanthippus corallipes panthermus* (Scudder). Similar to *X. c. corallipes*, but with inner surface of hind femur bluish black in color.

Southeastern Arizona at Douglas and Huachuca Mountains (Hebard, 1935c, p. 289).

Arizona to Texas and southern Great Plains.

*Xanthippus corallipes* leprosus Saussure. Length: male, 1% in.; female, 1% in. Darker than *X. c. corallipes*; markings on fore wings fewer and sometimes blurred.

Upper Sonoran, Transition, and Canadian zones in the grasslands. The specimens taken at lower elevations tend to intergrade with *X. c. corallipes*. Coconino County, Kaibab Plateau, Hualapai Mountains; Mohave and Yavapai counties to Apache County.

Arizona to Utah, New Mexico, and Wyoming.
Xanthippus corallipes altivolus Scudder. Length: male, 1 in.; female, 1½ in.; color dark; markings on fore wings more extensive, fused longitudinally, banding nearly absent; wings shorter than abdomen in females. Nymphs overwinter; adults April to July. Females contained twenty-four to sixty-four eggs.

Grasslands at high elevations and on mountain tops in Hudsonian, Canadian, and Transition zones. Santa Catalina, Pinaleno, and Tumacacori mountains (atypical toward X. leprosus) north to the White Mountains, Long Valley, Flagstaff, Lukachukai Mountains (atypical) and Kaibab Plateau (atypical). Usually above 8,500 feet, but the short-winged condition is found at lower elevations on steep mountain tops.

Arizona and New Mexico.

Xanthippus corallipes cupidus Scudder. Length: male, 1% in.; female, 1% in.; robust; wings of female shorter than abdomen; pronotum buff in females, darker in males. Eggs, twenty-eight to thirty-four, overwinter; adults April 23 to July 16.

Typical material taken at 7,500 on the Pinal Mountains in a small grass plot around a pump; atypical material Granite Dells, Yavapai County.

Xanthippus affrictus Scudder. Large; long-winged; fuscous markings on fore wings absent on apical one fourth. Described from two specimens from Yuma, not taken since.

Xanthippus montanus (Thomas). Length: male, 1% in.; female, 1% in.; slender; fuscous markings on fore wings fused together into longitudinal patches; depression of vertex deep, rough, and sharply defined; posterior margin of pronotum sharp. Nymphs overwinter; adults, June 22 to 29.

Sandy areas with light grass and greasewood (Sarcobatus sp.) in the Upper Sonoran Zone. Red Rock, Gap, and Red Lake (Ball), and Holbrook (Hebard), in northeastern Arizona, Arizona to Montana, South Dakota, and Kansas.

Cratypedes neglectus (Thomas). Length: male, 1% in.; female, 1½ in.; very dark; fore wing with indistinct bands and pale dorsal stripe; lateral lobes of pronotum slightly wider below than in the middle; hind wing with yellow disc and black border, spur extending halfway to base, and transparent apex; hind tibiae bright red. Nymphs overwinter; adults, June 22 to September 6.

A rather uncommon species in the grasslands of northern Arizona. Feeds on range grasses and, rarely, cultivated grain. Canadian and Transition zones, downward on the Kaibab Plateau into Upper Sonoran Zone. Dry grasses in mountain meadows and openings in coniferous forests and aspen groves. Kaibab Plateau to the Lukachukai Mountains and Bright Angel Point on south rim of Grand Canyon.

Western United States to Canada and New Mexico.

Genus Leprus Saussure. Large robust gray or brown grasshoppers with fuscous markings; fore wings with dark bands; hind wing with a blue or greenish yellow disc and black band; pronotum rugose, with median carina indefinite; hind tibiae bluish.
Leprus cyaneus Cockerell. (Atypical.) Length: male, $1\frac{1}{4}$ in.; female, $1\%$ in.; color grayish; fore wings regularly banded; wing disc blue; undersurface of thorax tinged with blue; lateral lobe of pronotum slightly wider. Overwinters in nymph or egg stage; average six-four eggs; adults, March 19 to September 16.

A fairly common early season species on rocky hillsides and ridges, also found to some extent in bare areas in the grassland. Lower and Upper Sonoran zones in southern Arizona, west to the Ajo Mountains (Ball). Tinkham records typical specimens from Springerville.

Arizona to Texas, Colorado, and Mexico.

Leprus glaucipennis Scudder. Length: male, $1\%$ in.; female, $1\%$ in.; fore wings somewhat irregularly banded; hind wings dark blue; lateral lobes of pronotum wider below; adults, July to September.

Northwestern Arizona south to Flagstaff and the Black River, in the Upper Sonoran Zone.

Arizona to California and Lower California.

Leprus interior Bruner. Length: male, $1\%$ in.; female, $1\%$ in.; slender; dark; fore wings banded to apex; hind wings blue; lateral lobes of pronotum not wider below.

St. Johns, Arizona, August 27, 1934 (Ball), in area sparsely covered with salt grass (Distichlis) and Panicum.

Arizona to Utah and Nevada.

Leprus robustus Hebard. Length: male, $1\frac{1}{2}$ in.; female, $1\%$ in.; reddish; fore wing regularly banded; hind wing pale bluish green; hind tibiae pale blue; lateral lobe of pronotum not widening below. Eggs, sixty-two to 110; overwinter; adults, August 29 to December 18.

A common species on bare rocky soil sparsely covered with grass, and rocky hillsides and ridges in the Lower and Upper Sonoran zones. Especially abundant in the desert grassland where it may be extremely destructive to range grasses.

Southeastern Arizona north to the Catalina Mountains and west to the Baboquivari Mountains. Type locality, San Bernardino Ranch, east of Douglas, Arizona.

Arizona to Texas.

Tropidolophus formosus (Say). Length: male, $1\frac{1}{2}$ in.; female, $1\%$ in.; green with reddish brown markings; pronotum high crested, with posterior margin toothed; hind wings with bright orange disc and imperfect black band. Overwinters in egg; nymphs, May, June; adults, June to August.

A beautiful and striking grasshopper of the desert grassland, where it is rather rare. Feeds largely on low growing Malvaceae such as Malvastrum and Sphaeralcea in areas of thick grass. Southeastern Arizona north to the Galiuro Mountains (Tinkham) and west to Willcox.

Arizona to Texas, Kansas, and Mexico.

Dissosteira Carolina linnaeus. Carolina grasshopper. Length: male, $1\frac{1}{2}$ in.; female, $1\%$ in.; brown or grayish brown; hind wings
black with narrow pale yellow border; median carina of pronotum high, deeply cut by one sulcus. Eggs deposited deeply in soft, dusty soil of valley floors; average fifty-two; adults, June to September.

Common in cultivated areas, pastures, and range land. Usually not abundant enough to warrant control but very easy to poison. In 1935 it was especially destructive to field beans in the vicinity of Flagstaff. Deep, dusty soil usually along the floors of valleys. Northern Arizona south to the White Mountains; also the Chiricahua Mountains (Flock). Transition and Upper Sonoran zones.

Widespread in the United States.

*Spharagemon collare* (Scudder). Length: male, 1¾ in.; female, 1% in.; grayish brown, marked with small darker patches; hind wings with yellow disc, black band, and pale apex; pronotum with median carina high and notched by a single sulcus; hind tibiae red. Overwinters in egg; adults, June to September.

Cultivated fields and grasslands in sandy areas in the Upper Sonoran and Transition zones. Most often taken in fields of wheat, oats, and other grain, and alfalfa. It is usually of little economic importance in the state, and probably feeds largely on grasses. Northern Arizona from Springerville to Williams and Williamson Valley.

*Scirtetica ritensis* Rehn. Lichen grasshopper. Length: male, 3 in.; female, 1 in.; greenish gray mottled with black; median carina of pronotum slightly raised and notched near middle; hind wings with orange disc, black border, and long spur. Overwinters in egg; eighteen to twenty per pod; adults, June to August. (Bull. Kans. Univ., 5:303, 1912.)

The nymphs and adults feed almost entirely on lichens in captivity (Tinkham). Its colors closely matching the lichens upon which it is found, this grasshopper is an outstanding example of concealing coloration.

Found only on lichen-covered cliffs and rock slides in the Santa Rita Mountains up to 8,700 feet, and on cliffs with northern exposure; also Sonoita Creek Canyon, near Patagonia (Flock).

*Lactista oslari* Caudell. Length: male, 1 in.; female, 1% in.; dark gray; cristation on pronotum low but distinct; median carina cut with one notch; wing with bright yellow disc, dark band, and dark tip; hind tibiae pale blue with pale basal ring. Overwinters in egg; adults, March to October, most common in June and July.

A rather rare grasshopper of the Lower Sonoran Zone. Most common on bare, rocky slopes in the palo verde-saguaro association. Southern Arizona north to Phoenix (Ball), and Yarnell Hill (Tinkham).

Arizona to California, New Mexico, and Mexico. Type locality, Nogales.

*Platy lactista aztecus* (Saussure). Length: male, % in.; female, 1 in.; cream or gray to reddish brown; fore wings with darker middle band in line with band on hind femora; median carina of pronotum very low and not cristate; wings with yellow disc and
black border. Eggs, six to twenty-five; overwinters in egg or nymph; adults, March to November.

One of the commonest grasshoppers of the Lower Sonoran Zone. Usually found on the desert but also found in dry, bare areas in the desert grasslands, where it is sometimes common enough to be destructive. Southern Arizona north to the Pinal Mountains.

Arizona to Texas and Mexico.

_Tomonotus ferruginosus_ Bruner. Length: male, 1 1/8 in.; female, 1 1/2 in.; tan or reddish brown; pronotum with median carina very strongly cristate; antennae flattened; wings with orange disc and black band; hind tibiae blue. Nymphs overwinter, September to May; adults, April to August.

The color very closely resembles that of dry oak leaves, and it is usually among them. Upper Sonoran Zone of southeastern Arizona in live oak belt. Chiricahua Mountains west to the Baboquivari Mountains, and north to the Catalina Mountains, Fort Grant (type), and the Pinal Mountains (Tinkham).

Southeastern Arizona to Mexico.

Genus _Derotmema_ Scudder. Small brownish grasshoppers with darker markings on the fore wings; pronotum with short ridges or rugae; median carina of pronotum with two lobes on the pronotum; fairly common on dry, hard, bare soil with sparse vegetation. Length: male, 3/8 in.; female, 1 in.

_Derotmema haydenii haydenii_ (Thomas). Dark; hind wings with disc yellow or red, a broad black band, and long spur; posterior margin of pronotum angulate; ridges on pronotum very large. Overwinters in egg; adults, July to September.

Upper Sonoran Zone of northern Arizona, south to Springerville and Prescott.

Arizona to Canada, on the plains.

_Derotmema haydenii laticinctum_ Scudder. Light brown; hind wings with yellow disc and narrow black band; posterior margin of pronotum rounded or obtuse-angulate; elevations on pronotum medium in size. Adults, July to December.

Lower Sonoran Zone, southern Arizona.

_Derotmema delicatulum_ Scudder. Very pale; hind wing with narrow black band not reaching fore or hind margin; median carina and ridges on the pronotum very low.

Extreme desert of Lower Sonoran Zone. Littlefield, Arizona, July 6 and 7, 1937 (Ball).

Arizona to California.

_Trepidulus rosaceus_ Scudder. Length: male, 3/8 in.; female, 1 1/4 in.; pronotum similar to _Derotmema_, but posterior and anterior angles of lateral lobes of pronotum toothed; wing with rose red disc, a cloudy band, and the apical half transparent with black veins. Overwinters in egg; adults, June to October.

Bare flats in the Lower Sonoran desert to lower edge of Upper Sonoran Zone. Yuma (type) and Willcox north to Fredonia (Ball).
Arizona to California, Nevada, and Utah.

*Rehnita gracilipes* (Caudell). Length: male, 7/8 in.; female, 1/2 in.; pale with distinct brown markings; pale stripe on head and fore wings; fore wings with large dark markings; pronotum subsellate; legs long, slender; hind wing with pale yellow disc and transparent apex. Overwinters in egg; adults, May to September, commonest June, July. (Caudell, 1905, p. 470; Hebard, 1935a, p. 56.)

Frequently taken at lights. Bare, dry, and often rocky areas in the Lower and Upper Sonoran zones. Southern Arizona north to Ashfork and the Black River. Type locality, Nogales.

Arizona to California.

Genus *Trachyrhachis* Scudder. Dark colored grasshoppers; median carina moderately high, deeply cut by two sulci; posterior angle of lateral lobes slightly produced and angulate; hind femora with upper and lower carinae elevated, the former suddenly decreasing near the middle.

*Trachyrhachis kiowa kiowa* (Thomas). Length: male, 7/8 in.; female, 1 in.; dark grayish; fore wings with two large irregular bands; hind wings with very pale yellow disc and no distinct dark band; hind tibiae blue; vertex and fastigium of head with prominent ridges and three depressions. Overwinters in egg, six to twelve per pod; adults, June 25 to August 24.

A very important range grasshopper, most common in sparse stands of grama grass (*Bouteloua* spp.). Northern grasslands in the Upper Sonoran and Transition zones. Alpine and Springerville, to Aubrey Valley and Kaibab Plateau.

Northern Arizona to Minnesota and Canada.

*Trachyrhachis mexicana* Saussure. Length: male, 1 in.; female, 1 1/8 in.; brown; fore wings with two large irregular bands; wing with yellow disc and black band; hind tibiae blue; fastigium and vertex of head with moderately high ridges and three depressions. Overwinters in egg, six to eight per pod; adults, taken June 19 to November 8.

At times one of the most common and destructive range grasshoppers in the southern grassland. Most abundant in areas of sparse grass. Southeastern Arizona in the Lower Sonoran and Upper Sonoran zones, west to the Baboquivari Mountains, and north to the Catalina Mountains.

Arizona to Mexico and New Mexico.

*Trachyrhachis coronata* Scudder. Length: male, 1 in.; female, 1 1/8 in.; dark; fore wings with five to seven dark markings; dorsal surface of head and pronotum with high ridges forming five pits on the head; lateral lobes of pronotum only slightly produced; hind wing with yellow disc and a black band; hind tibiae buff colored. Eggs average eight per pod; adults, June to August.

A rare species taken at Springerville (Ball, Tinkham) in short grass at the lower edge of the Transition Zone.

Arizona to New Mexico and Colorado.
Genus *Mestobregma* Scudder. Median carina of pronotum moderately high and deeply cut twice; posterior angles of lateral lobes rounded; side of pronotum with an oblique black stripe; fore wing with broad dark bank on costal margin; hind wing with yellow or red, black band, and long spur.

*Mestobregma terricolor* Rehn. Length: male, 1 in.; female, $1\frac{1}{4}$ in.; light brown; two lateral ridges at side of median carina of pronotum higher than the median carina; hind wing with rose-red disc and black band; hind tibiae pale, tinged with blue. Adults, July to September. (Rehn, 1919b.)

A rare species found on bare adobe flats. Willcox playa (Ball), to Bright Angel Point, Grand Canyon (Rehn).

Arizona to Texas.

*Mestobregma impexum* Rehn. Length: male, 1% in.; female, 1$\frac{1}{4}$ in.; light brown; wing disc red or yellow; frontal costa decidedly constricted in line with base of antenna; lateral foveolae of vertex large and circular; hind tibiae buff. Adults taken in September.

A rare species found in sandy or dry soil with scattered clumps of short grass in the sagebrush desert. Vermilion Cliffs (Rehn and Hebard), Fredonia (Ball), and Concho (Tinkham).

Northern Arizona to Utah, Idaho, and California.

*Mestobregma plattei rubripenne* (Bruner). Length: male, 1% in.; female; 1$\frac{1}{4}$ in.; brown; pronotum with prominent black lateral band; posterior angle of lateral lobes of pronotum slightly produced. Adults, August and September.

A moderately common grasshopper which is sometimes the most abundant of this subfamily on the range. Most common on rocky soil with sparse grass in the desert grassland; Lower Sonoran to Transition Zone.

Type locality, Oracle. Southeastern Arizona west to the Baboquivari Mountains and north to the Kaibab Plateau. The northern specimens are atypical.

*Mestobregma plattei corrugata* (Scudder). Length: male, 1 in.; female, 1$\frac{1}{4}$ in.; dark brown; ridges of pronotum and vertex prominent; posterior angle of lateral lobes of pronotum slightly produced. Adults, August and September.

St. Johns and Springerville (Ball), in Upper Sonoran and Transition zones.

Northeastern Arizona to Texas and Colorado.

*Metator pardalinus* (Saussure). Length: male, 1% in.; female, 1$\frac{1}{4}$ in.; dark brown; fore wing with irregular dark band or markings; hind wing with disc orange, red, yellow, or yellowish green, and dark band; hind tibiae blue; median carina of pronotum high and cut by two deep sulci; posterior angle of the lateral lobes of the pronotum acute-angulate. Overwinters in egg; nymphs May and June; adults, June 20 to September 1.
An important range grasshopper which is sometimes injurious to wheat and other grain crops.

Grasslands of Upper Sonoran and Transition zones of northern Arizona. Springerville and the Lukachukai Mountains, west to Pleasant Valley and Williamson Valley.

Arizona to Montana and North Dakota, on the plains.

Genus *Conozoa* Saussure. Size medium, color brown or gray; form slender; median carina of pronotum raised nearly the whole length and twice notched; posterior angle of the lateral lobes of the pronotum toothed; fore wings with two prominent dark areas on the costal margin; hind wings with yellow disc, black band, long spur, and transparent apex.

Moderately common grasshoppers which are of economic importance both on the range and in cultivated areas. Rather difficult to kill with poison bait but usually not abundant enough to warrant control.

*Conozoa sulcifrons* Scudder. Length: male, 1 in.; female, 1¼ in.; posterior portion of median carina of pronotum very low; hind tibiae red. Eggs, fourteen to twenty-five per pod; adults, March to November.

Common in the Lower Sonoran Zone, especially in cultivated areas, low flats, and arroyos. Usually found on alluvial soil but sometimes in areas of shallow soil and often in very dry situations. Western Arizona east to Phoenix, Sacaton, and Florence.

Arizona to Utah and California.

*Conozoa sulcifrons acuminata* Scudder. A northern race taken in Arizona in the sagebrush desert of the Upper Sonoran Zone at Fredonia (Ball), Holbrook (Tinkham), and Winslow (Hebard, 1935c, p. 294).

*Conozoa carinata* Rehn. Length: male, 1½ in.; female, 1⅖ in.; median carina of pronotum high; hind tibiae yellow. Overwinters in egg stage, fifteen to twenty-five eggs to a pod; adults, April to November. (Rehn, 1907, p. 38.)

A common grasshopper on the range and in cultivated fields at a higher elevation than *sulcifrons*. Especially common in sandy washes in the desert grassland. Feeds on herbaceous plants such as *Lupinus*, *Amaranthus*, and *Boerhaavia*, as well as grasses.

Type locality, Huachuca Mountains. Southeastern Arizona west to Tucson, the Baboquivari Mountains, Williamson Valley, and Prescott; north to Ashfork and Springerville.

Genus *Trimerotropis* Stal. Form slender; median carina of pronotum cut by two sulci and posterior portion very low; posterior angle of lateral lobes rounded or (in two species) toothed; hind wings usually with black band and a yellow, yellow-green, or blue disc.

This is the largest genus of the subfamily, containing forty-three species in North America, of which fifteen are found in Arizona. It is widely distributed and very abundant in the state, especially on the bare soil of the desert, rocky hillsides, arroyo beds, and other sparsely vegetated areas. Several species are quite
important on the range or from the standpoint of soil erosion and one species, *Trimerotropispallidipennis*, is important at times on cultivated crops.

**KEY TO SPECIES OF *Trimerotropis***

1. Median carina of pronotum cristate and bilobed; the second lobe as high as long.................................2
   Median carina not cristate...........................................................3

2. Posterior angle of lateral lobes of pronotum with small tooth.  
   *T. cristata* (p. 314)
   Posterior angle without tooth. 
   *T. bilobata* (p. 314)

3. Wing disc blue or bluish green..............................................4
   Wing disc yellow...........................................................................5

4. Wing disc pale blue; hind tibiae yellow.  
   *T. sparso* (p. 314)
   Wing disc greenish blue or blue; hind tibiae blue.  
   *T. cyaneipennis* (p. 317)

5. Hind tibiae bright red..................................................................7
   Hind tibiae not red.................................................................6

6. Hind tibiae yellow; apex of wings transparent.  
   *T. pallidipennis* (p. 314)
   Hind tibiae dark; apex of wings black or smoky........................15

7. Lower border of lateral lobes of pronotum with tooth.  
   *T. strenua* (p. 315)
   Lower border of lateral lobes of pronotum without tooth............8

8. Black band of hind wing broader than disc.........................9
   Black band narrower than disc; spur long..............................10

9. Black band of hind wing about one half as broad as length of the wing. 
   *T. latifasciata* (p. 315)
   Black band about two thirds as broad as length of hind wing.  
   *T. melanoptera* (p. 316)

10. Wing band about % inch wide; posterior angle of pronotum obtuse-angulate with rounded apex.  
    *T. latifasciata* (p. 315)
    Wing band more narrow; posterior angle of pronotum acute.....11

11. The apical portion of the hind wings clear..........................12
    The apical portion of the hind wings slightly smoky.................14

12. Bands of fore wings solid and well defined........................13
    Bands of fore wings irregular or indistinct.  
    *T. campestris* (p. 315)

13. Spur of hind wing long, reaching nearly half way to the base; size small, 1¼ inch or less.  
    *T. pistrinaria* (p. 315)
    Spur short reaching about one fourth the distance from the band to the base; size large, over 1½ inch.  
    *T. magnifica* (p. 315)
14. Median carina of pronotum distinct; general color dark. 
   T. inconspicua (p. 316)
   Median carina of pronotum distinct only on the anterior portion; general color reddish. 
   T. tolteca-modesta (p. 316)

15. Apex of hind wings smoky. 
   T. cincta (p. 316)
   Apex of hind wing black. 
   T. suffusa (p. 317)

*Trimerotropis cristata* McNeill. Length: male, 1 in.; female, 1½ in.; median carina of pronotum cristate and bilobed, the rear lobe higher than long; posterior angle of lateral lobe of pronotum with small tooth; fore wing without distinct bands; hind wing with yellow disc and black band; hind tibiae yellowish. Adults, March to July. (McNeill, 1901, p. 408.)

A rare species found in the extreme desert of the Lower Sonoran Zone. Western Arizona at Wellton (Hebard, 1935) and Tinajas Altas (Ball).

Lower California (type), California, Nevada, and Utah.

*Trimerotropis bilobata* Rehn and Hebard. Length: male, 1 in.; female, 1½ in.; similar to *cristata* but darker in color and lacking the teeth on the lobes of the pronotum. Adults, August and September. (Rehn and Hebard, 1906, p. 382.)

A rare species found in sandy areas in the desert of the Upper Sonoran Zone of northeastern Arizona at Springerville and Lupton (Ball); Holbrook (Hebard, 1935); and Concho (Tinkham). Arizona to Colorado and Kansas.

*Trimerotropis sparsa* (Thomas). Length: male, 1 in.; female, 1½ in.; color mottled grayish brown; hind wing with disc pale blue, band narrow, pale, and often lacking except for some blackened veins on the front margin.

A very rare species found on the bare floor of a small arroyo in the desert of the Upper Sonoran Zone at the Grand Canyon August 29 (Ball).

Arizona to New Mexico and Alberta, Canada.

*Trimerotropis pallidipennis pallidipennis* (Burmeister). Length: male, 1½ in.; female, 1½ in.; color gray marked with brown; fore wings banded; hind wings with pale yellow disc, narrow black band and short spur; hind tibiae yellow (Fig. 7 B). All stages may be found in the winter but the egg stage is most common. About thirty-five eggs developed at a time; egg pods delicate with a thin layer of froth over eggs.

One of the most abundant grasshoppers in the Lower and Upper Sonoran zones; up to about 8,500 feet elevation on rocky ridges. Breeds in areas of thin soil and sparse vegetation. Migrations occur especially in June and July at which time much damage may be done in cultivated areas. Many crops are injured, the most important being vegetables, alfalfa, milo, barley, cotton, and corn. Large numbers may come to lights and be very annoying unless trapped in pails of water hung under the lights.
Rarely these grasshoppers may remain in cultivated fields long enough to warrant poisoning.

Widespread in the western United States south to Chile, South America.

*Trimerotropis strenua* McNeill. Length: male, 1¼ in.; female, 1½ in.; lateral lobes of pronotum with a tooth on lower border; hind tibiae red. Similar in general appearance to *T. pallidipennis*. Adults, June to September, most common in August. (McNeill, 1901, p. 432.)

Fairly common on rocky soil with scattered clumps of grass from the higher portion of the Lower Sonoran Zone into the Transition Zone. Eastern Arizona west to Tucson and the Baboquivari Mountains, and north to Granite Dells in Yavapai County.

Arizona to Utah, Nevada, and California.

*Trimerotropis pistrinaria* Saussure. Length: male, 1¼ in.; female, 1½ in.; color reddish gray; bands on fore wings distinct; hind wing with disc yellow, the band broad and apex short. Overwinters in egg, twenty-five developed at a time; adults, mid-June to October.

A rather rare species found on the most barren, eroded areas in rolling country in the Upper Sonoran Zone. Southeastern Arizona west to the Catalina Mountains and north to Springerville and St. Johns.

Arizona to Montana, Alberta, Texas, and Mexico.

*Trimerotropis campestris* McNeill. Length: male, 1 in.; female, 1½ in.; color dark, disc of pronotum often much lighter in color than prozona; bands on fore wings irregular and composed of small black spots; hind tibiae red. Adults, August and September. (McNeill, 1901, p. 423.)

Grasslands of the Upper Sonoran and Transition zones. Kaibab and Mogollon plateaus of northern Arizona south to Flagstaff and Springerville.

Arizona to Alberta, Canada.

*Trimerotropis magnifica* Rehn. Length: male, 1½ in.; female, 1¾ in.; robust; antennae large; hind wing with band about one fourth as broad as the length; inner surface of hind femur black with light apical band; hind tibiae red; ventral surface of thorax yellow. Adults, August to November. (Rehn, 1907, pp. 42-44.)

A rare species found on patches of bare soil in areas of tall grass in the desert grassland in the Upper Sonoran Zone. Huachuca Mountains (type); Bonita (Tinkham); and near Greaterville on the east side of Santa Rita Mountains.

Arizona to Texas and southwestern Kansas.

*Trimerotropis latifasciata* Scudder. Length: male, 1¼ in.; female, 1½ in.; reddish brown; bands on fore wing definite; band on hind wing not more than one half as broad as the length of the wing; ventral surface of abdomen tinged with red; hind tibiae red. Specimens from the northern part of the range smaller and with proportionally narrower wing band. Flies very rapidly and
for long distances and is very hard to catch. Overwinters in the egg, twenty-six to twenty-eight developed at a time. Adults, June to October.

A common grasshopper of the grasslands in the Lower and Upper Sonoran zones. Especially common in the upper desert grasslands of southeastern Arizona. The rate of reproduction is high, and it is one of the important range grasshoppers. It often congregates in large numbers on bare spots, as around water holes and ant nests, in areas of tall grass. Also quite common in areas of sparse grass. Southeastern Arizona north to Springerville, Lupton, Aubrey Valley, and Fredonia.

Arizona to Texas and Washington.

*Trimerotropis inconspicua* Bruner. Length: male, 1 in.; female, 1¼ in.; color dark grayish brown; bands on fore wings irregular; black band on hind wing narrow and incomplete; apex of wing smoky; pronotum with distinct median carina; hind tibiae red. Adults, July to September.

Rocky soil in exposed situations in the Transition Zone extending into the Upper Sonoran Zone. Mogollon Plateau to the Pinal, Pinaleno, Chiricahua, Huachuca, and Catalina mountains of southeastern Arizona.

Arizona to Colorado and Utah.

*Trimerotropis melanoptera* McNeill. Length: male, 1¼ in.; female, 1¾ in.; black band of the hind wing two thirds as broad as the length of the wing; under surface of abdomen and thorax tinged with red. Adults, June to September. (McNeill, 1901, p. 430.)

Fairly abundant in openings in areas of tall grass in the desert grassland of the Lower and Upper Sonoran zones. Southeastern Arizona west to the Baboquivari Mountains and north to the Catalina and Galiuro mountains (Tinkham).

Arizona to Colorado, Texas, and Mexico.

*Trimerotropis cincta* (Thomas). Length: male, 1¼ in.; female, 1½ in.; dark brown; head, pronotum, and fore wings with black bands; hind wing with pale yellow disc; and indistinct band, long spur, and apex smoky; hind tibiae usually blue but occasionally brown or reddish. Adults, August and September.

A rare species found on rocky soil with sparse vegetation, usually near trees. Canadian and Transition zones extending into the Upper Sonoran Zone.

Northern Arizona at Ashfork, San Francisco Mountain, Flagstaff, Lupton, and the Kaibab Plateau.

*Trimerotropis tolteca-modesta* Bruner. Length: male, 1¼ in.; female, 1½ in.; light reddish brown; bands on fore wings indistinct; hind wing with yellow disc, narrow black band, and short stout spur, apex slightly smoky; posterior angle of pronotum acute; hind tibiae red. Adults, June to August.

One of the most common grasshoppers of the grasslands of the Transition Zone extending into the Lower Sonoran Zone. North-
ern and eastern Arizona to Oak Creek Canyon, the Baboquivari Mountains, and Tucson.

Arizona to New Mexico, Colorado, and Mexico.

*Trimerotropis cyaneipennis* Bruner. Length: male, 1% in.; female, 1% in.; dark; fore wings indistinctly banded; hind wing with blue or bluish green disc, black band, and long spur; hind tibiae blue or brown. Adults, July to October.

Rocky slopes in wooded areas in the Upper Sonoran and Lower Transition zones.

Arizona to Utah and New Mexico.

*Trimerotropis suffusa* Scudder. Length: male, 1% in.; female, 1½ in.; dark grayish brown; wing with disc yellow and outer half black; makes loud crackling noise in flight. Adults, June to September.

Rocky mountain slopes and ridges in wooded areas in the Transition and Canadian zones. Northern Arizona from Kaibab Plateau and Lukachukai Mountains south to Flagstaff and the White Mountains.

Western United States to Canada.

*Hadrotettix trifasciatus* (Say). Length: male, 1% in.; female, 1% in.; stout; antennae long; median carina of pronotum represented by a mere line or absent; inner surface of hind femur dark blue with light colored apical band; fore wing with three broad solid bands; hind wing with yellow disc, black band beyond middle, and short spur. Overwinters in egg, twelve to seventeen eggs to a pod; adults, June to September.

A widely distributed but not common inhabitant of the grasslands of the Upper Sonoran Zone. Found on shallow gravelly soil with sparse grass. The food consists of various weeds. Southeastern Arizona west to the Baboquivari Mountains, and north to Williamson Valley, Prescott, and Springerville.

Arizona to Mexico, Texas, and Canada.

Genus *Circotettix* Scudder. Similar to *Trimerotropis*, but with the radiate veins of the hind wing reinforced and the posterior margin of the wing truncate rather than rounded. Wing with yellow disc and traces of a black band and spur. A loud and sustained crackling noise is made in flight. Found at high elevations and of no economic importance.

*Circotettix rabula rabula* Rehn and Hebard. Length: male, 1½ in.; female, 1% in.; pale gray brown, with small darker markings; hind tibiae buff, sometimes tinged with blue; fore wings % inch longer than body. Adults, August and September. (Rehn and Hebard, 1906.)

The food consists to some extent of moss and low growing weeds. Transition and Canadian zones on the Kaibab Plateau.

Arizona to Canada.

*Circotettix rabula altior* Rehn. Transition and Canadian zones in the White Mountains of Arizona, to Utah, New Mexico, and Colorado. (Rehn, 1921, p. 183.)
Circotettix coconino Rehn. Length: male, 1\(\frac{1}{4}\) in.; female, 1\(\frac{1}{2}\) in.; similar to C. rabula but with the wings only \(\frac{1}{4}\) in. longer than the abdomen. Adults, June to September. (Rehn, 1921, p. 187.)

Rather widely distributed in the Transition and lower Canadian zones. Pinaleno Mountains and Mogollon Plateau from the White Mountains to Ashfork.

Anconia integra Scudder. Alkali grasshopper. Length: male, 1\% in.; female, 1\% in.; green or gray; pronotum saddle-shaped and marked with pale yellow; fore wings with faint brown spots; hind wings transparent or pale blue. Nymphs, October to June; adults, March to July.

Fairly common in alkali areas in the Lower Sonoran Zone. Feeds on alkali plants such as Suaeda, Atriplex canescens, A. polycarpa, and Sarcobatus vermiculatus. Western Arizona east to Phoenix, Eloy, and Tucson.

Arizona to California, Nevada, and Utah.

Coniana snowi Caudell. Length: male, \% in.; female, 1 in.; white, with small black spots; posterior angles of lateral lobes of pronotum produced; hind wings transparent; hind tibiae white. Adults and nymphs, July and August. (Caudell, 1916a, p. 26.)

A rare species found associated with the low growing plant Coldenia palmeri in sandy areas in the Lower Sonoran Zone. Southwestern Arizona from Yuma to Phoenix and Bill Williams Fork (type).

Arizona to California.

Cibolacris parviceps aridus (Bruner). Cream grasshopper. Length: male, 1\% in.; female, 1\% in.; color cream or gray; fore wings marked with brown; hind wings transparent or blue; pronotum slightly saddle-shaped, with two small projections on anterior margin, posterior margin subangulate, lateral lobes produced; hind tibiae white or pale blue. Overwinters in nymph stage; nymphs common into May; adults, March to June.

A widely distributed very common grasshopper which rarely becomes abundant enough to attract much attention. Occurs on thin exposed soil and overgrazed range in the Upper and Lower Sonoran zones.

Arizona to California, Utah, Colorado, New Mexico, and Mexico.

Heliastus benjamini Caudell. Arroyo grasshopper. Length: male, \% in.; female, 1\(\frac{1}{4}\) in.; color brown; fore wings with dark band at base and traces of two others; disc of hind wing red. Adults, July to October. (Caudell, 1905, p. 474.)

A fairly common grasshopper in washes and arroyos in the Upper Sonoran Zone extending into the Lower Sonoran Zone. Food consists in part of algae growing about pools of water, and in part of weeds. Occasionally found in grassland or irrigated land near the arroyos. Southeastern Arizona west to the Baboquivari and Tucson mountains, north to the Blue Range, Pleasant Valley, and Granite Dells of the Arizona Plateau.

Arizona to New Mexico.
Xeracris minimus (Scudder). Length: male, \% in.; female, \% in.; tan marked with brown; posterior angles of lateral lobes of pronotum rounded; metasternal space elongate. Adults, July and August.

A very rare species found in sandy areas in the Lower Sonoran Zone. Associated with plants such as Dicoria canescens, Petalonyx thurberi, and Eriogonum. Southwestern Arizona from Yuma to Blaisdell and Phoenix. Arizona to California.

SUBFAMILY ROMALEINAE. LUBBERS

This subfamily contains five species, distinctive and easily recognized, only one of which, the plains lubber, is widespread and injurious in Arizona. If short-winged, the wing pads are oval in shape. The external spine of the hind tibia is located near the apex. (Fig. 2.)

KEY TO GENERA AND SPECIES OF ROMALEINAE

A. Size large; wings or wing pads present.
   B. Very large; black, with green-veined fore, and pink hind wings; spur between front legs.
      Horse lubber—Taeniopoda eques

BB. Smaller; not black.
   C. Body subcylindrical; pronotum smooth, simply carinate, normal in size.
      D. Wings reduced to pink pads with small black dots; hind legs very stout.
         Plains lubber—Brachystola magna
      DD. Wings fully developed; hind legs normal. Extreme western Arizona.
         Malpais lubber—Tytthotyle maculata
   CC. Body flattened; pronotum flat, broad, elongated, covered with tubercles.
      Toad lubber—Phrynotettix tschivavensis

AA. Size small; antennae very long; wings absent.
   Long-horned lubber—Tanaocerus koebelei

Taeniopoda eques (Burmeister). Horse lubber. Length: male, 2 in.; female, 2\% in.; shining black, with orange and yellow markings on head, pronotum, antennae, and hind legs; fore wings dark with pale green veins; hind wings rose red (Fig. 8 A). Overwinters in egg; adults, August to November.

This large, ponderous grasshopper is one of the most strikingly colored species to be found in the United States. It feeds to a large extent on spiny shrubs such as mesquite (Prosopis), Callicandra, Acacia, Lycium, and Mimosa, and also feeds on many low plants such as burroweed (Haplopappus tenuisectus), Jatropha, and succulent annuals. Members of the lily family such as wild onions are especially favored food. Yards and cultivated areas are sometimes invaded. A colony established on the University of Arizona campus in 1905 by Professor Thornber is still thriving.
around the Memorial Pool where it feeds largely on crocuses. A hissing sound, which Hebard compares to that made by a horse when drinking, is made by forcing air and a distasteful fluid through glands on the thorax. A clacking noise is also made by the wings of the males.

Desert grassland and low live oak belt of the Sonoran zones in southeastern Arizona, west to Baboquivari and Quinlan mountains, north to San Carlos and Clifton.

Arizona to Texas, Mexico, Honduras, and Costa Rica.

*Brachystola magna* (Girard). Plains lubber. Length: male, 1% in.; female, 2 in.; reddish brown, marked with greenish and brown; large, short-winged, easily distinguished by black spots on pinkish wing pads (Fig. 2). Eggs, thirty-five in large, gourd-shaped pod, overwinter, hatch July and August; adults, August to October.

Usually on rocky or gravelly soil with sparse grass and coarse weeds. Isely (1938, p. 574) in cage tests found it fed by preference on cotton, sunflower, and ragweed. It is at times of economic importance. Common in the desert grassland and also the northern grassland.

North to Chino Valley, Peeples Valley, and Springerville, and west to Covered Wells (Tinkham) in Arizona. Southern Coahuila, Nuevo Leon, and northern Mexico, to Montana, North Dakota, and Minnesota.

*Tytthotyle maculata* Bruner. Malpais lubber. Length: male, 1½ in.; female, 2 in.; bluish gray and brown mottled; inner sides of hind tibiae bright pink; underwing clear except for irregular gray markings. Eggs laid in summer, hatch following spring; nymphs, March and April; adults, May to July.

A beautiful, long-winged grasshopper, rather slow and wary in movement; will fly a short distance and then hide in the shadow of a rock. Feeds mostly on ephemeral plants such as horned toad buckwheat (*Chorizanthe rigida*), *Eriogonum* sp., and composites, but when numerous may move to cultivated land and cause damage to vegetables and other crops. Easily killed by bait but usually does not remain long enough to do much damage.

Extreme desert or malpais region of western Arizona. Most common along the edges of washes and on rocky hills but occasionally on near-by flat desert. Occurs along the Colorado River from Mexico to Littlefield; east to Wellton, Mohawk, the Gila Bend and Sauceda mountains. Needles, California, is the type locality.

*Phrynotettix tschivavensis* (Haldeman). Toad lubber. Length; male, 1.1 in.; female, 1% in.; pronotum very broad and flat, nearly one half as long as body, coarsely rugose, extending back over the abdomen; wings reduced to small oval pads; inner side of hind femur black; reddish brown, gray, or mottled like the rocks on which it is found. Eggs, twenty-four per pod, overwinter; nymphs, April to August; adults, June to October.
This lubber is very toadlike in actions and in general squat appearance. Most common on rocky ground with some grass in desert grasslands of the Sonoran zones. Feeds largely on herbaceous plants such as *Euphorbia* and is never very abundant. Sometimes found in open gravelly places in the Transition Zone on the Mogollon Plateau, or in the mountains of southern Arizona. Specimens taken at high elevations are about one half the size of those from lower elevations and may be a distinct race. Southwestern Arizona west and north to Baboquivari and Pinal mountains, Williams, Showlow, and Blue Range of White Mountains.

Texas and northern Mexico, New Mexico, Arizona, and California.

*Tanaocerus koebelii* Bruner. Long-horned lubber. Length: male, $\frac{1}{2}$ in.; female, $\frac{3}{4}$ in.; antennae of female slightly shorter than body; of male, longer than body; pale gray, lightly marked with fuscous and black. The remarkable long antennae and absence of wings readily distinguish this small species.

Type specimens (mature) taken in April, 1891, and nymphs taken in September and October indicate a winter species. Ball found the nymph feeding on northern black brush (*Coleogyne ramosissima*), and Tinkham found it feeding on *Franseria dumosa* and *Hymenoclea salsola*. It feeds also on ephemeral plants.

Previously known only from the type locality, the barren Panamint Range forming the west side of Death Valley. Extremely rare in Arizona, found only in the northwest corner of the state; Mohave County, 16 miles south of Boulder Dam (Ball), and Black Mountains (Tinkham).

Charleston Peak, Indian Springs, and Beatty, Nevada; Funeral, Panamint, and Casa ranges, California (Tinkham).

**SUBFAMILY CYRTACANTHACRINAE. SPUR-THROATED LOCUSTS**

This subfamily contains most of the important economic species which are found in cultivated areas and also many which are important on the range. Nearly all may be easily recognized by the presence of a prominent prosternal spine between the forelegs. In a few cases, however, this spine is elongated and low, and may cause the species to be confused with certain slant-face locusts of the subfamily Acridinae. Most of the economic species belong to the largest genus, *Melanoplus*, and a few belong to the genus *Schistocerca*.

While many of the Cyrtacanthacrinae are omnivorous, others are selective in food habits, feeding mostly on dicotyledons, especially the composites. Omnivorous forms are most easily and profitably controlled by the use of poison baits. These are not, comparatively, so important on range grasses, most of them feeding on herbaceous plants.
KEY TO THE ARIZONA GENERA OF CYRTACANTHACRINAE

1. Body form very long and slender ........................................... 2
   Form shorter and stouter, normal ....................................... 5

2. Tegmina and wings short, not reaching to apex of abdomen .... 3
   Tegmina and wings long, reaching tip of abdomen or beyond ... 4

3. Base of antenna set the width of an eye in front of the fore margin of the eye; male subgenital plate very long and very narrow; antennae very long, more than \( \frac{1}{2} \) inch. 
   **Prorocorypha** (p. 323)
   Base of antenna close to the fore margin of the eye; male subgenital plate much shorter; antennae less than \( \frac{1}{2} \) inch long. 
   **Parapomala** (p. 323)

4. Prosternal spine conical, subcircular in outline with flattened apex. 
   **Leptysma** (p. 323)
   Prosternal spine practically absent. 
   **Eremiacris** (p. 324)

5. Frontal costa strongly and convexly bowed out in front of the eyes; tegmina very narrow and elliptical. 
   **Clematodes** (p. 325)
   Frontal costa not strongly and convexly bowed out, the fastigium rounding evenly into frontal costa and face; tegmina either long or small oval pads ...................................................... 6

6. Size very large, with very long tegmina and wings; male subgenital plate with deep apical cleft. 
   **Schistocerca** (p. 325)
   Size small to large; male subgenital plate without cleft ............ 7

7. Form small, very squat, broad; without trace of tegmina or wings. 
   **Bradynotes** (p. 345)
   Form normal; with oval tegmina, or long tegmina and wings ........ 8

8. Tegmina and wings small oval pads ....................................... 9
   Tegmina and wings reaching end of abdomen or beyond ............. 16

9. Color bright, deep-purpleish blue marked with red. 
   **Dactylotum** (p. 346)
   Color not as above .......................................................... 10

10. Body color greenish ....................................................... 11
   Body color darker .......................................................... 13

11. Posterior margin of pronotum transverse or straight; body color deep foliage green with brilliant crimson red stripe on head and pronotum. 
   **Perixerus** (p. 346)
   Posterior margin of pronotum convexly curved or angulate ......... 12

12. Posterior margin rounded, convex; body uniformly greenish without stripes. 
   **Aeoloplus** (p. 330)
   Posterior margin angulate; body bright green with full-length dorsal white stripes; side of pronotum with patch of black. 
   **Hesperotettix** (p. 331)

13. Pronotum with distinct lateral keels. 
   **Oedaleonotus** (p. 331)
   Pronotum without trace of keels ......................................... 14
   *Conalcea* (p. 329)

15. Head of normal size.
   *Melanoplus* (p. 332)

16. Prosternal spine transverse.
   *Aidemona* (p. 332)

17. Body color bright green with white dorsal stripe on pronotum and white lateral patches on thorax; tegmina bluish green, with very narrow white stripes.
   *Hesperotettix* (p. 331)

18. Tegmina pale greenish; pronotum and caudal femora bluish green marked with red and yellow, or profusely spotted with white, blue, and black dots.
   *Poecilotettix* (p. 345)

19. Subgenital plate with a subapical cone.
   *Aeoloplus* (p. 330)

   *Leptysma marginicollis* (Serville). Cattail grasshopper. Length: male, 1% in.; female, 1% in.; slender species; long-winged; heavy spine between forelegs; eyes much more closely spaced than in *Paropomala.*

   Lives on cattails along the margins of ponds and streams, along the Colorado River, Arizona, south into Mexico.

   Yuma, Arizona, and Bunkerville, Nevada (Ball).

   *Paropomala wyomingensis* (Thomas). Length: male, 1 in.; female, 1% in.; slender; grasslike, with white lateral stripe; wings two thirds length of abdomen; prosternal spine compressed laterally into narrow ridge; antennae very close to eyes. Overwinters in egg; nymphs, June and July; adults, July to October.

   Found in both the northern and desert grasslands, and especially common in tall grass in swales. Feeds largely on the coarser grasses such as *Andropogon.* West to Baboquivari Mountains, *Pima* County, and the grasslands of Mohave County, Arizona.

   Prairies of Wyoming and South Dakota.

   *Prorocorypha snowi* Rehn. Toothpick grasshopper (Fig. 9 13). Length: male, 1% in.; female, 2 in.; very long, slender; antennae long, sword-shaped (as in some of the slant-faced grasshoppers), distant from eyes; prosternal spine a narrow longitudinal ridge; male subgenital plate long. Nymphs overwinter, and into early July; adults, June to October.

   This is the most extreme form of the slender locusts and is very grasslike in appearance. It lives on tall grasses such as *Andropogon emerselyi,* *A. barbinodis,* *Aristida,* and *Elyonurus*
Another Mexican species, the range of which extends into southern Arizona, this unique form is restricted to the lower edge of the live oak belt in the Upper Sonoran Zone of southeastern Arizona in the Santa Rita, Tumacacori, Mule, and Huachuca mountains.

Genus *Eremiacris*. Form slender; size small to medium; abdomen little longer than wings and hind femora; prosternal spine poorly developed (which character will distinguish it from other slender-form, spur-throated locusts, but may cause it to be confused with some of the slant-faced forms); subgenital plate short.

**KEY TO SPECIES**

A. Head moderately produced; form rather slender, slightly compressed.

   B. Fore wings not exceeding apex of abdomen; occiput more or less inflated; size larger.

   **Eremiacris pallida**

BB. Fore wings exceeding apex of abdomen; occiput not appreciably inflated.

   **Eremiacris virgata**

AA. Body very slender, considerably compressed; head strongly produced; size small.

   **Eremiacris acris**

*Eremiacris pallida* (Bruner). Length: male, 1 in.; female, 1½ in.; eggs laid in summer; nymphs, early spring; adults, May 19 to October 30 (Yuma).

This is the largest species of the genus to be found in Arizona. Feeds on various grasses; taken at Yuma and Boulder Dam on *Hilaria rigida*, growing in sparsely separated clumps on the hot desert mesas. Found east in the Gila Valley to Phoenix, which is about as far as *Hilaria rigida* is found. Most common in the Lower Sonoran Zone in Yuma and Mohave counties, but extending east into Maricopa, Yavapai, and Coconino counties. Since it is recorded by Hebard (1935) from Santa Cruz in north central New Mexico, it is probably more widespread in northern Arizona.

*Eremiacris acris* Rehn and Hebard. Cigarette grasshopper (Fig. 10 1). Length: male, % in.; female, 1½ in.; smaller than pallida; slightly larger and more slender than *virgata*; lateral brown band usually more slender; posterior ends of lateral keels and horseshoe impression of the fastigium in front of the eyes. Overwinter in egg; nymphs, May and June; adults, June to October.

Occurs on many grasses of southern Arizona such as the grama grasses (*Bouteloua* spp.); *Sporobolus* spp., including Sacaton grass (*S. wrightii*), *Aristida* spp., and tobosa grass (*Hilaria mutica*).

Grasslands of the Lower and Upper Sonoran zones in southeastern Arizona north to Superior in Pinal County and west to the Quinlan Mountains.

*Eremiacris virgata* (Scudder). Similar to *acris*, but horseshoe impression and posterior ends of lateral fastigial keels projecting behind the fore margin of the eyes.
Uncommon in Arizona. Recorded only from St. Johns and Willcox. Appears to be associated with *Hilaria jamesii*; this species is more widely distributed in the east and is found in the plains region of New Mexico and Colorado.

*Clematodes larreae* Scudder. This rare species is peculiar because of the long nose or prolongation of the upper half of the frontal costa between the antennae and the eyes. Outer wings narrow, elliptical pads, same color as body; mottled gray or brown, similar to stems of host plant. Eggs, September and October, twenty to twenty-two in a pod, overwinter; adults near Altar, Sonora, May 9, 1932 (Ball).

Confined to creosote bush (*Larrea divaricata*). Reported by Hebard from Ajo and 6 miles north, in Arizona, and taken by Owen Bryant at Globe, Arizona, July 20, 1933. Very rare here, but more common in the Chihuahua Desert of Mexico.

Genus *Schistocerca* Stal. Subgenital plate split; lobes of mesosternum longer than broad, with inner margins bent inward toward each other posteriorly.

This genus contains some of the largest Arizona grasshoppers—powerful flyers, difficult to catch, and of somewhat slender build. One of the most important groups of grasshoppers from an economic standpoint, rather omnivorous, feeding mainly on herbs and other dicotyledons.

Members of this genus, *S. gregaria* of Africa and Asia, and *S. paranensis* of South America are two of the most destructive grasshoppers in the world.

**KEY TO SPECIES**

1. Mottled gray in color with faint evidence of dorsal yellowish stripe.  
   *Schistocerca vaga*

   Coloration green or greenish brown...............................2

2. Color uniform deep foliage green. A yellow stripe occasionally present, especially on those from higher elevations.  
   *Schistocerca shoshone*

   Color greenish brown with a long dorsal yellow stripe ........3

3. Caudal tibiae red with black spines; caudal femora yellow with two dorsal black bands.  
   *Schistocerca albolineata*

   Caudal tibiae black on top, white underneath, spines white, tipped with black, hind femora uniformly brown.  
   *Schistocerca lineata*

   *Schistocerca vaga* (Scudder). Gray bird locust (Fig. 8 B). Length: male, 1% in.; female, 2½ in.; body mostly mottled gray, antennae buff, hind tibiae dark with black-tipped, white spines; nymphs large, green or brown, often mottled. Eggs, fifty-four to 130 per pod; nymphs, most common May to November; adults, August to November; but both stages may be found throughout the year.

   This is the large, conspicuous, gray locust so commonly seen on irrigated land, and one of the most common pests in yards.
Fig. 20.—Feculae of: A, Tenebrio molitor; B, Schistocerca gregaria. (× 2)
Often the damage done in a dooryard by a very few of these large, voracious hoppers would suggest a large number. This species is very destructive at times to such crops as citrus, alfalfa, and cotton. It lives to a considerable extent on mesquite (*Prosopis*), at times migrating into cities in some numbers, but feeds on a wide variety of plants, especially low weeds and herbs, of which ragweed (*Franseria tenuifolia*) and pigweed (*Amaranthus palmeri*) are especially important. May also develop on such widely different plants as *Jatropha, Hilaria rigida*, oaks, and *Larrea divaricata*. A member of the Lower Sonoran desert fauna, and has been taken in Arizona as far north as Boulder Dam, Mohave County.

California to Texas, Mexico, and Nicaragua.
Schistocerca shoshone (Thomas). Green bird locust (Fig. 8 D). Length: male, 1\% in.; female, 2\% in.; large, heavily built; uniform deep green except coral red hind tibiae. Nymphs, May to September; adults, June to November.

Found mostly in irrigated areas or along streams and other places where the vegetation is dense and succulent, this locust does serious damage to such cultivated plants as cotton, alfalfa, garden plants, and citrus trees. At Willcox considerable damage has been done to crops by large numbers of this locust which migrated from mesquite. Occurs on many wild plants such as willows, mesquite (Prosopis sp.), Acacia, oak, and low plants such as Ambrosia, Franseria, Brickellia, Lactuca, Epilobium, Solidago. Typically in the Upper Sonoran Zone in Arizona but also in smaller numbers in the damper areas of the Lower Sonoran Zone.

California to Texas, south to Sinaloa and Baja California, and north to Utah, Nevada, and Colorado.

Schistocerca shoshone (phase). Chaparral grasshopper. The taxonomic status of this form is in doubt. Hebard (1935c, p. 299) states that detailed revision is necessary to determine whether it is a distinct species, a race, or merely a striking environmental adaptation. At any rate, this form, occurring in the higher elevations of the plateau region, is smaller, and has a definite yellow dorsal line. Specimens which have the yellow line as in the chaparral form are also taken at low elevations (Yuma) in damp areas and also on weeds in cultivated areas (St. Johns), but may represent another form.

This locust develops in tremendous numbers and causes serious damage in areas around Prescott. Ball records that the oaks of that region, especially the chaparral oak (Quercus turbinella), were completely defoliated, and the hoppers were dying of what was assumed to be poisoning from eating the young foliage. They lay by the thousands in the roads, especially in the roadside ditches, and water holes were filled with dead hoppers, constituting a serious danger to livestock. Damage was especially serious in the Williamson Valley, Prescott, and Ash Creek area, and on the Prescott National Forest. Besides eating the oak, the hoppers fed to some extent on Rhus trilobata, while cliff rose, aster, Eriogonum, and some other low plants appeared to be untouched.

Chiricahua Mountains to Mogollon and Coconino plateaus.

Schistocerca lineata Scudder. Spotted bird locust. Length: male, 1\% in.; female, 2\% in.; reddish brown, with conspicuous yellow dorsal stripe and many yellow spots on posterior portions of pronotum; hind tibiae blackish, with long white spines tipped with black. Nymphs, May to September; adults, August to November.

Taken in the live oak belt of the Upper Sonoran Zone at Nogales and in the Tumacacori Mountains. The distribution in Arizona is the same as that of a few Mexican species. However, this species
is the most widespread of the genus in North America, being found east to Texas and Minnesota and north to southeastern Alberta. The Arizona specimens are atypical, and Hebard states that it may represent a southwestern phase, or race.

While in the east this locust is of great economic importance, and in Arizona is also very destructive, it is too rare and local here to be very important. Taken mostly on wild plants such as willow, cottonwood, mesquite, *Mimosa*, side oats grama (*Bouteloua curtipendula*), and bear grass (*Nolina*), it probably feeds largely on low plants and depends on larger plants for protection.

*Schistocerca albolineata* (Thomas). White-lined bird locust (Fig. 8 C). Dark greenish brown, with conspicuous dorsal stripe; antennae yellow; hind femora yellow, with three dorsal black bars and lateral black stripe; hind tibiae reddish with black spines. The most conspicuously marked species of this genus in Arizona. Adults, August through October.

Found on various shrubs, such as *Coursettia microphylla*, desert hackberry (*Celtis pallida*), *Jatropha cardiophylla*, and on *Gymnolomia*. Upper edge of the Lower Sonoran Zone in southeastern Arizona, on rocky hillsides and benches in giant cactus-palo verde association; also in lower edge of oak belt of the Upper Sonoran Zone.

Southeastern Arizona and northern Sonora.

Genus *Conalcea* Scudder. Small to medium-sized grasshoppers with narrow oval scalelike wing pads and concave posterior margin of the pronotum. The spine between the front legs is short and very broad at the base. The male cerci are rounded at the upper apical angles, and the lower apical angles are pointed and considerably produced.

KEY TO SPECIES

A. Tibiae of hind legs orange buff.
   Size very small; northwestern Arizona.
   *Conalcea coyotero*

   Size large; southern Arizona.
   *Conalcea humphreysii*

AA. Tibiae of hind legs reddish orange or reddish pink.
   Hind tibiae orange red, tegmina half black, half whitish; southeastern pine zone.
   *Conalcea huachucana*

   Hind tibiae pinkish red, tegmina uniform bluish gray; southwestern desert.
   *Conalcea humphreysii poecila*

*Conalcea coyotero* Hebard. Length: male, % in.; female, % in. This is the smallest species of the genus in Arizona. Overwinters in egg; adults, July to October 3.

In the Upper Sonoran chaparral and oak zone in northwestern Arizona, it is found feeding on low plants, such as *Eriogonum* and *Lactuca*. It was described from Prescott (Hebard) and is found from that region north to Williams and Williamson Valley at
5,400 to 6,500 feet; also from Pinal and Hualapai mountains (Tinkham).

*Conalcea huachucana* Rehn. Line back. Length: male, % in.; female, 1½ in.; dark grayish brown, with broad dorsal stripe of yellow on abdomen; dark brownish black lateral stripe on thorax; upper half of small oval wing pads whitish, and lower half black; hind tibiae orange red. Overwinters in egg; adults, July to October, in grassy areas.

Upper Sonoran and Transition zones of the mountains of southern Arizona; Baboquivari Mountains east to Chiricahua Mountains, north to the Pinaleno Mountains and Black River in the Natanes Plateau (Ball).

*Conalcea humphreysii* Thos. Gray back. Length: male, 1 in.; female, 1¼ in. This large species may be recognized by a broad grayish band on the upper surface of pronotum and a small, yellow stripe on dorsal surface of abdomen; broad, shining black stripe on sides of pronotum, crossed by narrow, diagonal yellow stripe; undersurface yellowish. Eggs overwinter; adults, July 17 to October 7 in grassy areas.

A rather common grasshopper in the Upper Sonoran Zone and the higher desert grassland of the Lower Sonoran. Southern Arizona from the Baboquivari Mountains east to the Chiricahua Mountains and north to the Santa Catalina Mountains and Galiuro Mountains.

*Conalcea humphreysii poecila* Hebard. Similar to typical *C. humphreysii* but slightly larger and having reddish hind tibiae. The male cerci are also slightly shorter.

Occurs in the saguaro-palo verde association of the Lower Sonoran Zone. The only record for Arizona is from the Cobabi Mountains (Tinkham), on the Papago Indian Reservation, Pima County.

Common in the region of Magdalena and Santa Ana, Sonora, and south to Sinaloa, Mexico.

Genus *Aeoloplus* Scudder. Small, grayish green; spine between forelegs more slender and more sharply conical than in *Melanoplus*; male cerci very narrow and sharply pointed; male sub-genital plate small with subapical cone.

*Aeoloplus tenuipennis* Scudder. Length: male, 7⁄8 in.; female, 1 in.; grayish, with dorsolateral pale stripes on head and pronotum; buff bands on hind femora; hind tibiae pale reddish pink; very variable. Overwinters in egg, eight to twelve per pod; nymphs, May and June; adults, June to October.

Found on plants of alkaline regions in the Lower Sonoran Zone. Most common on *Atriplex canescens*, but also found on *Atriplex polycarpa* and other species as well as on *Suaeda* and *Sarcobatus vermiculatus*.

*Aeoloplus chenopodiï* (Bruner). Length: male, 9/16 in.; female, % in.; greenish; hind tibiae bluish green; a heavily built species with short wings. Nymphs, June; adults, July to September.

According to the name it should live on pigweeds of the genus
Chenopodium, but all of our records are from the saltbushes (Atriplex canescens and A. argentea) and greasewood (Sarcobatus vermiculatus).

All Arizona records are Ball’s. Painted Desert, St. Johns, and Lupton, northeastern Arizona; and northern New Mexico.

*Oedaleonotus borckii orientis* Hebard. Length: male, 9/16 in.; female, 7/8 in.; small grayish, with short oval wing pads; strong median and lateral carinae on pronotum; posterial spine heavy, blunt; small, black patch on side of pronotum; hind tibiae bluish gray, with spines black-tipped. Overwinters in egg; adults, June to September.

Taken by Ball on small bushes, such as sagebrush (*Artemisia tridentata*), and on grass and herbs in rocky or pebbly soil in the juniper-pine association of the Upper Sonoran Zone into the Transition Zone on the Kaibab Plateau, and east to Lupton in Apache County.

Described from Nevada.

Genus *Hesperotettix* Scudder, Bright green, with dorsal pink-edged, white stripe on pronotum and abdomen; wings either long or short; hind femora bluish or bluish green; sides of thorax green, with black and white markings.

*Hesperotettix curtipennis* Scudder. Length: male, % in.; female, 7/8 in.; bright green, with dorsal white, pink-margined stripe; lateral black stripes on pronotum, edged below with white; wings oval and widely separated; legs and wing pads greenish. Eggs, twelve to fourteen per pod, overwinter; adults, July and August.

Chiefly found on goldenrod (*Solidago*), especially where it forms solid mats. Also found on Artemisia ludoviciana, rabbit brush (*Chrysothamnus*), and occasionally snakeweed (*Gutierrezia*). At Williams Tinkham found it on the shrub *Ceanothus fendleri*. Transition Zone, Mogollon Plateau; from Williams to Springerville and the Black River.

Arizona to Colorado and New Mexico.

*Hesperotettix viridis viridis* (Thomas). Length: male, % in.; female, 1 in.; green, with pearly white dorsal stripe on pronotum and patches of white on sides of thorax and pronotum; fore wings pale green with two narrow, white streaks; hind tibiae pale bluish green.

This species may generally be found on burroweed (*Haplopappus tenuisectus*), one of the worst weeds on the ranges of southern Arizona, and on snakeweed (*Gutierrezia*). According to some ranchers it is quite important in checking the growth of burroweed. In Texas other plants are found to be hosts, and in Arizona individuals are occasionally found on other plants, such as *Baccharis*. Usually twelve to fourteen eggs in a small pod near the surface of the ground at the base of the plants. Lower and Upper Sonoran zones over most of state.

Arizona to Kansas, Colorado, and Texas.
Hesperotettix viridis nevadensis Morse. Wings: female, three fourths length of abdomen; male, one half length of abdomen. Very similar to viridis viridis, from which it may be distinguished by the smaller size and shorter wings.

Principally found on snakeweed (Gutierrezia) and burroweed (Haplopappus).


Aidemona sp. Length, 1 in.; mottled brown, with amber underwings; prosternal spine very wide and wedge-shaped. Eggs, July; adults, mid-October, overwinter.

Occurs among grasses and bushes under oaks in live-oak association of Upper Sonoran Zone. Feeds on Eriogonum wrightii and other plants.

This is the first record of this genus in the United States. Taken in the cottonwood grove near Tumacacori Mission (Lower Sonoran Zone) and in Florida Canyon, Santa Rita Mountains, by Ball; Canelo Hills and Tumacacori Mountains (Tinkham).

Genus Melanoplus Stal. This is a very large genus (thirty-one species in this bulletin), which includes some of the most important economic species, such as the differential, two-striped, red-legged, and migratory grasshoppers. (Hebard 1935c, 1937a.)

The species are for the most part dull colored and rather small in size, and many are very similar in size, color, and general appearance. A close examination of the abdominal appendages of the male is necessary to separate most of the species (Figs. 9, 10). The females of many species are so similar that only the expert can distinguish them. The high mountain and woodland species are often short-winged and those in open fields, grasslands, and cultivated areas are usually long-winged. In some cases, however, the wing length varies in the same species. Practically all of species of Melanoplus lay their eggs in the fall, and the nymphs emerge the following year.

KEY TO THE ARIZONA SPECIES OF Melanoplus (MALES)

1. Wings much shorter than the abdomen .................................................. 2
   Wings as long as or longer than the abdomen ..................................... 12

2. Hind tibiae bluish green in color ......................................................... 3
   Hind tibiae red .................................................................................. 10

3. Cerci long and slender ................................................................. 4
   Cerci broad and short ...................................................................... 6

4. Cerci not flattened; size medium (Fig. 10 13),
   M. desultorius (p. 338)
   Cerci slightly flattened; size small .................................................. 5

5. Common and widespread (Fig. 10 4),
   M. aridus (p. 338)
   Rare and confined to extreme northern Arizona.
   M. tristis (p. 338)
6. Cerci bulbous; apex pointed (Fig. 97).
   \textit{M. lakinus} (p. 342)
   Cerci not bulbous; apex rounded

7. Cerci much broader at apex than at base (Fig. 1016).
   \textit{M. snowii} (p. 336)
   Cerci not greatly expanded at apex

8. Apex of cerci spoon-shaped and strongly bent inward (Fig. 1020).
   \textit{M. femur-nigrum} (p. 336)
   Cerci flat

9. Cerci broader at apex than at middle (Fig. 1012).
   \textit{M. chiricahuae} (p. 336)
   Cerci tapering from middle to apex (Fig. 1021).
   \textit{M. pinaleno} (p. 338)

10. Tegmina overlapping dorsally, hind femora banded; sternites of abdomen yellowish.
    \textit{M. franciscanus} (p. 338)
    Tegmina widely separated dorsally; hind femora not banded; sternites of abdomen whitish

11. Furcula moderately large (Fig. 1017).
    \textit{M. truncatus} (p. 336)
    Furcula very small.
    \textit{M. magdalenae} (p. 336)

12. Color dark, mottled with gray and brown; rare.
    \textit{M. splendidus} (p. 339)
    Color lighter, without mottling

13. Cerci broad, apical half as wide or wider than base.
    Cerci slender, apical half slender and tapering to apex

14. Size large; cerci with upper and lower apical angle expanded, boot-shaped; furcula small or absent.
    Size medium to small; cerci not boot-shaped; furcula variable

15. Upper and lower apical angles of cerci equally expanded (Fig. 94).
    \textit{M. yarrowii} (p. 339)
    Upper apical angle of cerci larger than the lower apical angle

16. Hind tibiae red; body color bluish green with pale dorsolateral stripes (Fig. 910).
    \textit{M. thomasi} (p. 339)
    Hind tibiae not red; body color brown and yellow

17. Hind femora with black herringbone markings; body without stripes (Fig. 91).
    \textit{M. differentialis} (p. 339)
    Hind femora with a solid black stripe; body with two pale stripes (Fig. 911).
    \textit{M. bivitattus} (p. 341)

18. Cerci flat

19. Cerci broad and of nearly uniform width throughout; apex of subgenital plate notched (Fig. 96).
    \textit{M. mexicanus} (p. 342)
Cerci expanded at middle or apex; subgenital plate simple............. 20

20. Cerci broad and short, expanding from base to middle (Fig. 9 9).
   *M. occidentalis* (p. 342)

Cerci more slender, at least twice as long as wide...................... 21

21. Furcula minute; supra-anal plate not constricted apically........ 23
   Furcula one third as long as supra-anal plate; supra-anal plate
   constricted at apical fourth (Fig. 10 2, 3).
   *M. angustipennis* (p. 343)

22. Pronotum with dark median stripe and pale lateral stripes (Fig. 10 15).
   *M. packardii* (p. 343)

Pronotum brown, stripes absent or faint (Fig. 10 15).
   *M. foedus* (p. 343)

23. Cerci with median lobe on lower edge (Fig. 10 5).
   *M. confusus* (p. 341)

Cerci without median lobe.................................................. 25

24. Size medium; furcula short; supra-anal plate suddenly depressed on
    apical half (Fig. 9 3).
   *M. gladstoni* (p. 341)

Size small; furcula half as long as supra-anal plate; supra-anal plate
    flat (Fig. 10 6, 7).
   *M. arizonae* (p. 343)

25. Coloration conspicuous; furcula small (Fig. 9 8).
   *M. regalis* (p. 341)

Coloration dull; furcula large, more than one half the length of the
    supra-anal plate.......................................................... 26

26. Hind tibiae red; supra-anal plate longitudinally ridged; apex of
    abdomen broadly rounded; furcula slender (Fig. 9 2).
   *M. femur-rubrum* (p. 341)

Hind tibiae blue; supra-anal plate flat; furcula flat.................... 27

27. Cerci grooved and slightly expanded at apex.......................... 28

Cerci not grooved or expanded apically.................................. 31

28. Cerci broad; arms of furcula long and tapering to a point.......... 29

Cerci slender; arms of furcula broad and abruptly terminated........ 30

29. Fore wings long and slender, considerably surpassing the hind femora;
    without spots.
   *M. complanatipes complanatipes* (p. 344)

Fore wings only slightly surpassing the hind femora; with a row of
    small spots (Fig. 10 71, 14).
   *M. complanatipes canonicus* (p. 344)

30. Color green or brown; arms of the furcula united for two thirds its
    length (Fig. 10 10, 11).
   *M. herbaceus* (p. 343)

Color brown; arms of the furcula united for one half its length (Figs.
    9 5; 10, 19).
   *M. pictus* (p. 344)

31. Size medium; color dull.
   *M. bowditchi* (p. 344)

Size small; color bright (Fig. 10 9, 18).
   *M. flavidus* (p. 344)
Figure 9.—1-11, Terminal segments of male Melanoplus, showing cerci (stippled), drawn to same scale; 12, Phoetaliotes nebrascensis, female (x 1 1/2); 13, Prorocorypha snowii, male (x 1 1/2).
Melanoplus chiricahuae Hebard. Length: male, % in.; female, 7/8 in.; short-winged, with glaucous-colored hind tibiae, and wing pads which touch over the back. Very similar in appearance to femur-nigrum of the Mogollon Plateau. Adults, June 9 to September 11.

Found among grasses, bracken ferns, and low herbs under ponderosa pine. Confined to the Transition Zone, usually above 8,000 feet, in the Chiricahua Mountains. Especially common on the hillsides near Rustlers' Park. Type locality Ida's Peak. (Hebard, 1920c.)

Melanoplus femur-nigrum Scudder. Length: male, % in.; female, 7/8 in.; small, short-winged; hind tibiae glaucous. Adults, June to September.

Among grasses and weeds in open ponderosa pine forests, Transition Zone, and edge of Upper Sonoran Zone, at 6,000 to 9,000 feet. Feeds on many plants, such as snakeweed (Gutierrezia), Potentilla, Helianthus, Iris missouriensis, and timothy (Phleum pratense). The dominant species of the group in the Flagstaff region; in drier situations and at lower elevations than M. snowii. On the Blue Range in Greenlee County, north to Springerville, and west to Williams and Flagstaff in Coconino County (Ball), and Mingus Mountain (Tinkham).

Melanoplus snowii Scudder. Length: male, % in.; female, % in.

An uncommon species at such high elevations as to be of little economic importance. Upper Transition and Canadian zones, usually associated with low plants such as the grass Muhlenbergia montana under ponderosa pine or Gambel oak; sometimes found in mountain meadows.

From Showlow (6,500 ft.) to White Mountains (10,000 ft.); one record (Ball) from Oak Creek Canyon, south to Flagstaff, Mogollon Plateau of Arizona and Magdalena Mountains of New Mexico.

Melanoplus magdalenae Hebard. Length: male, % in.; female, 7/8 in.; very similar to truncatus; hind tibiae rich pink, except rarely buffy.

High elevations, Canadian Zone, in grass under aspen (Populus tremuloides), or in bracken fern (Pteridium aquilinum), under fir and poplar.

Known only from specimens taken by Tinkham in the Blue Range south of Alpine, Arizona, and the Magdalena Mountains, New Mexico. (Hebard, 1935.)

Melanoplus truncatus Scudder. Length: male, % in.; female, % in.; hind tibiae normally rich pink, rarely buffy; wing pads small, oval, well separated. Adults, July to September.

Inhabits small openings in fir-aspen forests and mountain meadows in the Canadian Zone. Supplants femur-nigrum in the higher elevations of the Mogollon Plateau; generally above 9,000 feet from Bill Williams Mountain (Hebard) and San Francisco Mountain (type), southeast to Showlow, Springerville, and Alpine.
Figure 10.—1, *Eremiacris acris*, female (x 1½); 2-21, terminal segments of male *Melanoplus*, showing cerci (stippled), drawn to same scale.
Melanoplus pinaleno Hebard. Similar to *magdalenae*, but hind tibiae glaucous and femora rich, deep red below, lacking pale marginal band.

Small openings in forests and mountain meadows of Canadian Zone on Mt. Graham, Pinaleno Mountains, associated with the grass, *Muhlenbergia montanus*.

This species was first discovered by Ball on the ridge northwest of Helicopter Peak, Pinaleno Mountains, at 9,700 feet. (Hebard, 1937a, p. 155.)


Melanoplus aridus (Scudder). Length: male, ½ in.; female, 1 in.; small, bluish gray, with lateral black stripes on pronotum; wings short, oval, widely separated; hind tibiae glaucous; similar to *M. desultorius* but smaller, more grayish, with narrower wing pads. One of the most common short-winged grasshoppers in the Southwest. A widely distributed species occurring from the Lower Sonoran Zone desert into Canadian Zone to at least 9,400 feet. Lives on a variety of low growing plants, most commonly on *Eriogonum* spp., especially *Eriogonum wrightii*. Occasionally important in cultivated fields.

Nearly all of Arizona to California and Texas.

Melanoplus desultorius Rehn. "Red whiskers." Length: male, ¾ in.; female, 1 in.; yellowish green; short-winged with oval, bluish gray wing pads; hind tibiae bluish. Eggs, twenty-two to thirty-four per pod; adults, July to November.

Common on low plants of desert grassland, and also found in upper Lower Sonoran desert, and lower oak belt in Upper Sonoran Zone, 2,000 to 5,600 feet elevation. The nymphs and adults feed to a considerable extent on ephemeral plants, especially the ragweeds, *Franseria tenuifolia* and *Ambrosia psilostachya*. Common on burroweed (*Haplopappus tenuisectus*), moderately so on desert broom (*Baccharis sarothroides*) and the composite, *Gymnolomia*. Does not feed on grasses to any extent and is probably a beneficial grasshopper on the range.

Southeastern Arizona to Ajo Mountains, Pima County; Bradshaw Mountains, Yavapai County; Pleasant Valley, Gila County; St. Johns, Apache County; southwestern Texas (Tinkham), and Sonora.

Melanoplus franciscanus Scudder. Length: male, 7/8 in.; female, 1¼ in.; undersurface yellowish; hind tibiae red; wing pads pointed, meeting over back. Eggs, twenty-six to fifty-four per pod; adults, June to September.

A strikingly marked species feeding on grasses such as hairy grama (*Bouteloua hirsuta*) and *Muhlenbergia*, and occurring under pines in the Transition Zone.

San Francisco Mountains (type locality), and Oak Creek Canyon east to Magdalena Mountains, New Mexico (Tinkham), and south to Pinal Mountains (Flock).
Melanoplus splendidus Hebard. Length: male, 1% in.; female, 1% in.; a fairly large, long-winged, arboreal, dark gray grasshopper, matching the bark of the juniper trees on which it is found almost exclusively. Eggs, forty per pod; adults, July to September.

This species is one of the rarest in the state and is probably nocturnal. In captivity it feeds on juniper and piñon.

Pinal Mountains; 15 miles east of Flagstaff on Juniperus utahensis (Ball); and north central New Mexico (Hebard).

Melanoplus yarrowii (Thomas). Length: male, 1¼ in.; female, 1¾ in.; slender; greenish brown; hind tibiae red; apical portions of male cerci evenly expanded. Eggs forty to fifty-nine per pod; adults, July to October at Yuma.

Normally inhabits rich vegetation in washes, but occasionally injurious to cultivated crops. At times one of the most destructive species on alfalfa, clover, and cotton in the Yuma district. Most common along the Colorado River in Yuma, Mohave, and Coconino counties; common in Upper Sonoran Zone of Yavapai County.

California to New Mexico, and north to Colorado.

Melanoplus thomasi Scudder. Length: male, 1% in.; female, 1% in. The most strikingly colored Melanoplus in Arizona. Bluish green, with pale dorsolateral stripes; hind tibiae red; male cerci less expanded than in M. yarrowii. Eggs, thirty-five to fifty-nine per pod; adults, late September, through October.

Usually found in low, dense vegetation in the desert grassland of the Lower Sonoran Zone. Feeds on such plants as pigweed (Amaranthus palmeri), and Verbesina encelioides. Near Webb, Elfrida, and Benson it occasionally becomes moderately destructive to beans, corn, and other cultivated crops.

Southeastern Arizona, west to the Baboquivari Mountains, north to Bonita, Graham County; Arizona to central New Mexico, southwest Texas, Sonora, Sinaloa, and Durango.

Melanoplus differentialis Thomas. Differential grasshopper (Fig. 11 F). Length: male, 1½ in.; female, 1% in.; brownish yellow; hind tibiae yellow with rows of conspicuous black teeth; hind femora with black herringbone markings on outer face. Females contained eighty-four to 160 eggs.

An omnivorous destructive species, very common in cultivated areas in the state. Especially destructive to corn, hegari, alfalfa, and other grain and forage crops in Arizona. Also found in large numbers on Baccharis glutinosa and other succulent native plants and weeds, as well as sugar beets, and occasionally fruit trees and cottonwood trees.

Cultivated areas of the state, but less common west of the Salt River Valley and north of the Mogollon Rim. The only record from northern Arizona is at Alpine in the White Mountains. Widely distributed in western United States and northern Mexico.
Figure 11.—Female Melanopli, drawn to same scale (x 1½): A, Melanoplus mexicanus; B, Melanoplus femur-rubrum; C, Melanoplus lakinus; D, Melanoplus pictus; E, Melanoplus bivitatus; F, Melanoplus differentialis.
Melanoplus bivitattus (Say). Two-striped grasshopper (Fig. 11 E). Length: male, 1⅛ in.; female, 1½ in.; dark brownish black; two conspicuous, pale stripes on either side of pronotum; hind tibiae bluish black.

One of the most injurious species of grasshoppers in the western United States, but rather local in Arizona, occurring in damp, rich vegetation, usually in well-watered areas. Very destructive to alfalfa and rather important on red clover, grass, corn, wheat, barley, cabbage, beets, potatoes, onions, cane fruits, and deciduous fruit trees in the state.


Melanoplus gladstoni Scudder. Length: male, 1⅛ in.; female, 1¼ in.; heavily built; hind tibiae red or glaucous; subgenital plate of male unnotched; cerci short, uniform in width, apex rounded, outer apical half with a spoon-shaped concavity. Distincted from regalis by the more brownish coloration and type and size of male genitalia. Specimens from southern Arizona are larger than the northern ones. Adults, July 6 to October 29.

Most common in weedy places in the grasslands of the Upper Sonoran and Transition zones, but also found in the upper part of the desert grassland. It is an important species in the short grass ranges of northern Arizona.

Northern Mexico and southwest Texas north to plains of Nebraska, Montana, and Alberta, Canada.

Melanoplus regalis Dodge. Form and size like gladstoni, but readily distinguished by shorter wings; bright, variegated in brown, red, and green; male genitalia small; male cerci short, pointed; hind tibiae blue. Nymphs, April to June; adults, June to October.

Grasslands of southeastern Arizona, especially in association with curly mesquite (Hilaria belangeri) and grama grasses (Bouteloua spp.); west to Baboquivari Mountains and north to Empire Mountains, Pima County.

Arizona to southwestern Texas, western Kansas, eastern Colorado, and Nebraska; Sonora, Chihuahua, Coahuila, and Nuevo Leon, Mexico.

Melanoplus confusus Scudder. Size small; moderately long-winged; heavy black postocular bands on lateral lobes of pronotum; hind tibiae blue; cerci short, with tooth on lower margin, and broader in middle. Eggs, eight to twelve per pod; adults, May and June, unlike others of the genus.

In Arizona, taken only in the Lukachukai Mountains at 8,800 feet (Ball), feeding on Helensium hoopsii and other large-leaved herbs under Pinus ponderosa, Transition Zone.

The species ranges from Arizona to Texas and Alberta, Canada.

Melanoplus femur-rubrum De Geer. Red-legged grasshopper (Fig. 11 B). Length: male, ⅚ in.; female, ⅓ in.; greenish gray,
with yellow underparts; hind tibiae bright red; subgenital plate broadly rounded, lacking pointed and notched apex characteristic of *mexicanus* (Fig. 9; cf. 2 and 6).

One of the most destructive grasshoppers of the United States and Canada. In Arizona it is especially important on grain, beans, and alfalfa. On the eastern portions of the Mogollon Plateau, as at Springerville, Showlow, and Snowflake, this grasshopper is usually more important than *mexicanus*.

Kaibab, Coconino, and Mogollon plateaus in Arizona; north over northern United States and southern Canada.

*Melanoplus lakinus* Scudder (Fig. 11 C). Size, % to 1 in.; wings short, pointed; hind femora banded; hind tibiae deep blue; male cerci bulbous (Fig. 9 7). Long-winged forms are occasionally found, especially at high elevations. Eggs, twenty to twenty-five in a pod; adults July to November. The small, slightly recurved egg pods are deposited among the roots of plants such as the tall grass *Heteropogon*.

In southern Arizona this species does considerable damage to cultivated crops. Sugar beets and garden flowers are most frequently eaten. Does not feed to any extent on grasses or alfalfa. Many different weeds, especially of *Atriplex* and Russian thistle type, are eaten.

Upper Sonoran Zone and fringes of Lower Sonoran and Transition zones from about 2,000 to 8,000 feet.

Arizona to southwestern Texas, Kansas, Nebraska, Colorado, and Mexico.

*Melanoplus occidentalis* Thomas. Flabellate grasshopper. Length, % to 1 in.; in appearance similar to *mexicanus*; hind tibiae blue; wings not exceeding hind femora; male cerci very broad at base, tapering to rounded apex (Fig. 9 9). Adults, June to September.

An early season species, rather rare but widely distributed in the state; this does not appear to be of economic importance. Feeds largely on mallows such as *Sphaeralcea coccinea* and *Sida* sp. Most abundant in grasslands of Lower and Upper Sonoran zones and extending into Transition and Lower Canadian zones, from 3,800 to 9,000 feet.

Naco, Arizona, Huachuca and Chiricahua mountains are the most southern records.

Arizona to central Kansas, western Oklahoma, and north to the southern prairie provinces of Canada.

*Melanoplus mexicanus* Saussure. Migratory grasshopper (Fig. 11 A). Length: male, 1 in.; female, 1½ in.; light brown and yellow; hind tibiae red; male subgenital plate notched or bilobed at apex; male cerci broad. Males have a distinct swelling between the middle legs. Eggs, greenish white, twenty-five per pod, hatch intermittently; adults, April to October. The egg pod is slightly curved, about 1 inch long, and may be easily recognized by the brownish green froth and the heavily cemented sides.

This is the most injurious locust in the United States. While
important over all of Arizona, it is most abundant in the irrigated regions of the southern part of the state. It may be efficiently controlled by the use of poison bait, but because of its migratory habits in the states to the north and semimigratory habits in Arizona, it has been found necessary to resort to community action to control this species. Damage is most severe on cultivated crops, but grazing ranges may also be seriously injured.

Widespread in Arizona and the western United States.

*Melanoplus packardii* Scudder. Length: $\frac{7}{8}$ to 1 in. This species is very similar to *M. foedus* and can only be accurately separated by examination of the internal genitalia. Both species have coral red hind tibiae, but *packardii* is the smaller and darker of the two. About twenty eggs to a pod; adults, June to September.

Not usually abundant in Arizona but occasionally very injurious to alfalfa and cabbages near Springerville. Transition Zone and fringe of Upper Sonoran Zone in Yavapai County and on Mogollon Plateau from Flagstaff to White Mountains, 5,500 to 8,500 feet.

Arizona to Canada and Minnesota.

*Melanoplus foedus* Scudder. Length: male, 1% in.; female, 1\% in. Arizona specimens are larger and paler in color than *packardii*; some specimens can only be separated by study of the internal genitalia. Adults, late June through August.

This species also is injurious at times to cultivated crops in the St. Johns and Springerville districts. Usually found in grass and weeds in damper situations.

From northern Arizona (Fredonia, and Coconino and Mogollon plateaus), north over much of the western United States in Upper Sonoran and Transition zones.

California to Texas and north to Canada.

*Melanoplus angustipennis* (Dodge). Length, about 1 in. Very similar to *mexicanus* but smaller; more brownish; subgenital plate less produced. Taken August 1.

Very rare in Arizona; specimens only from Fort Apache and Sycamore Canyon, Apache County; 5,500 to 6,000 feet. This is a common plains species, which may become serious on pastures and range.

*Melanoplus arizonae* Scudder. Length: male, 1 in.; female, 1% in. Closely resembles *mexicanus* but usually darker and more heavily marked; apex of subgenital plate entire, rather than notched; hind tibiae blue (usually); furculae much larger. Adults, late May to October.

Lower Sonoran Zone; desert grasslands and northern grasslands, southeastern Arizona north to Aubrey Valley, Coconino County.

Arizona to Oklahoma, Kansas, southwestern Texas, and Mexico.

*Melanoplus herbaceus* Bruner. Arrowweed grasshopper. Length: male, 1 in.; female, 1\% in.; slender; greenish; wings without spotting; hind tibiae pale glaucous; furculae very broad,
narrowed before apex, and widened at apex. Adults, March 29 (Yuma) to October 9 (Tucson).

Almost entirely confined to arrowweed (Plucheasericea), along the margins of streams and arroyos in the Lower Sonoran Zone. Because of its restricted food habits will probably not prove injurious except in a small degree near the host plant. The adults will feed on anything available within about a quarter of a mile from the host.

Most common along the Colorado River from Yuma north to Littlefield, Coconino County, and east to Maricopa and Pima counties.

California to Texas and Mexico.

Melanoplus flavidus Scudder. Length, 1 to 1 1/8 in.; male cerci elongate, very slender, the rounded apices with merest trace of thickening. (Fig. 10 9.)

Hebard (1936b, p. 50) states that this species is an inhabitant of sandy areas. It feeds to some extent on alfalfa, vegetables such as cabbage, and fruit trees. A series taken on Artemisia at St. Johns, August 9, 1933 (Ball), is the only record for Arizona.

Melanoplus pictus Scudder. Length: male, 1 in.; female, 1 1/4 in.; similar to herbaceus but richer brown; hind tibiae deeper blue; male furculae narrower, apical half narrow and apex expanded into round lobes; male cerci very broad at base, narrowing decidedly to slightly expanded apex (Fig. 9 5). Eggs, sixteen to thirty-eight per pod; adults, May 19 (Yuma) to November 18 (Tucson).

This is not an important economic species but does considerable damage to small plantings of alfalfa, cotton, soybeans, and other cultivated crops. Common on many weeds and such plants as Hymenoclea monogyna, Baccharis glutinosa, Baccharis sarothroides, Flourensia cernua, and Suaeda.

Most common in the Lower Sonoran Zone but also found in the Upper Sonoran Zone from southern and western Arizona (Boulder Dam) to Granite Dells, Yavapai County, and Pinal Mountains.

Melanoplus bowditchi Scudder (atypical). Hebard states that this race is similar to that of the upper Rio Grande Valley in New Mexico. Taken among alfalfa and composites in the grasslands, Lupton and St. Johns, Apache County (Ball).

Melanoplus bowditchi Scudder, Typical of southern grasslands in Upper Sonoran and Transition zones. Widespread on northeastern Mogollon Plateau and higher elevations of Yavapai County, south to Tucson.

Melanoplus complanatipes Scudder. Recorded by Hebard from the western edge of Arizona, Yuma to Boulder Dam and Fredonia, and taken by Ball at Fredonia; Lower Sonoran Zone.

Arizona to Lower California and Mexico.

Melanoplus complanatipes canonicus Scudder. Length: male, 3 1/2 in.; female, 1 1/2 in.; slender; dark grayish; hind tibiae blue.

Described from the Grand Canyon, but typical of sagebrush (Artemisia tridentata) areas of the Great Basin Desert, Upper
Sonoran Zone. Our only record is from the Navajo Bridge, September 9, 1932, by Ball.

*Phoetaliotes nebrascensis* (Thomas) (Fig. 9 12). Length: male, ¾ in.; female, 1½ in.; greenish gray; usually short-winged; wing pads pointed; fore wing of long-winged form broad; head (especially of female) considerably inflated; male cerci short, tapering from base to acute apex; hind tibiae bluish green. Nymphs whitish, head and sides of pronotum black-streaked. Adults, July to October.

Very widespread in grasslands of Upper Sonoran Zone (usually) above 4,000 feet. An important range land species.

Southeastern Arizona and northern Mexico to western Texas and southern Canada.

*Bradydectes kaibab* Hebard. Length: male, % in.; female, 1 in.; robust; brownish; wings entirely lacking; prosternal spine low, pyramidal; pronotum distinctive, with lateral carinae two thirds of its length, and posterior margin slightly notched; legs light brown, hind tibiae red. Eggs, average seventeen per pod; nymphs may overwinter; adults, June to September.

Transition Zone, on rocky soil among pearly everlasting, *Potentilla*, a mat *Aster*, and a mat *Eriogonum*. The *Potentilla* appears to be the host plant.

Pleasant Valley and V. T. Ranch on Kaibab Plateau; one nymph from White Mountains (Ball), determined by Hebard.

Genus *Poecilotettix* Scudder. Very colorful grasshoppers, with green, red, blue, and yellow spots and stripes; wings fully developed; confined to Sonoran deserts.

*Poecilotettix sanguineus* Scudder. Red-lined grasshopper. Length: male, % in.; female, 1½ in.; long-winged; red line on middle of head and pronotum, the latter with two lateral red lines; antennae black; outer wings pale bluish green; hind tibiae dark bluish green with two patches of yellow above. Nymphs, March to late April; adults, April 1 to August.

Feeds on a number of shrubs such as *Baccharis wrightii*, *B. sarothroides*, *Hymenoclea salsola*, northern blackbrush (*Coleogyne ramosissima*), *Ephedra*, and large composites. *Baccharis wrightii* is apparently most important.

Lower and Upper Sonoran zones, southern and western Arizona. Specimens from the Gila Mountains, Yuma, Boulder Dam, Littlefield, Nevada, and California are more brightly colored than those from higher elevations. The dark form has been taken from Granite Dells (Yavapai County) southward to Phoenix, Gila Bend, Tinajas Altas, Nogales, the Santa Rita and Catalina mountains.

*Poecilotettix pantherinus* (F. Walker). Spotted grasshopper. Length: male, 1 in.; female, 1% in.; ground color, greenish yellow; head and pronotum with rows of black and white spots; antennae black with rings of white on alternate joints; prosternal spine very long, slender; fore- and middle legs, and femora of hind legs with rows of black spots; hind tibiae pale bluish green. Eggs,
average fifteen per pod; nymphs, April to August; adults, April to November.

One of the most beautiful grasshoppers of Arizona. Most common in the lower live oak belt in the Upper Sonoran Zone but also occurs in the Lower Sonoran Zone. The primary food plants appear to be low-growing sunflowers (Helianthus spp.). It has also been taken from other low plants such as Baccharis wrightii, B. sarothisoides, B. glutinosa, Eriogonum wrightii, Franseria, and in one place from Acacia.

South central Arizona from Bradshaw Mountains (Tinkham), and Casa Grande, south and east to Tombstone, and Sonora, Mexico.

*Perixerus gloriosus* Hebard. Length: male, % in.; female, 1 in.; short-winged; green, with bright dorsal stripe on head and pronotum; fore- and middle legs red, and hind femora red-bordered above and below; wing pads oval, green, widely separated. Eggs, laid December, hatch August or later; adults, October 10 to December and even January. The egg pod is covered with a brownish yellow cement, and the egg is pearly white with a broad but shallow cap.

A beautiful green species. The principal food plant appears to be *Baccharis wrightii* (Ball), but it is also found on B. sarothisoides, Gymnolomia (Tinkham), and Encelia (Flock).

Known only from the grass and live oak covered slopes of Atascosa Peak in the Tumacacori Mountains, near Mexican boundary, and west to Ruby (Flock).

*Dactylotum variegatum* (Scudder). Length: male, % in.; female, 1¾ in.; short-winged; black, with red, yellow, white, and blue markings; wing pads short, oval, well separated; pronotum evenly rounded but with definite grooves, posterior border obtusely angled with rounded apex. Eggs, overwinter; nymphs, June; adults, June to October.

An extremely colorful species; omnivorous; occasionally abundant in alfalfa fields but more common on plants such as *Baccharis sarothisoides*, *Grindelia*, and *Haplopappus*, usually on rocky or gravelly soil sparsely covered with grass and other plants.

Desert grasslands of Lower and Upper Sonoran zones and into Transition Zone in Arizona; to southwestern Texas and northern Mexico.

**FAMILY TETTIGONIIDAE. LONG-HORNED GRASSHoppers**

Many species of this large family are among the most attractive in appearance of the entire order. They are mostly large insects with long slender antennae; jumping hind legs; four-jointed tarsi; a sword-shaped ovipositor; and wings, if present, held roof-like over the body. The long-horned grasshoppers are not so easily seen as the short-horned grasshoppers because most of the species are active only in darkness. The group as a whole is somewhat omnivorous in food habits. Most feed on living plants, but some feed on insects or are scavengers. The stridulating or
Plate II.—A, Male *Microcentrum californicum*, from life, resting on citrus leaves, approximately natural size; B, grapefruit leaf with border of eggs of angular-winged katydid. (Photos by Vorhies.)

sound-producing organs are situated at the base of the wings, as in the crickets; while hearing organs, if present, are located on the
tibiae of the front legs. Most species can be identified by their songs and may often be most easily caught by following the sound at night.

The katydids are green or brown in color and very hard to see on the plants on which they live, while meadow grasshoppers are found near the ground in dense grass. Shield-back crickets are mostly ground inhabiting; cave or camel crickets live in caves or burrows and cracks in the ground; and the large, wingless sand crickets have strong legs adapted for burrowing in the ground.

Eggs of common katydids are flat, flaxseed-shaped, and are laid slightly overlapping in a neat row along a twig or forming a decorative border on the edge of a leaf (PL II B). Frequent inquiries are received from persons apprehensive of harm to the tree on which they are found. Few species are abundant enough to be of economic importance. Damage is most often caused by the angular-winged katydid, the bush katydid, and the Mormon cricket.

KEY TO SUBFAMILIES OF TETTIGONIIDAE

A. Wings present or represented by short pads; front tibiae with an auditory organ.

B. Mostly long-winged green species. First two tarsal joints without lateral grooves; ovipositor broad, flat, sharply curved upward.

Round-headed katydids—PHANEROPTERINAE (p. 348)

BB. Mostly short-winged. Wing covers as long as wings; ovipositor long, narrow.

C. Vertex produced forward into a long cone bearing a ventral tooth. Size large.

Cone-nosed katydids—COPIPHORINAE (p. 354)

CC. Vertex much less produced and without ventral tooth.

D. Form slender. Pronotum normal in size; hind tarsi without plantula.

Meadow grasshoppers—CONOCEPHALINAE (p. 355)

DD. Form robust. Pronotum large, produced over base of abdomen, often concealing rudimentary female wing covers; hind tarsi with free plantula at base of first segment.

Shield-back crickets—TETTIGONIINAE (p. 356)

AA. Wings absent; front tibiae without auditory organ.

B. Head large; antennal bases widely separated; tarsi with pulvilli.

Sand crickets—STENOPELMATINAE (p. 360)

BB. Head smaller; antennal bases very close together; tarsi without pulvilli.

Camel crickets—RHAPHIDOPHORINAE (p. 360)

SUBFAMILY PHANEROPTERINAE. ROUND-HEADED KATYDIDS

KEY TO GENERA OF PHANEROPTERINAE

ta. Wings short; antennae very long; fore coxae unarmed; color brown.

Short-winged katydid—Dichopetala (p. 348)
lb  Wings usually long; antennae moderately long; fore coxae bearing a spine; usually green.

2a. Size small, less than 1½ inches; fore wing narrow, hind margin usually sinuate; pronotum saddle-shaped.

3a. Comparatively robust species; fore wings rather broad, frequently barred with white; hind wings not over ¼ inch longer than fore wings; dorsal abdominal segments with margins straight or crenulate. Usually found in bushes and trees.

Dwarf katydids—Insara (p. 349)

3b. Extremely slender long-legged species; wings if present uniformly colored and fore wings more than ¼ inch shorter than hind wings; dorsal abdominal segments with margins angularly produced in the center. Found in grass and low plants.

Grass katydids—Arethaea (p. 352)

2b. Size large, more than 1½ inches; pronotum not saddle-shaped, with hind margin broadly rounded.

3a. Fore wing long and narrow, but little wider at middle than at apex; fastigium between antennae little wider than first antennal segment.

Bush katydids—Scudderia (p. 353)

3b. Fore wing distinctly wider at middle than at apex; fastigium much wider than first antennal segment.

4a. Hind femora short, less than two thirds as long as wing covers; metasternal lobes elongate; ovipositor short, bent abruptly upwards. Common.

Angular-winged katydid—Microcentrum (p. 354)

4b. Hind femora nearly as long as wing covers; metasternal lobes rounded; ovipositor long, gently curved. Rare.

Amblycorypha (p. 354)

Dichopetala brevihastata Morse. Short-winged katydid (PL III 8). Length: male, ½ in.; female, 1 in.; antennae, 2½ in.; short-winged; antennae extremely long; reddish brown to greenish brown with (sometimes) a white line down the lateral carina of the pronotum and the side of the abdomen. Nymphs, August and early September; adults, August to October 15.

Ball found the flat eggs of this species deposited in rows in the blades of the grass Sporobolus airoides near Willcox, Arizona. Feeds on many low plants, including grasses, burroweed (Haplopappus), and wild cotton (Thurberia). Desert grasslands of the Lower and Upper Sonoran zones. Southern Arizona west to the Baboquivari Mountains, north to the Catalina Mountains, and the north end of the Chiricahua Mountains.

Arizona to southwestern Texas and Mexico.

Genus Insara Walker. Dwarf katydids. Greenish- or white-marked katydids less than 1½ inches in length. Common bush- and tree-inhabiting species. (Rehn and Hebard, 1914a.)

Insara elegans elegans Scudder. Mesquite katydid (PL III 7). Length: 1¾ in.; slender; wing covers light green with seven to
eight bands of white and a darker shade of green; abdomen with small lateral black marking. Overwinters in egg; nymphs, April 22 to August 14; adults, June to September; recorded to November 18 (Tucson).

Lives on mesquite (*Prosopis*), catclaw (*Acacia greggii*), and other spiny shrubs and trees. From Lower Sonoran Zone into Upper Sonoran Zone to about 4,400 feet in the southern mountains. Southern Arizona north to Ashfork, Bill Williams Fork, and Littlefield.

Arizona to Mexico, New Mexico, and southwestern Texas.

*Insara elegans consuetipes* (Scudder). A pale brownish yellow to green race which lacks the markings on the wing covers. Nymphs, March to May; adults, April 11 to October 30.

Taken on various plants, including mesquite (*Prosopis*), willow (*Salix*), desert willow (*Chilopsis linearis*), arrowweed (*Pluchea sericea*), creosote bush (*Larrea*) (once), and low composites. Extreme desert region of western Arizona from Yuma to Littlefield and east to Phoenix.

Arizona to California and Nevada.

*Insara apache* (Rehn). Length: 1% in.; robust; uniform pale green with no markings; fore wings wide, not sinuate on hind margin. Adults, July 15 to August 2.

A very rare species taken in clump grass in the Upper Sonoran Zone in southern Arizona above 4,500 feet. Huachuca Mountains (Rehn [type], Ball, and Tinkham), Catalina Mountains (Flock); Santa Rita Mountains (Tinkham); and Pleasant Valley, Gila County (Ball).

*Insara covilleae* Rehn and Hebard. Creosote-bush katydid (PL III 9). Length, 1% in.; green, beautifully marked with brown; fore wings with five large white markings; pronotum bordered with white, distinctly saddle-shaped. Eggs flat, black; nymphs, March to August; adults, May to October.

Found only on creosote bush (*Larrea divaricata*) on which its bright colors make it very hard to see. In color it closely resembles the creosote-bush grasshopper (*Bootettix punctatus*).

Occurs over most of the creosote bush desert from Altar, Sonora, Mexico, north to Boulder Dam, Yarnell Heights, Globe, and Duncan, Arizona.

*Insara tessellata* Hebard. Checkered katydid. A beautiful katydid similar to *Insara juniperi* Hebard; gray marbled; fore wings with pale areas as broad as long and as large as the intervening green areas; lateral lobes of pronotum longer than deep.

A rare species occurring in the Upper Sonoran Zone of northwestern Arizona. Recorded by Hebard (1935c, p. 308) from the Hualapai Mountains (type), Prescott, Kingman, and Boulder Spring. One nymph, Ashfork, July 1, 1932 (Ball).

*Insara juniperi* Hebard. Jumper katydid. Length: 1% in.; beautiful green, white mottled; fore wings with row of bars some-
what as in *elegans*; legs banded; pronotum less saddle-shaped than in *coyiiae*.

Described by Hebard (1935) from Santa Fe County, New Mexico, at 7,000 feet elevation. Found on juniper on the Arizona and New Mexico plateau. Taken by Ball at Superior, Arizona, July 17, 1935, and July 7, 1936 (nymph); and at Black River (4,500 feet), August 28, 1936.

Genus *Arethaea* Stal. Grass katydids. Small, light green katydids with very long slender legs and fore wings. They are very hard to see in their usual habitat on narrow-leaved grass or other low plants. Although most closely associated with various grasses, they occur on other low plants, and Tinkham has recorded them feeding commonly on the flowers of *Eriogonum* sp. Usually rather rare and hard to find but occasionally attracted to lights in numbers. The genus is almost entirely confined to the semiarid Southwest and adjacent northern Mexico. (Hebard, 1936a.)

*Arethaea coyotero* Hebard. Female, short-winged. Adults, July to September.

Lower and Upper Sonoran zones from 5,500 to 7,300 feet in Arizona, and from 2,300 to 6,000 feet in Nevada. Recorded by Hebard (1935b, p. 132) from Senator, Kingman, Granite Peak, Mount Tyndall, and (type) Prescott.

*Arethaea gracilipes gracilipes* Thomas. A specimen from Pine, Arizona, is considered by Hebard (1935c, p. 308) probably to belong here.

*Arethaea* sellata Rehn. Length: male, 1\(\frac{3}{4}\) in.; female, 1 in.; female short-winged, wings shorter than pronotum; first abdominal segment of male not specialized. Nymphs, June to August; adults, June 8 to August 25.

Upper Sonoran Zone and upper edge of Lower Sonoran Zone. Taken on *Mimosa*, low second-growth oak, and grass by Ball.
Southeastern Arizona in the Chiricahua, Huachuca (type), Santa Rita, Patagonia, and Washington mountains.

*Arethaea carita* Scudder (PL III 12, 13). Length: male, 1% in.; female, 1 in.; wings of female much shortened but longer than pronotum; first abdominal segment of male not specialized. Adults, August 21 to October 21.

Open grassy areas in the Lower Sonoran Zone from 2,300 to 5,600 feet. More common at a lower elevation than *sellata*. Southeastern Arizona, northwest to the Catalina Mountains, east to central northern New Mexico; northern Chihuahua.

*Arethaea polingi* Hebard. Female short-winged.

Northwestern Arizona at Prescott (type), Truxton, and Kingman (Hebard); and Glenn Oaks, August 19, 1933, in dense growth in canyon bottom (Ball).

*Arethaea brevicauda* (Scudder). Wings of female short. Adults, May, June, July, and August. Tinkham says chiefly in egg stage in summer.

Hebard (1935c, p. 309) records this species from Boulder Springs, near Kingman. Northwestern Arizona to southern Nevada and southern California.

*Genus Scudderia* Stal. Bush katydids. The bush katydids are medium-sized green insects with narrow wings and antennae close together. The last dorsal segment of the male is greatly prolonged, curved, and forked.

These insects are common, and frequently seen, over most of the state on bushes and other low vegetation. More common in the damper situations along stream beds and the edges of cultivated areas. The large flat eggs are laid on the margins of leaves and sometimes in rows along small twigs. In the Tucson region the eggs are frequently parasitized by a small parasitic wasp, *Anastatus* sp. (Det. Gahan). (Rehn and Hebard, 1914b.)

*Scudderia furcata furcifera* (Scudder). Forked-tail katydid (PL III 6). Length, both sexes: 1% in.; forks of last abdominal segment spherical, nearly as long as broad. Adults, June to October.

This species is occasionally common enough to be of economic importance. Horton and Pemberton (1915) report a loss of one fourth of the crop in certain citrus orchards in the San Joaquin Valley, California. In this case damage was caused by feeding on blossom buds and young fruit. The species also feeds on foliage, especially tender new growth.

Common over most of the state but most abundant in the higher elevations and northern part of the state in the Upper Sónoran Zone. Huachuca, Tumacacori, and Santa Rita mountains north to Lupton, San Francisco Mountain, the Kaibab Plateau, and Littlefield.

Arizona to southern California, Nevada, Colorado, and Texas.

*Scudderia mexicana* (Saussure). Mexican katydid (PL III 5). Length: male, 1% in.; female, 1% in.; forks of last abdominal segment laterally flattened. Adults, June to November.
Very common in southern Arizona west to Ajo Mountains, and north to Pinal Mountains.
Arizona to California, Texas, Mexico, and Guatemala.

*Amblycorypha insolita* Rehn and Hebard. Round-headed katydid (PL III 1. 2). Length: 2 in.; robust; green, often marked with purple spots on fore wings; legs long; ovipositor long, rather straight. Eggs overwinter and are deposited in the ground; adults, July to September.

An extremely rare species found on low bushes in the Upper Sonoran Zone of southern Arizona. Catalina and Pinal mountains (Ball); Baboquivari Mountains (Tinkham); Oak Creek Canyon (Snow).

Arizona to southwest Texas and Mexico.

Genus *Microcentrum* Scudder. Large green katydids with broad fore wings. Two species are found in Arizona, one of which, the angular-winged katydid, is very common in the southern portion.

*Microcentrum californicum* Hebard (PL III 4). Length: male, 1% in.; female, 2 in.; fore margin of pronotum concave; fastigium broad; styles on subgenital plate small, cerci slender. Adults taken in September. (Hebard, 1932a, p. 322.) The song of this species is quite distinct from that of *rhombifolium*. Rarely seen in its natural habitat because it lives in the tops of oak trees. Taken at lights by Tinkham.

Upper Sonoran Zone of southern Arizona east to the Baboquivari Mountains and north to Kingman (Hebard).

Arizona to California and Lower California.

*Microcentrum rhombifolium* (Saussure). Angular-winged katydid (PL III 3). Length: male, 2 in.; female, 2½ in.; front margin of pronotum with a median tooth. Overwinters in egg; the large, flat eggs are glued in double rows on the sides of slender twigs or on edges of leaves (PL II B); nymphs, March to August; adults, June to December.

Most common on willows and cottonwood, but found on many other plants. In cultivated areas most common on ornamental and citrus trees (PL II A). Seldom, if ever, common enough to be of economic importance.

Southern United States from the Pacific Coast to the eastern United States and north to Utah, Colorado, and Kansas.

**SUBFAMILY COPIPHORINAE. CONE-NOSED KATYDIDS**

*Neoconocephalus triops* (Linnaeus). Cone-nosed katydid (PL III 10). Length: male, 2 in.; female, 2¼ in.; general color brown, sometimes green; head prolonged into a cone, bearing pointed tooth beneath at tip; ovipositor 3 to 4 in. long, straight, narrow; fore wings longer than hind wings. Overwinters as nymph or adult. Nymphs, September to November; adults nearly every month of the year, but most common in the spring. The song is very loud.
Most common in dense, low vegetation, and especially common on Johnson grass (*Sorghum halepense*) and other rank grasses including cultivated corn, sorghum, and hegari. Lower Sonoran Zone of southern Arizona.

Arizona to southern California and the eastern United States.

**SUBFAMILY CONOCEPHALINAE. MEADOW GRASSHOPPERS**

Small, slender-bodied, long-horned grasshoppers in which the ovipositor is long and narrow and the head is cone-shaped. Most common in the dense growth in damp meadows and the margins of ditches, ponds, and streams. They are occasionally quite common in dense grass on the range.

**KEY TO GENERA OF CONOCEPHALINAE**

1a. Prosternal spines cylindrical, slender, 18 mm. or longer; ovipositor upcurved.  
   *Orchelimum*

1b. Prosternal spines very short or wanting; ovipositor nearly straight; wings usually short, less than 17 mm.  
   *Conocephalus*

**GENUS ORCHELIMUM SERVILLE. KEY TO SPECIES**

Apex of cercus not decidedly acuminate; tooth of cercus not distinctly ventro-mesad in insertion.  
*O. concinnum delicatulum*  
Apex of cercus decidedly acuminate; tooth of cercus diverging from ventral internal face.  
*O. unispina*

*Orchelimum concinnum delicatulum* Bruner. Adults, June to October.  
Southern and western Arizona. This species is widespread in North America.  
*Orchelimum unispina* (Saussure and Pictet). Length: male, 1¾ in.; wings long.  
Desert grassland of Upper Sonoran Zone. A very rare species in Arizona. Its capture by Ball in the Baboquivari and Tumacacori mountains marks a great extension northward of its previously known range in central and south central Mexico.

**GENUS Conocephalus THUNBERG. KEY TO SPECIES**

Wings short, not reaching apex of hind femora; apex of cerci broad and rounded.  
*C. strictus*

Wings long, reaching beyond apex of hind femora.  
*C. fasciatus vicinus*

*Conocephalus strictus* (Scudder) (PL III 11). Length: male, % in.; female, 1% in. Nymphs, June to September; adults, September to November.  
Rank grasses of the desert grassland. Southeastern Arizona, from Douglas, Naco, and Bisbee, to the Tumacacori and Baboquivari mountains.
Widely distributed in the western United States.

*Conocephalus fasciatus vicinus* (Morse). Length: male, \% in.; female, 1 in. Nymphs, June; adults, June to September.

Habitat, very damp meadows. Northern Arizona at St. Johns, Littlefield, and Cornville; one record from Buckeye.

In the United States west to Arizona, Wyoming, and Montana.

SUBFAMILY TETTIGONIINAE. SHIELD-BACK CRICKETS

Members of this subfamily have the pronotum enlarged and produced shield-like over the base of the abdomen. The free plantula at the base of the first joint of the hind tarsus is usually conspicuous (Caudell, 1907). While in three species the wings are long and capable of flight, they are usually very short. The short-winged species are stout, ground-inhabiting forms. The “Mormon cricket” is the only one of great economic importance, but all feed on plants to some extent. Many are predacious to some extent and may be beneficial.

KEY TO ARIZONA GENERA OF TETTIGONIINAE

1a. Wings fully developed, extending beyond the tip of the abdomen in both sexes.

2a. Prosternum armed with a pair of spines; posterior femora armed below on apical half with several distinct spines, *Capnobotes* (p. 356)

2b. Prosternum unarmed; posterior femora unarmed below.

*Anoplodusa* (p. 358)

1b. Wings short; scarcely longer than pronotum, and often, especially in the female, rudimentary or wanting,

2a. Pronotum without indications of lateral carinae on anterior half, or indicated only by color.

3a. Size large; pronotum \( \frac{1}{2} \) in. or more in length, with distinct lateral and median carinae on the posterior half.

*Anabrus* (p. 358)

3b. Size small, pronotum \( \% \) in, or less in length, without carinae on posterior half.

4a. Lateral lobes of pronotum not well developed; anterior tibiae of female rarely with more than one dorsal spine.

*Ateloplus* (p. 360)

4b. Lateral lobes of pronotum well developed; anterior tibiae of both sexes with more than one spine.

*Eremopedes* (p. 359)

2b. Pronotum with prominent lateral carinae except on anterior one fifth.

*Plagiostira* (p. 358)

Genus *Capnobotes* Scudder. Large shield bearers; wings longer than the body; mottled gray or green. The two species are extremely wary and hard to find, as well as being quite rare. They are to a large extent predacious on other insects.

*Capnobotes fuliginosus* (Thomas) (PL IV 1). Length: male, \( 2\frac{1}{2} \) in.; female, \( 2\% \) in.; body and fore wings mottled gray; hind wings sooty; ovipositor distinctly shorter than hind femora.
Plate IV.—Some Arizona species of Tettigoniinae: 1, Capnobotes fuliginosus, female; 2, Anabrus simplex, male; 3, Capnobotes occidentalis, female, gray phase; 4, Atelopus minor, male (type); 5, Anabrus simplex, female; 6, Eremopedes bilineatus, male; 7, Eremopedes bilineatus, female; 8, Eremopedes scudder, male; 9, Eremopedes balli, male (type); 10, Eremopedes balli, female (type); 11, Eremopedes balli, male; 12, Eremopedes balli, female; 13, Atelopus schwarzi, male; 14, Atelopus schwarzi, female; 15, Eremopedes ephippiatus, male; 16, Plagiostira albonotata, male; 17, Plagiostira albonotata, female; 18, Eremopedes ephippiatus, male. (Photo by Tinkham from mounted specimens.)
Probably overwinters in egg; nymphs, March to July; adults, May to October. The song is loud, long, and continuous.

Taken on many plants, including trees such as mesquite (*Prosopis*) and palo verde (*Cercidium aculeatum*); bushes, *Atriplex*, *Hymenoclea*, and *Haplopappus*; and grasses.

Southern and western Arizona in the Lower and Upper Sonoran zones, west to the Kofa Mountains, and north to Boulder Dam.

Arizona to Utah, Nevada, California, and Mexico.

*Capnobotes occidentalis* (Thomas). Clear-winged shield bearer (PL IV 3). Length, about 2 in.; gray or greenish finely marked with white, especially on the fore wings. Adults, July and August.

A Great Basin insect found in the juniper-piñon association and desert of the Upper Sonoran Zone. Northern Arizona (Littlefield, Ball) to California, Utah, New Mexico, and southern Idaho.

*Anoplodusa arizonensis* Rehn. Length: 2 in.; wings long; greenish or buff with large ivory-white markings on pronotum and fore wings. Adults, April to July.

Taken on creosote bush desert at Florence, Arizona (type); Nevada (Rehn and Hebard); and California (Tinkham). Previously rare, this species was taken in some numbers at night in July, 1941, by Mrs. H. K. Gloyd, near Florence.

*Plagiostira albonotata* Scudder (PL IV 16, 17). Length: male, 1 in.; female, 2 in.; green and brown with white markings; lateral keels of the pronotum prominent. Overwinters in egg; nymphs, June and July; adults, July to September.

Common on low plants such as sagebrush (*Artemesia tridentata*), *Atriplex confertifolia*, and snakeweed (*Gutierrezia*).

Great Basin desert of Upper Sonoran Zone; northern Arizona at Springerville, Lupton, Painted Desert, and Winslow, west to Williams, Peach Springs, the Kaibab Plateau, and Fredonia.

*Anabrus simplex* Haldeman. Mormon cricket (PL IV 2, 5). Length: male, 1 in.; female, 1½ in.; very stout; wings absent; dark brown, black, or green; ovipositor curved upward and about the same length as the hind femora. Overwinters in egg (deposited in the ground); adults, June to August in Arizona.

An extremely destructive species in the states north of Arizona but rare and not reported to be of economic importance in Arizona. This is the grasshopper which was so important in the early days of Mormon settlement in Utah. Feeds on low succulent vegetation and many other plants as well as other insects and dead animals to some extent. May be controlled by poison baits, but control by barriers is often more effective. The species commonly breeds on dry, sparsely vegetated hillsides and migrates into cultivated areas and range land.

Taken in Arizona only in Pleasant Valley, 7 miles north of "V. T. Ranch" (Kaibab Plateau) on lime rock cliffs (Ball). Widespread in the northern Rocky Mountain states, north to Canada.
Genus *Eremopedes* Cockerell. Medium-sized, short-winged shield bearers; grayish or greenish, often with pale dorsolateral markings; pronotum slightly longer and narrower with deeper lateral lobes than in *Ateloplus*. Like that genus, found on the ground and in buildings, pack rat dens, and other protected places. Like most of the subfamily, it is nocturnal in habits.

**KEY TO SPECIES OF *Eremopedes***

1a. Cerci long and slender, with median tooth; outer pagina of hind femora not striped with black.
   
   2a. Color green, with prominent white dorsolateral stripes.
      
      *E. bilineatus*
   
   2b. Color green or gray.
      
      *E. scudderi*

1b. Cerci short and broad, with inner apex toothed; outer pagina of hind femora with two basal black stripes; color dark.
   
   2a. Size smaller; undersurface yellowish; cerci longer.
      
      *E. balli*
   
   2b. Size larger; cerci short and broad.
      
      *E. ephippiatus*

*Eremopedes scudderi* Cockerell (PL IV 8). Color variable; green or gray; sometimes with a white or buff dorsal band or faint pink stripes on the abdomen. Adults, July to September.

The only Arizona record is from 4 miles east of Concho, July 16, 1940 (Tinkham), on *Yucca buccata*.

Northeastern Arizona to Colorado, New Mexico, Texas, and Mexico.

*Eremopedes bilineatus* (Thomas) (PL IV 6, 7). Length: male, 1 in.; female, 2 in.; greenish with white dorsolateral stripes. Nymphs, April to September; adults, July to October.

Active during the day; very common on many low perennial plants and bushes. Lower Sonoran Zone, extending into the Upper Sonoran Zone. Southern and western Arizona (type locality, San Carlos), north to Boulder Dam and Peach Springs.

Arizona to Nevada, California, New Mexico, and Mexico.

*Eremopedes balli* Caudell (PL IV 9, 10, 11, 12). Length: male, % in.; female, 1½ in.; dark brown; two black stripes on hind femora; ventral portion of abdomen sulphur yellow in life. Nymphs, June to August; adults, July to September.

Usually found among fern and grasses or in nooks in trees or houses. Upper Sonoran and Transition zones of Mogollon Plateau and higher mountains. Type locality, Williams.

*Eremopedes ephippiatus* (Scudder) (PL IV 15, 18). Length: male, 1 in.; female, 1% in.; female femora over 19 mm. long; dark brown, with two black stripes on hind femora. Nymphs, May to July; adults, July to November.

Most common in the Upper Sonoran but also found in the Lower Sonoran Zone. Southeastern Arizona north to Phoenix and west to the Baboquivari Mountains.
GENUS *Ateloplus* Scudder. **KEY TO SPECIES**

Medium-sized species very similar to *Eremopedes*. Pronotum short, the posterior margin truncate, and lateral lobes shallow; fore tibiae armed above on outer side, usually with one spine.

1a. Size medium to small; cerci almost as broad as long with a short-toothed inner prominence.

2a. Outer and apical margins of cerci acute angled; size larger.
   *A. schwarzi*

2b. Outer and apical margins of cerci obtuse angled; ovipositor nearly as long as posterior femora; size smaller.
   *A. minor*

1b. Size small; cerci much longer and narrow with an apical or subapical tooth directed inwards.
   *A. coconino*

*Ateloplus minor* Caudell (PL IV 4). Described from Oracle, Arizona, in the Upper Sonoran Zone.

*Ateloplus schwarzi* Caudell (PL IV 13, 14). Length: male, % in.; female, 1% in.; adults, July and August.

This nocturnal insect is usually found on the desert floor or in pack rat dens.

Lower Sonoran Zone of southern Arizona. Tinajas Altas (type), Phoenix, Santa Rita Mountains, and Mescal. Hebard (1935c, p. 312) records it from the Baboquivari Mountains, Jerome, Florence, and Hot Springs.

*Ateloplus coconino* Hebard. Recorded by Hebard (1935b, p. 140) from Bill Williams Fork (type), Kingman, Yucca, and Ashfork. Taken by Ball at Bill Williams Fork in June.

**SUBFAMILY STENOPELMATINAE. SAND CRICKETS**

The members of this subfamily are also called Jerusalem crickets and are known by the Mexicans as "child of the earth." These are wingless species with strong, spiny legs, and a large inflated head with powerful jaws, with which they can bite severely. They are nonpoisonous, though much feared in this region. They live in the soil or under stones and other objects and are able to burrow rather rapidly. Their food consists, to a large extent, of other insects.

*Stenopelmatus fuscus* Haldeman. Length, 1½ in. Adults, June to September.

Upper Sonoran and Transition zones. Widespread in the western United States east to Kansas.

*Stenopelmatus intermedius* Davis and Smith. The anterior plate of the prosternum is truncate rather than rounded (Davis and Smith, 1926, p. 178).

Upper Sonoran and Transition zones; Arizona and California.

**SUBFAMILY RHAPHIDOPHORINAE. CAMEL CRICKETS**

Brown wingless species, with body curved or humped, rather than flattened as in the true crickets. Although very common,
they are not often noticed, since they are nocturnal in habit or live in caves or other cavities in the ground.

*Gammarotettix apache* Rehn. Basal segment of hind tarsus produced above into spikelike process; fastigium between antennae biconical (Rehn, 1940).

This Arizona species of a west coast genus is known only from a male from the Black River (east central Arizona), August 17, 1932 (Ball). Probably taken by sweeping underbrush (not subterranean).

Genus *Ceuthophilus* Scudder. This is the largest genus in the subfamily and is very thoroughly discussed by Hubbell (1936).

*Ceuthophilus utahensis* Thomas. Northern Arizona at Bright Angel Point and San Francisco Mountain to Jerome.

Arizona to Utah, Idaho, Colorado, Oklahoma, and Texas.

*Ceuthophilus yavapai* Hubbell. Northern Arizona from Mt. Trydal, 7,300 feet (type), to Flagstaff (Hebard) and San Francisco Mountain (Ball).

*Ceuthophilus paucispinosus* Rehn. High elevations in the Huachuca Mountains.

*Ceuthophilus pima* Hubbell. Transition Zone in Santa Catalina (type) and Santa Rita mountains, southern Arizona.

*Ceuthophilus chiricahuae* Hubbell. Upper Sonoran Zone; Chiricahua (type) and Pinaleno mountains.

*Ceuthophilus hualapai* Hubbell. Northeastern Arizona from the Hualapai (type) and Cerbat mountains in southern Mohave County.

*Ceuthophilus baboquivariae* Hubbell. Baboquivari Mountains, 4,000 to 5,000 feet elevation.

*Ceuthophilus papago* Hubbell. Lower edge of Upper Sonoran Zone, Santa Catalina Mountains, southern Arizona.

*Ceuthophilus pinaleno* Hubbell. Upper Sonoran and Transition zones, Pinal Mountains.

*Ceuthophilus tinkhami* Hubbell. Chiricahua Mountains, 8,900 feet.

*Ceuthophilus arizonensis* Scudder. High elevations in the region of Prescott (type), Hualapai, White, Santa Catalina, and Chiricahua mountains.

Arizona to New Mexico.

*Ceuthophilus pallidus* Thomas. A very common and widespread species from desert grasslands of the Lower Sonoran Zone, Arizona, to the Great Plains. Santa Rita, Chiricahua, and Catalina mountains (Hubbell), Douglas (W. W. Jones), Prescott, and Flagstaff.

Southern Canada to Texas and northern Mexico.

*Ceuthophilus fossor* Hubbell. In dens of banner-tailed kangaroo rat (*Dipodomys spectabilis*), Tucson (type) and Santa Rita Experimental Range (Vorhies). Desert and desert grassland of Lower Sonoran Zone, southeastern Arizona.

Southern California and Nevada.
Ceuthophilus lamellipes Rehn. Hind tibiae of male strongly bent.

Desert region of Arizona in Cochise, Pima, Maricopa, and Conconino counties to Utah. Type locality, Phoenix.

Ceuthophilus wheeleri Hubbell. Hind tibiae of male strongly bent.

Type series taken in Ramsay Canyon, Huachuca Mountains, 4,800 feet.

Pristoceuthophilus arizonae Hebard. Base of hind tibiae of male strongly bowed out; on vertex, between the antennae, is a downward projecting horn (Hebard, 1935c, p. 144).

Upper Sonoran and Transition zones of southeastern Arizona. Catalina (type), Pinaleno, Santa Rita, and Chiricahua mountains.

Styracoceles neomexicanus (Scudder). Robust; dark brown, with no lighter markings; legs short; ovipositor short.

Transition Zone, Chiricahua, Pinaleno, White, and San Francisco mountains, Flagstaff, and Yavapai County, Arizona; to New Mexico and Colorado.

Daihiniodes hastiferum Rehn, Fore tarsi 3-jointed.

This burrowing camel cricket is recorded from San Carlos, Arizona, by Hebard.

Arizona to New Mexico and Colorado.

Ammobaenetes sp. Fore and middle tarsi 3-jointed.

Southeastern Arizona (Ball) and northeastern Arizona (Tinkham).

FAMILY GRYLLIDAE. CRICKETS

The crickets are grasshopperlike Orthoptera with jumping hind legs, long, round antennae, 3-jointed tarsi, and a spear-shaped ovipositor. The wings, if present, are flat upon the body with outer portions turned abruptly downward, rather than roof-shaped as in the grasshoppers and katydids. Some species live on the ground and others live chiefly in bushes and trees. All are rather omnivorous in their food habits. They are chiefly nocturnal, and their songs may be heard most of the year in the warmer areas. The sound-making organs are located on the outer wings of the male, and the hearing organs are on the front tibiae. The field crickets are of major economic importance, while the tree and lawn crickets are of minor importance in the state. (Blatchley, 1920; Hebard, 1934b.)

ECONOMIC IMPORTANCE AND CONTROL

Injury by crickets to cultivated crops is much more important than is generally believed, because of their nocturnal-feeding and day-hiding habits. The crickets have biting mouthparts, and their damage to plants greatly resembles that of grasshoppers. They are, however, more apt to feed on flowers and developing seeds as well as on underground parts. Cotton leaves may be conspicuously eaten along the midrib, and often many small dried leaf
fragments are to be found on the ground under the plant on which they have been feeding.

Crops of wide variety are seriously injured by crickets. As with grasshoppers, the damage is apt to be most severe on land unbroken during the winter. Alfalfa, cotton, grains, watermelon, cantaloupes, cucumber, tomatoes, and most of the vegetable crops may be damaged by crickets. Sprouting seeds and young plants of crops such as cotton may be eaten to such an extent that replanting is necessary. On very young plants the injury is to the stem, but on older plants the apical bud, leaves, or flowers may be injured. Injury to alfalfa is important chiefly because of the destruction of flowers and developing seed. Severin states that in South Dakota the entire seed crop of alfalfa in certain fields is sometimes destroyed in 7 to 10 days.

Field control of crickets is best accomplished by poison baits. While the ordinary grasshopper baits are satisfactory, a slightly stronger concentration of arsenic may be used to advantage. Munroe and Carruth recommend the use of sodium fluosilicate rather than arsenicals, according to the following formula.

\[
\begin{align*}
\text{Bran} & : 50 \text{ lbs.} \\
\text{Sodium fluosilicate} & : 2.5 \text{ lbs.} \\
\text{Molasses (cane)} & : 1 \text{ gal.} \\
\text{Water} & : 6 \text{ gals.}
\end{align*}
\]

Molasses is the best material to make the bait attractive to the crickets. Meat products (sometimes recommended) at best probably only make the bait more expensive. The bodies of the crickets which first die of poison will serve as the best meat bait. Other materials, such as watermelon and cantaloupe pulp in season, may also be used as the flavoring of cricket bait. Baits should be scattered thinly over the field in the evening.

Thorough plowing, harrowing, or diskng of fields during the winter is effective in destroying many of the overwintering eggs, as well as some of the hibernating nymphs and adults. Cotton sown after a winter grain crop on land not plowed in January is apt to be especially badly damaged. T. P. Cassidy found that irrigation during the day on dry, cracked soil at Eloy and Maricopa was effective in sealing in enough crickets to prevent serious damage to cotton.

Crickets of the common field variety are often very serious pests in houses, some being attracted by lights at night and others by foods and shelter. The cricket problem in houses is similar to the cockroach problem. They do much the same damage in eating foodstuffs but are also destructive to clothing and other fabrics, especially those which have been soiled by perspiration. Crickets may be controlled by dusting the corners and cracks which they frequent with roach powders, such as a mixture of sodium fluoride and pyrethrum. They may also be controlled by the use of the baits recommended for field control. The bait may be placed in small containers where the crickets are found, but care must be taken that children or pets do not have access to it. A bait may
also be made of fruit or other attractive material mixed with Paris green or other bait poisons.

**KEY TO THE SUBFAMILIES OF GRYLLIDAE**

A. Hind legs armed with rows of long spines on tibiae.

B. Form robust; brown or black; head vertical.

C. Free living species. Medium to large size; winged, at least in the adult male; spines of hind tibiae without small teeth between.

D. Hind tibiae armed with fixed long spines; no large bristles on body or legs; medium to large size.

Field Crickets—**GRYLLINAE** (p. 364)

DD. Tibiae armed with long, movable spines; many bristles on body and legs; smaller.

Lawn crickets—**NEMOBINAE** (p. 365)

CC. Inhabitants of ants' nests; wingless; hind femora enormously enlarged; eyes small; minute size.

Ant-loving crickets—**MYRMECOPHILINAE** (p. 368)

BB. Form slender; greenish; hind tibiae armed with long, delicate spines with minute teeth between; head horizontal.

Tree crickets—**OECANTHINAE** (p. 366)

AA. Hind legs without rows of long spines on tibiae.

B. Hind tibiae with rows of short teeth, but no long spines; body covered with scales; tarsi 3-segmented.

Wingless bush crickets—**MOGOPLISTINAE** (p. 368)

BB. Hind tibiae with flat plates for walking on water; front legs specialized for burrowing; tarsi with less than 3 segments.

Pygmy mole crickets—**TRIDACTYLTINAE** (p. 369)

**SUBFAMILY GRYLLINAE. FIELD CRICKETS**

This subfamily includes our most common and important crickets, and two less common forms. These robust brown or black crickets are easily recognized by the rows of fixed spines on the tibiae of the hind legs.

**KEY TO ARIZONA SPECIES OF GRYLLINAE**

1a. Very common. Hind tibiae with five to eight spines on each upper margin; fore wings of male with three to six transverse veins. Larger in size.

Field cricket—**Gryllus assimilis**

1b. Rather rare. Hind tibiae with four to six spines on upper margin; fore wing of male with two transverse veins; medium size.

2a. Brown, marked with yellow on pronotum, and longitudinal yellow lines on top of head; hind tibiae short; widespread in desert.

Miogryllus lineatus

2b. Uniformly brown; glabrous, distribution very local.

Gryllita arizonae

*Gryllus assimilis* Fabricus. Field cricket. Length: male, 1 in.; female, 1 3/4 in.; ovipositor % in.; head uniformly dark brown or black, except some races with longitudinal lines on top of head.

This is the common brown or black, thick-bodied cricket which is so widely distributed in Arizona. It is found nearly everywhere in the state, although there is a great deal of local variation.
Specimens from the mountains and plateaus tend to be small and black, while specimens from the irrigated valleys tend to be large and yellowish. In the past, various authors have considered many of these forms to be distinct species, but Hebard (1917) considers them all to be one. The writers have studied differences in ecological habitat, seasonal distribution, song, and habits which were correlated with the color and structural races. In the more elevated portions of the state the winter is passed mainly in the egg, but at lower elevations nymphs and adults may also be found all winter in considerable numbers.

_Gryllia arizonae_ Hebard. Length: ½ in.; uniform brown; female wingless; male with two transverse veins on the wings.

A very rare species known only from specimens taken by Hebard and Rehn in the Baboquivari Mountains (Hebard, 1935b, p. 148) and on Atascosa Peak in the Tumacacori Mountains near the southern border of the state. All were taken in September in the Upper Sonoran Zone.

_Mio granny lineatus_ (Scudder). Length, over all: about 1 in.; pale yellowish brown, with darker markings; head and pronotum with yellowish brown longitudinal marks; hind tibia not more than two thirds the hind femur, and armed above with four to six spines on each margin. In general appearance like a small field cricket.

Taken in cotton fields at Tucson (Flock) and reported feeding on cotton blossoms in California (McGregor). Also found in the dry desert and foothills. This species is widely distributed but seems to be very rare. Tucson, Yuma, and near Ft. Mohave in Arizona; and from all neighboring states and Texas.

SUBFAMILY NEMOBIINAE. SMALL GROUND CRICKETS

_Genus Nemobius_. Small, brown, robust crickets with long movable spines on the hind tibiae and numerous small bristles on the body and legs. Common in lawns and other damp places. (Hebard, 1913; Fulton, 1931.)

_Nemobius carolinus neomexicanus_ Scudder. Length: % in., exclusive of wings; fore wings of female about as long as abdomen; distoventral spurs of hind tibiae unequal; underwings long.

A rather uncommon species of Mexico and the southern part of California, Arizona, and New Mexico; north on the Colorado River to Littlefield.

_Nemobius cubensis mormonius_ Scudder. Length: 5/16 in.; fore wings much shorter than body; no underwings.

Found along streams and other damp places, and especially common in the Bermuda grass lawns of southern Arizona, where it is occasionally very injurious. May be controlled by the regular cricket bait, if necessary.

Common in southern Arizona; east to Texas and north to Nevada, Utah, and Colorado.
Nemobius fasciatus socius Scudder. Length: male, % in.; female, % in.; ovipositor very long and straight. This large, dark-colored species has been taken in very moist meadows near the New Mexico border at Cortez and may occur in northern Arizona.

SUBFAMILY OECANTHINAE. TREE CRICKETS

The tree crickets are small, delicate crickets about % inch long. The color is whitish, usually shaded with green or brown. The wings are fully developed and in the male are broadly expanded and paddle-shaped and lie flat on the back. In the female the fore wings are narrow and wrapped closely about the body. The ovipositor of the female is rod-shaped, about % inch long.

Tree crickets are not found on the ground but occur on trees and bushes, and in this region are especially common on low plants such as weeds and alfalfa. The song is loud and is one of the most noticeable night noises. These insects are active at night but may be seen commonly during the day. The eggs are deposited in the bark of trees or in the pithy center of plants. These crickets feed not only on leaves, flowers, fungi, and fruit but consume also large numbers of small insects, such as aphids and scales.

ECONOMIC IMPORTANCE AND CONTROL

Usually the tree crickets are of but little economic importance. The injurious insects eaten may compensate in large measure for the injury caused by feeding on plants. The nymphs are especially fond of aphids and may develop entirely on this food. Damage from feeding on leaves is not serious, but flowers and flower parts are also favored foods, resulting in damage to certain crops. Fruits, such as plums, peaches, and grapes, may be eaten into, thus disfiguring them and allowing for the entrance of fungi. Stems are seriously injured by the deposition of eggs, especially in the case of fruit trees and cane fruits. In Tucson, control has even been found desirable at times because of the disturbance to sick people by the high-pitched song.

A mixture of 5 gallons of water, % pound of lead arsenate, and 1 quart of molasses may be sprayed about in the trees or bushes. Ordinary grasshopper bait, or a bait consisting of 10 ounces of bran, 1 ounce of sodium fluosilicate, 2 1/2 ounces of molasses, 5 ounces of water, and 30 drops of amyl acetate may be scattered on the plants. In cases of serious damage to grapes in California, a dust consisting of 70 per cent sodium fluosilicate and 30 per cent diatomaceous earth was applied at the rate of 50 pounds per acre.
KEY TO ARIZONA SPECIES AND VARIETIES OF OECANTHINAE

A. First and second antennal segments each with a round or oval black spot.
   O. niveus

AA. First and second antennal segments either without black markings or with more than a single round black spot.

B. Front side of first antennal segment never ornamented with more than a narrow black line along inner edge; subgenital plate of female with a notch half as broad as the widest part of the plate. Found largely on thickets of wild shrubs.
   C. Elytra of males plainly colored. Very common.
      O. californicus

CC. Elytra of males strikingly colored with brown along the principal oblique veins.
      O. californicus pictipennis

BB. Front side of first two antennal segments ornamented with more than a narrow line along inner edge; female subgenital plate with a narrow notch. Found on low weeds, alfalfa, and other low plants.
   C. First two antennal segments each with two black marks; first segment with black line and dot which are narrow and well separated.
      O. nigricornis quadripunctatus

CC. Markings on first two antennal segments heavier and usually touching.
      O. nigricornis argentatus

*Oecanthus niveus* (De Geer). Snowy tree cricket. This pale tree cricket has a single black spot on the front side of each of the two first antennal segments. Sometimes injurious to deciduous trees and shrubs.

Occurs widely in Arizona, except at highest elevations, and in most of the United States and Central America.

*Oecanthus californicus* Saussure. Often quite brown; first antennal segment plain or marked only with a black line; wings of male and notch in subgenital plate of female very wide.

Very common on oaks, chaparral, and other shrubs in the Upper Sonoran Zone, extending somewhat into Transition Zone. Widespread in the western United States.

*Oecanthus californicus pictipennis* Hebard, Conspicuous brown markings along wing veins (Hebard, 1935).

Common on juniper trees, but also found on other plants in the juniper-piñon belt. Kaibab Plateau and Aubrey Valley, Coconino County, Arizona.

New Mexico, Colorado, and Utah (Hebard), to Hermosillo, Mexico (Ball).

*Oecanthus nigricornis quadripunctatus* Beutenmuller. Body entirely pale; four black marks on first two antennal segments very distinctive.

The eggs are laid on pithy weeds which are usually only 1 to 2 feet high. Common in alfalfa.

Widely distributed in Arizona and the United States.
Oecanthus nigricornis argentatus Saussure. Body entirely pale or with fine markings on the abdomen. This is probably the more common form in the lower cultivated areas in Arizona and is especially common in alfalfa fields. Widespread in the western United States but less common at higher elevations. The eggs are laid in rows in the stems of pithy weeds.

SUBFAMILY MYRMECOPHILINAE. ANT-LOVING CRICKETS

The ant crickets are tiny, pale-colored crickets less than % inch long, the smallest true Orthoptera. They are oval in shape and the femora and tibiae of the hind legs are very much enlarged. The eyes are very small.

These crickets are symbiotic in ants’ nests. They feed on the secretions of many kinds of ants (Hebard, 1920a).

Myrmecophila manni Schimmer. Most common in the pine zone. Widespread in the state; extending to Washington, California, and Nevada.

Myrmecophila nebrascensis Lugger. Widespread in the state; east to Texas and Nebraska.

SUBFAMILY MOGOPLISTINAE. BUSH CRICKETS

Small, flat, slender-bodied crickets brown in color and covered by translucent scales. The hind tibiae have two rows of short teeth but no true spines (Hebard, 1931a).

KEY TO GENERA OF MOGOPLISTINAE

A. Pronotum of male produced, covering most of wings; ovipositor wider near apex than shaft,

   Cycloptilium

AA, Pronotum of male only slightly produced, leaving large area of wing exposed; apex of ovipositor no wider than shaft.

   Hoplosphyrum


This is a very common cricket over most of the Lower Sonoran Zone of southern Arizona, north to the vicinity of Prescott and Boulder Dam. Most common in the desert but also occurs in the lower part of the oak belt. Found on the ground as well as on various plants such as burroweed (Haplopappus tenuisectus), creosote bush (Larrea divaricata), and blackbrush (Flourensia cernua). The insect is nocturnal, and Hebard states that the song is a high-pitched, trilling, da-dit-dee-dit, which is often continued over a considerable period.

Type locality Ajo, Arizona; also in Texas and California.

Cycloptilium comprehensens interior Hebard. Similar to C. fortior except that the projections of the female subgenital plate are no longer than wide.

Described from specimens taken in Utah (Hebard) and the northern edge of the Mojave Desert in California. Our only Arizona record is from Littlefield.
**Hoplosphyrum boreale** Scudder. Length: male, $\frac{1}{2}$ in.; female, $\frac{9}{16}$ in.; brown. Larger in size than *Cycloptilium*.

Rather rare, and difficult to find, since it lives under leaves and rock fragments or in crevices of trees. Hebard records the song as a "high-pitched, continuous cree-cree-cree, higher and more rapid than that of *Gryllus*."

Taken in the Upper Sonoran Zone in the mountains of south-eastern Arizona and in the Lower Sonoran Zone at Tucson.

Texas, north central New Mexico, California, and Lower California.

**SUBFAMILY TRIDACTYLINAE. PYGMY MOLE CRICKETS**

Genus *Tridactylus* Oliv. Very small, slender crickets with front tibiae specialized for burrowing; front and middle tarsi 2-jointed; hind tarsi 1-jointed, or wanting; antennae shorter than body; wings at least to tip of abdomen.

These small burrowing crickets are found almost entirely in the sandy edges of creeks and ponds. The burrows are usually less than an inch deep and the individuals can usually be found on the surface of the sand.

*Tridactylus apicalis* Say. Larger; length: $\frac{5}{16}$ in.; light brown; hind tarsi 1-jointed; hind tibiae with four pairs of long slender plates used in swimming. Adults overwinter.

A species of wide distribution, from the New England States to southern California and South America, but of rare occurrence in southern Arizona.

*Tridactylus minutus* Scudder. Smaller; length: about $\frac{3}{16}$ in.; dark brown or black with buffy markings; tarsi of hind legs wanting; hind tibiae with only one pair of long plates, used for swimming.

Very common in Upper and Lower Sonoran zones of southern Arizona.

New Jersey to California and Mexico.
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