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Revisionary Studies in the Nearctic Decticinae

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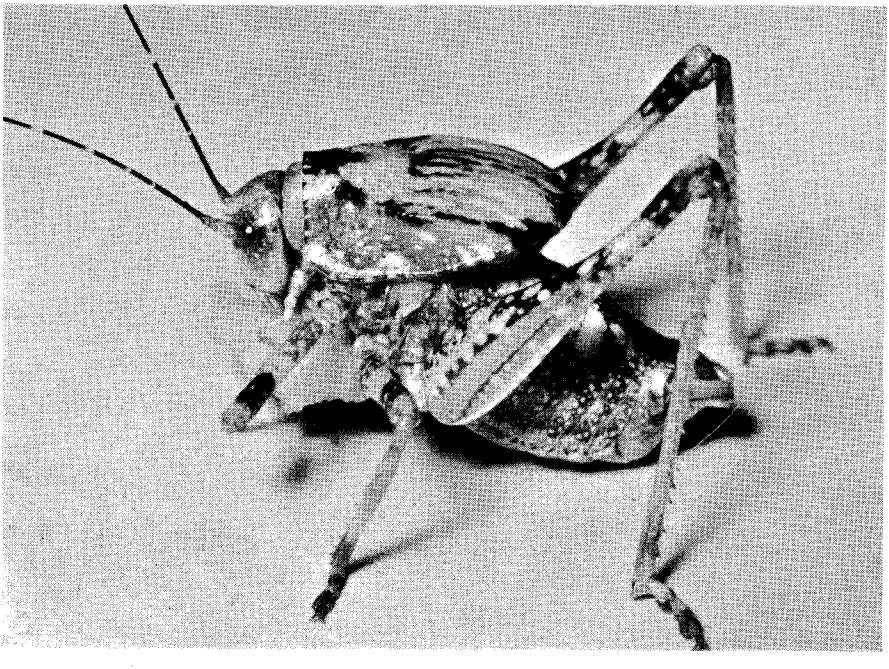

Male *Neduba (Aglaothorax) ovata* (Scudder)

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We dedicate this work to the late Harold J. Grant, Jr., of the Academy of Natural Sciences of Philadelphia, who inspired and encouraged us to complete this study.

Preface

The shield-backed katydids have long attracted the attention of entomologists whether by their presence in large numbers destroying crops and rangeland or by the striking appearance of most species when seen alive in the field. Not since 1907 has the group been systematically studied for the entire Nearctic Region, but rather scattered reports have appeared from time to time regarding single genera or limited geographic regions.

The great American orthopterists Rehn, Hebard, Gurney, and Tinkham have frequently reviewed parts of the Decticinae and laid much of the foundation for the present study. Due to the lack of resident entomologists in the past, most of what was written concerning the biology of the species has been discovered either by Dr. E. R. Tinkham or by Rehn and Hebard on one of their many trips to the West. The habits of many species are still unknown.

It is the hope of the authors that this work will stimulate interest in the Decticinae and encourage students to pursue the fascinating taxonomic and bionomic problems which still remain.

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CONTENTS

Tables of Measurements

INTRODUCTION

The Decticinae or Shield-backed katydids of the family Tettigoniidae occur in the Nearctic Region mostly in the western part of North America. The majority of species are thicket-loving or bush-dwelling, but several are grassland types and others live entirely on the ground in forested areas. A few, such as the Mormon cricket *(Anabrus simplex)* and the Coulee cricket *(Peranabrus scabricollis)*, are often serious economic pests. In outbreak years large numbers band together and "migrate" in search of food. All but three Nearctic genera are rather gaudy and impressive when seen alive and catch the fancy of most general collectors, but because of the secretive habits of the katydids they are seldom collected. In northern Europe where many species occur, certain common species are known as "wart-eaters" by the peasants, who cause them to bite off warts. The belief being that warts thus injured never return (Caudell, 1907).

The subfamily Decticinae is almost entirely confined to the Palearctic and Nearctic Faunal Regions. A few genera narrowly extend southward into Mexico and several isolated genera are known from South America. Many Nearctic forms show relationships with Palearctic species and may even be congeneric with them.

An accumulation of field notes, large collections of specimens and use of new techniques in the systematic study of species have prompted the authors to present what we feel are pertinent observations on the bionomics and systematics of certain decticines with which we are familiar. A brief resumé of the more important works of the past, a section on techniques and collecting methods, a zoogeographical and biological section and key to genera follow. An illustration of the sclerotized portion of the male genitalia (titillators) of the type species of all genera, with the exception of *Atlanticus* (a more common species is figured) is presented. Several genera are completely revised. In addition a checklist of species is placed at the end of the paper as an aid in systematic arrangement of collections. Titillators are also figured for all species studied in detail.

Certain genera in our study are revised more thoroughly than others, owing to the lack of specimens from critical areas. In the fully revised genera *(Capnobotes, Neduba, Idionotus, Decticita)* all species are redescribed except those which are well known or have been previously described in adequate fashion. Other genera have keys to species and notes on bionomics when known. *Idiostatus* is now being revised by the senior author and consists of many more

species than are currently recognized. A list of species of this genus, synonymies and type localities is presented. The keys and biological will appear in a later publication. *Eremopedes* and *Pediodectes* present interesting taxonomic problems and are currently under study by workers at the University of Michigan. A key to the *Eremopedes* species is given with notes on each species. Because of the rarity of specimens of certain species of *Pediodectes* and the confusion of the identity of most of them, no key is presented. However, a list of the species is given with their synonymies and type localities as an aid to future study. The genus *Atlanticus* was completely studied by Rehn and Hebard (1916) who gave a detailed account of each species. Only a single subspecies has been described since that time. Because of the depth of the work of Rehn and Hebard, only a key to the species is given here with a list of the species, type localities, and synonymies. The interested reader is referred to the earlier work. *Steiroxys* still presents the most baffling taxonomic situation in the subfamily and it would be folly to attempt to write a key to the four species because actual type localities are vague and types are lost.

REVIEW

Scudder (1894) reviewed the known North American genera and gave a key. In 1899, he presented an unillustrated discussion of the two genera *Tropizaspis* (later the species were placed in *Neduba* and *Aglaothorax*) and *Cacopteris* (later to become part of *Idiostatus*). Caudell (1907) published the most extensive work to this day on the North American Decticinae. He included an expanded key to the genera and species and described many new forms. Generic and specific descriptions were added by Rehn, Hebard, Tinkham and Fulton. Gurney (1939) presented a key to *Anabrus* and its allies. Tinkham (1944) published a work on the decticines of the North American deserts. Barnum (1964) gave some notes on the species occurring at the Nevada Test Site. Helfer (1963), in a beginner's guide to Orthoptera, gave keys to many species in the Nearctic Region.

The genus *Hubbellia* was described by Hebard (1927) and included a single species, *H. praestens*. Uvarov (1940) discovered that an old Walker species, *marginifera*, was the same as the more recent *praestens*. At the same time he placed the genus in the subfamily Tettigoniinae based on the size of the free plantulae of the posterior metatarsus.

Large, aggressive species of the former decticine genus *Rehnia* (placed as a synonym of *Neobarrettia* by Cohn 1965) were referred to the subfamily Listroscelinae by Rehn (1957) and Cohn (1957), the latter author treating the subject in greater depth.

COLLECTION AND PRESERVATION TECHNIQUES

Most decticine katydids are nocturnal. To obtain specimens the collector must adjust his collecting methods and learn the habits of the species. Larger and more noisy forms can be collected at night by driving in an automobile along little-traveled roads and listening for the call of the male. Smaller and quieter species can be similarly collected on foot; but often for climatological or other reasons, specimens do not stridulate. A productive means of locating these katydids is the careful searching of bushes at night with the aid of a strong flashlight. A headlamp is quite useful since it leaves the hands free for spreading the branches. A gasoline lantern provides extremely good light. When the lamp is held up on one side of a bush, another person can look through the bush from the other side in the direction of the light and easily see hiding specimens. We have recently discovered that the technique of slow driving along little-traveled roads at night, as used by herpetologists, is useful in obtaining wandering species of many genera such as *Clinopleura*, *Ateloplus*, *Idionotus*, and *Capnobotes*. Collecting in this manner usually results in collections of mostly females.

It will be seen that even with genera under detailed consideration here, little is known about the habits of the various species. It is the hope of the authors that this paper will encourage interested parties to make collections from critical areas and also observe specimens in the field in order that more may be learned of the bionomics of this interesting group of katydids.

Rentz (1962) reported on a technique useful for the dry preservation of soft-bodied insects. This method is rather complicated and might not be convenient for use in the field. For dry preservation of specimens we prefer a method developed by Dr. Julio A. Rosas-Costa of Buenos Aires, Argentina and put to successful practice by Prof. Carlos Carbonell of Montevideo, Uruguay. The dorsal cervical membrane (neck) of the insect is cut and the alimentary canal is removed. The gut and its contents, along with the proventriculus, are placed in alcohol and properly labelled to be associated with the specimen for later study. A dry mixture of 3/4 talcum powder and 1/4 boric acid powder is dusted on and into the abdominal cavity of the eviscerated katydid. Then a small amount of loose cotton is added to maintain body shape. The powder seems to aid in preserving the colors and even green specimens dry with little discoloration. Use of an infra-red lamp has also been successful in preservation of color. Specimens dry in a very short time and the absence of white light prevents fading. One must, however, not place the specimens too close to the light source since intense heat will cook the insects and ruin the pinning medium. Special care must be exercised with pinning media of styrofoam or polyethylene foam which

readily melt under extreme heating.

Some of the most taxonomically useful specimens often are those which were preserved in alcohol. In many instances determination rests on detailed examination of concealed male genitalia. These can be easily seen in properly preserved specimens. The most useful technique the authors have employed is to drop the living specimens into 70% alcohol. If it is a male, the unsclerotized genital lobes and titillators (Fig. 2) will be exposed. Ashlock (1957) described a method for protrusion of the aedeagus of certain Hemiptera and this might possibly be of use in protruding the fleshy parts of dried specimens. Dry specimens must be relaxed and the titillators removed by careful dissection with fine forceps. Although the fleshy lobes of the concealed genitalia likely contain valuable taxonomic characters, they are most often so badly degenerated in dried specimens that they are useless for study. The sclerotized titillators, however, are always intact. Preservation of the living specimens in alcohol seems to be the only certain way of retaining the fleshy lobes for detailed examination.

The titillators may be removed from the specimen, cleared for a short time in 10% potassium hydroxide solution, then placed in individual microvials beneath the proper specimen. The "genitalia vial" may also be placed in a larger vial of alcohol with a katydid if it is to be stored in that manner. Except where noted, only the right half of the titillators has been drawn. All drawings of the titillators are dorsal views greatly enlarged.

Caudell (1907) used the term "infracercal plates" and Rehn and Hebard (1920) emended that to "intercercal plates" to described a pair of appendages which lie beneath the supra-anal plate (10th tergum). Tinkham (1944) referred to these plates as "pseudocerci", a term which we choose to retain since it best describes the functions of the appendages as can be seen under the description of mating of *Neduba ovata gigantea*.

It should be noted that when it is stated in the key and elsewhere "ovipositor longer than hind femur" this does not concern whether the ovipositor extends beyond the hind femur in an intact specimen but refers to the actual length of the ovipositor being more than that of the hind femur. The length of the ovipositor is determined by measuring it from base to apex. See Cohn (1965: 13).

Paratypes of all new species described are to be deposited in the major museums and the authors' collections. Descriptions are made of series rather than individual specimens.

ZOOGEOGRAPHY

The Decticinae are primarily members of the Nearctic and Palearctic Regions. In North America only a single genus, *Atlanticus*, is limited to the eastern part, while twenty-one genera and one-hundred and two species are known from, and all but a single native genus are peculiar to, the western part of the Continent. An interesting peculiarity exists in the genus *Atlanticus* which has its greatest diversity in our continent but a considerable number of species also in eastern Asia. This distribution is paralleled by the old acridid genus *Zubovskya* (now considered *Boonacris*) and the roach genus *Cryptocercus* and also by a number of trees and shrubs which have similar patterns of discontinuous distribution and are not now represented in western North America.

Two species have been introduced recently from Europe and have established themselves successfully. One, *Platycleis tessellata* (Charpentier), a circum-Mediterranean species, is now found in large numbers during the summer in the Sierra Nevada of California (Rentz, 1963). It belongs to a genus of Palearctic distribution. The other introduced species, *Metrioptera roeselii* (Hagenbach) has been found in Montreal, Canada and has been the subject of several publications (Kevan, 1961, Kevan et al, 1963, Urquart and Beaudry, 1953, Vickery, 1965). Another species in the genus is found naturally occurring in Canada in sphagnum bog situations. *Metrioptera* is the only native genus shared with the Palearctic Region.

The genus *Metrioptera* is a truly boreal type, not found south of Alberta. European orthopterists consider its nearest relative to be *M. ussuriana* of the Soviet Far East. *Eremopdes* and *Pediodectes* are surely of Sonoran development (see Dice, 1943, for faunal regions) with sixteen of a total of eighteen species occurring in that region. Some narrowly extend into the Neotropical Region. *Ateloplus* consists of seven species primarily found in the Sonoran-Mojave Desert system. The subgenus *Aglaothorax* consists of four species, one of which is composed of some six subspecies occurring in the Great Basin-Mojave Desert system. The other three species are found in the Coast Range and mountains of southern California. *Plagiostira*, chiefly a Great Basin genus, consists of four species which spread southward and eastward into sections of New Mexico. *Capnobotes*, long considered as a strictly west Sonoran genus, consists of eight species only two of which are found in the Sonoran Desert system. A single species is found throughout the Great Basin and the remainder are found in the mountains of California. Rehn (1958) felt *Anabrus* was of Sonoran origin but we feel that with its distribution centered over the Great Basin and Columbia Plains and Rocky Mountains, it likely is of Palearctic origin. Four species occur over that area including

the Mormon cricket which can be of considerable economic significance to crops. *Peranabrus* and *Apote* have Palearctic relationships and are possibly congeneric with Palearctic genera.

In the Pacific Coast area, the Oregonian-Californian of Dice (1943), are a number of endemic genera and subgenera. The subgenus *Neduba* occurs chiefly in coniferous forests but also may be found in brush and thickets in coastal areas from British Columbia to southern California. One of the six species is strictly Sierran. Another is found on the eastern slopes of the Sierra Nevada of California in the Great Basin Zone. Still another species occupies a range in the Sierra-Cascade Mountain system of California and Oregon. Two species occur in the Coast Range Mountains of California and a single species is found in the mountainous regions of southern California. A single species of *Neduba* of unknown distribution occurs in the Puget Sound area of Washington.

Idiostatus occupies a broad range in western North America. Two of its fourteen species are found in the mountains of southern California. Only a single species may be regarded as strictly Sierran while nine occur in the Great Basin. The remaining species are found in the mountains of northern California. *Inyodectes* and *Oreopedes*, both monotypic, are closely related to *Idiostatus* and found in an extremely limited area of the Great Basin.

Cyrtophyllicus with but a single widespread species is found over a broad area of northern California west of the crest of the Sierra Nevada. *Acrodectes*, also monotypic, is known from a narrow portion of the Sierra Nevada above tree line from Mono Pass south to Mt. Whitney.

California endemic genera of lower elevations west of the crest of the Sierra Nevada include fourteen species in *Idionotus, Decticita* and *Clinopleura*. *Steiroxys* with four currently recognized species contains but few records east of the Rockies, but it is largely confined to the mountainous northwest.

It seems likely that the complex and greatly differentiated fauna of the Nearctic Region represents several lines of infiltration of Palearctic elements (Rehn, 1958) and that they have come into our area long since the sole eastern representative of the subfamily, *Atlanticus*, either moved in from eastern Asia or traveled there from eastern North America (Rehn, 1958). Certain genera apparently have no counterparts in the Palearctic Region. These include: *Neduba-Aglaothorax, Zacycloptera, Capnobotes, Plagiostira*. Others, such as *Eremopedes, Pediodectes, Ateloplus, Idiostatus* were thought to exhibit almost as well-marked differences and represent distinct lines from the many Old

World genera of the subfamily. A considerable period of time, isolation, evolutionary pressure, and opportunity has been required to make evident what is seen in the Nearctic Decticinae.

The center of distribution for the Nearctic Decticinae is the Owens Valley of Inyo County, California. This was first reported by Tinkham (1944) and we have much additional evidence in support of the claim. More species are to be found there than in any other area in the Nearctic Region of comparable size.

The Owens Valley of eastern California is bounded on the west by the Sierra Nevada, and on the east by the Inyo and White Mountains, Bishop to the North and Owens Lake to the south. The valley is formed by a trough of the horst-graben type due to seismological activity. If we consider the fauna of the valley to include the slopes of the facing mountains, an interesting list of species can be assembled. They are arranged according to the faunal element thought to be contributing them.

Great Basin

Capnobotes occidentalis (Thomas)
Plagiostira gillettei Caudell
Idiostatus inermis (Scudder)
Idiostatus inyo Rehn and Hebard

Sonoran Desert

Capnobotes arizonensis (Rehn)
Capnobotes fuliginosus (Thomas)

Sonoran Desert (Mohave Subdivision)

Neduba ovata gigantea Rentz and Birchim, new species
Neduba ovata armiger (Rehn and Hebard)
Ateloplus hesperus Hebard

Endemic Genera (All Derived From Sonoran)

Oreopedes cryptoptera Rehn and Hebard
Inyodectes pallida Rentz and Birchim, new genus and species

Sierran

Neduba macneilli Rentz and Birchim, new species

The reason for such a large number of species occurring in such a comparatively small geographic area is interesting to examine. We feel that the Owens Valley contains many species because of a single basic reason. The Owens Valley is an ecotonal area, that is, it occupies a position where several floral and faunal elements converge. These are the Sierran from the west, the Great Basin from the north and east, and the Sonoran-Mojave desert element extending up from the south. All of these elements are rich in decticine species and each contributes a number to the fauna. Apparently two have been separated long enough to become distinct genera.

BIOLOGY

Of the twenty-two genera of the Decticinae occurring in the Nearctic Region, twelve may be regarded as primarily nocturnal in habits. These are: *Capnobotes, Neduba, Cyrtophyllicus, Zacycloptera, Plagiostira, Atlanticus, Pediodectes, Eremopedes, Inyodectes, Oreopedes, Ateloplus,* and *Idionotus*. Eight genera are diurnal: *Apote, Anabrus, Peranabrus, Acrodectes, Steiroxys, Metrioptera, Platycleis* and *Decticita*. Two genera, *Idiostatus* and *Clinopleura,* possess species which are either nocturnal, diurnal or both. Nocturnal forms tend to be found at lower elevations where temperatures remain warm well into the evening. Diurnal species tend to be most active during morning hours and it is at this time when stridulation and mating occur. They tend to cease feeding and become inactive as the day wears on.

The life histories of most species are not well known. Some of the economic species have been well studied (Wakeland, 1959, Cowan, 1929) and other scattered reports have appeared. All species complete their life cycles in the course of a year, eggs hatching in spring and life cycles completed by late fall.

Males of all species stridulate primarily to attract females. There is no known case of female stridulation and it seems unlikely since most have the tegmina greatly aborted. However, in *Capnobotes, Metrioptera, Platycleis,* and *Cyrtophyllicus* it may be possible since the tegmina are of considerable length. The calling songs of most species are quite loud and easily heard. In certain desert areas during a warm summer evening, the air may be filled with song most of which is due to the singing of decticines.

The food habits of the Decticinae are likely quite uniform. They are omnivorous. The food primarily consists of plant material but insects such as grasshoppers, moths, and beetles are often eaten. Cannibalism can frequently be observed. Devastation of agricultural crops by Mormon and

Coulee crickets in past years in the west is well known. A combination of several years of favorable weather conditions and abundant food permits the buildup of huge populations on uncultivated "scab land" of the Pacific Northwest. Bands of tens of thousands of individuals then move together in a single direction eating nearly everything in their path including the injured of their own species. A detailed study by Snodgrass (1905) who watched "migrating" hoards of *Peranabrus scabricollis*, the Coulee cricket, in 1902-03 gave much data on the life history of that species. Migrating bands are able to cover ten feet a minute by walking and hopping (they are brachypterous). Certain bands take part in the movement, other bands are stationary. Mating, stridulating and feeding take place in the morning and migration begins in mid-afternoon. During late afternoon females were seen ovipositing by thrusting the ovipositor in the ground either from a normal sitting position or from an upright position grasping a bush. The eggs were placed in plant roots two or three to a site and were not enclosed in a case. The female was then seen to die the next day.

Snodgrass (1903) vividly described cannibalism in an anthropomorphic style worth quoting here. "They apparently never attack and disable a healthy individual, but whenever one becomes injured or weakened from any cause his neighbors at once turn upon and devour him alive. Mercy or feeling for another's pain are sentiments they have no notion of. Since an individual does not die until almost completely destroyed, many gruesome sights may be seen. Such fragments as a head, one side of the body, the ovipositor and a leg or so remain alive, and the palpi and ovipositor move about and the legs kick until all is devoured."

The devastating effects of large masses of crickets migrating over extensive areas seem to have abated somewhat in recent years. Perhaps with more agricultural use of lands and imporved control techniques, large numbers of crickets cannot build up and cause damage. Most species, however, are of no economic importance and seem to be rather rare in nature.

Oviposition takes place in the ground or in plant stems (Rentz, 1963a, b). Other species with serrated ovipositors probably deposit their eggs in wood.

USE OF THE CALLING SONG OF DECTICINE KATYDIDS AS A MEANS OF IDENTIFICATION

Most decticids possess short wings (tegmina) which are often nearly completely concealed by the pronotum. A few genera (*Capnobotes, Platycleis*) are fully winged and capable of flight. In the greater majority of cases the wings are used either for defensive displays (two genera: *Plagiostira,*

Zacycloptera) or stridulation, the latter of which is performed only by the males. All species of Decticinae stridulate.

The call, varying from a very low buzz or click in some species to a variety of raucous calls in others, is produced by rubbing together the specialized tegmina. A portion of the left tegmen is modified into a scraper and the right tegmen has been modified as a file which consists of a series of ventral-facing teeth on knobs. When the male cricket stridulates the tegmina are not raised as in Oecanthinae (see Walker, 1962) but the head is bent forward and the pronotum raised to more fully expose the tegmina. Sound is likely only produced during the closing stroke as is the case in gryllids, although no experiments have been performed to settle this.

Walker (1962) noted that gryllid crickets trill (continuous sound production) or chirp (sound production, pause, then resume call). Decticine katydids produce both trills (Fig. 37B, D, E, F, H) and chirps (Fig. 37A, G). The chirp rate (chirps per minute) is somewhat more variable depending upon various physical factors in the environment. Some genera (*Neduba*, Fig. 37B) produce a continuous high trill with chirps at definite intervals during the trill.

Many authors have noted the specificity of the calling songs of crickets. Walker (1964) has demonstrated the existence of sibling (cryptic) species which apparently differ only in stridulation and biological habits. It will doubtless be found that such species exist in the Decticinae.

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Specimens borrowed from various collections or individuals are designated as follows:

Academy of Natural Sciences of Philadelphia (ANSP)
California Academy of Sciences (CAS)
United States National Museum (USNM)
British Museum (Natural History) (BMNH)
University of Michigan, Museum of Zoology (UMMZ)
University of California, California Insect Survey (CIS)
University of California, Davis (UCD)
California State Department of Agriculture (CDA)
Jacques R. Helfer collection (JRH)
David C. Rentz and James D. Birchim collection (DCR)
Ernest R. Tinkham collection (ERT)
Harvard University, Museum of Comparative Zoology (MCZ)

CHARACTERIZATION OF THE DECTICINAE

No single taxonomic character can be used to separate the Decticinae as a whole from other subfamilies of the Tettigoniidae. It had formerly been thought that the presence of free plantulae on the basitarsus (probably half of a modified pulvillus) was a unique characteristic of the subfamily. Cohn (1957, 1965) showed that certain genera of other subfamilies possess this structure while it is variously developed even within the Decticinae. The presence of dorso-external spurs on the fore tibia, however, occurs in most species of Decticinae. Shield-backed katydids also possess a broad fastigium and usually a broad, carinate pronotum. The fore legs are shorter than the middle ones, in contrast to the reverse condition as seen in the Listroscelinae (Cohn, 1965). The pronotum has a free ventral border in most species. Spines of the sternum are not elongate as found in the Listroscelinae, a subfamily with species once believed to be in the Decticinae (Cohn, 1965). The key below will be of use in separating the Nearctic subfamilies of Tettigoniidae.

KEY TO THE NEARCTIC SUBFAMILIES OF TETTIGONIIDAE
(Modified from Borror and Delong, 1959)

1. Dorsal surface of first tarsal segment laterally grooved; prosternal spines usually present; tegmina about as long or longer than hind wings.....2

   Dorsal surface of first tarsal segment smoothly rounded; prosternal spines absent; hind wings longer than tegmina or tegmina obliquely truncate at apex. (Usually green, leaf-like species, widely distributed) .....Phaneropterinae

2. Pronotum nearly as long as broad, with two transverse grooves; tegmina broadly oval, convex when viewed laterally; mesal margins of antennal sockets elevated, ridgelike, extending nearly or quite to dorsal surface of vertex. (True katydids, arboreal in habit, wings bulbate).....Pseudophyllinae

Pronotum longer than broad, only a single transverse groove, or none at all; tegmina variable, usually not broadly oval and convex; mesal margins of antennal sockets nor particularly ridgelike, rarely approaching dorsal portion of vertex.....3

3. Anterior portion of vertex conical, frequently acuminate, extending well beyond basal antennal segment. (Green and brown meadow-dwelling forms with slant-faces, powerful jaws for seed eating).....
.....Copiphorinae

Anterior portion of vertex usually not conical or acuminate, does not extend beyond basal antennal segment.....4

4. Anterior portion of vertex of head laterally compressed, less than half as broad as basal antennal segment. (Large aggressive species, southern United States and Mexico).....Listroscelinae

Anterior portion of vertex of head variable, always more than half as wide as basal antennal segment.....5

5. No spines at all on dorsal surface of fore tibia. (Small, greenish forms found in moist situations, meadow katydids).....Conocephalinae

One or more spines on dorsal surface of fore tibia.
.....6

6. Pronotum extending posteriorly to abdomen, except in alate forms; tegmina usually greatly reduced. (Robust, usually short-winged species found mostly in western United States).....Decticinae

Pronotum never extending posteriorly to abdomen; tegmina well developed, green, unspotted. (Slender green forms resembling Conocephalinae. Occur in pines in southeastern United States).....
.....Tettigoniinae

KEY TO GENERA AND SOME SPECIES OF NEARCTIC DECTICINAE

1. Wings and tegmina fully developed, exceeding apex of abdomen, used in flight.....2

Wings and tegmina short, not exceeding apex of abdomen (dried males of *Cyrtophyllicus* may have the tegmina slightly longer than the abdomen due to shrinkage, Fig. 36 G), not used in flight; wings in females often rudimentary or completely lacking.....4

2. Size large, 37-77 mm; ovipositor of female nearly as long as posterior femur, not shaped as in Figs. 1A, 1B.....*Capnobotes* (p. 19)

Size small, 15-27 mm; ovipositor not more than half as long as hind femur, shaped as in Figs. 1A, 1B.....3

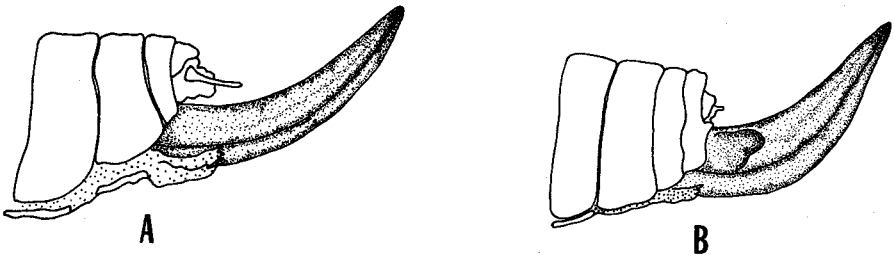

Fig. 1. A, Ovipositor of female *Metrioptera roeseli*. B, ovipositor of female *Platycleis tessellata*.

3. Tegmina light brown, immaculate, unmarked with darker areas. Subgenital plate of female with deep V-shaped notch. Known only in North America from central and western Canada.....*Metrioptera* (p. 151)

Tegmina light brown but laterally marked with 4-7 linearly arranged quadrate dark brown spots. Subgenital plate of female with a shallow, truncate notch. Male genitalia (Figs. 2C, 2D). Known in North America only from the western Sierra Nevada of California..... .....*Platycleis tessellata* (Charpentier) (p. 152)

4. Ovipositor of female usually much less than half the length of hind femur, sickle-shaped, not straight, in cross section extremely thin, dorso-ventrally elongate, shaped as in Fig. 1A; cercus and the 10th tergum of male shaped as in Figs. 2A, 2C; 31F.....5

Ovipositor half as long or longer than posterior femur, straight to slightly upcurved, swordlike, in cross section round, not shaped as in Figs. 1A, 1B; cercus and 10th tergum of males not as in Figs. 2A, 2C.....6

5. Tegmina of both sexes as long or longer than the dorsal length of the pronotum. Subgenital plate of female with a V-shaped notch. Known in North America from central and eastern Canada.....*Metrioptera* (p. 151)

Tegmina of male extending only slightly beyond posterior edge of pronotum or concealed by it. Wings of female completely concealed by pronotum. Subgenital plate of female without notch. California west of the Sierra Nevada.....*Decticita* (p. 154)

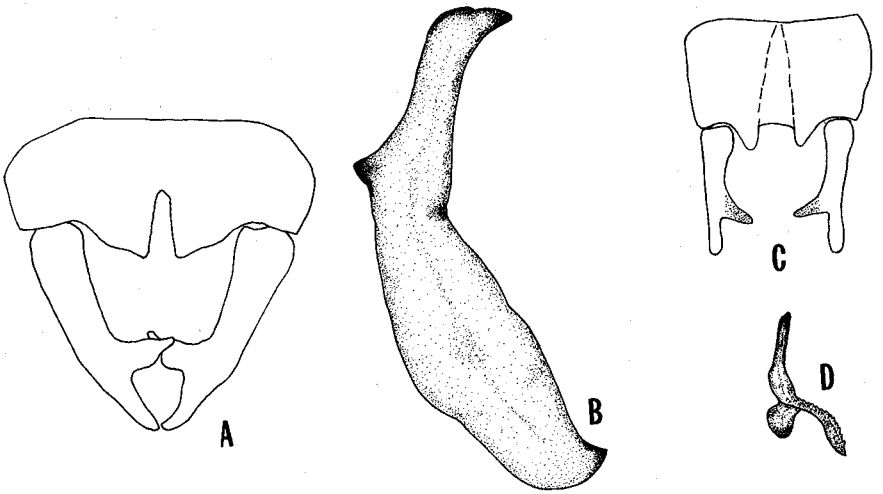

Fig. 2. Cerci and last abdominal segment, B, right half of titillator of male *Metrioptera roeselii*. C, cerci and last abdominal segment. D, right half of titillator of male *Platycleis tessellata*.

6. Prosternum armed with a pair of spines.....7

   Prosternum unarmed.....13

7. Portion of tegmen extending beyond posterior edge of pronotum longer than pronotum.....8

   Portion of tegmen extending beyond posterior edge of pronotum shorter than the pronotum.....9

8. Color uniform green or straw brown. Cercus with shaft long, more than 3 times longer than basal width, with or without a minute subapical tooth. Large, robust species (Fig. 36I). California west of the crest of the Sierra Nevada.....*Cyrtophyllicus* (p. 87)

   Color not as above. Wings prominent, black, used in defense display. Cercus with shaft short, less than 3 times longer than broad, with large subapical tooth. Nevada.....*Zacycloptera atrippenis* Caudell (p. 92)

9. Lateral carinae of pronotum present, persistent throughout.....10

   Lateral carinae of pronotum absent, or if present indicated only on posterior portion and not distinct...11

10. Apex of posterior tibia with 6 spurs. Ovipositor of female straight, no serrations at apex..... .....*Atlanticus* (p. 98)

Apex of posterior tibia with 2 spurs. Ovipositor of female curved upward, minutely serrated. (Figs. 34B, 34D, 35B, 35I).....*Neduba* (p. 38)

11. Posterior femur comparatively short, not more than twice as long as length of pronotum; apex of posterior femur extending to apex of abdomen. Ovipositor of female curved downward. Titillators of male genitalia consisting of 4 arms.....*Apote* (p. 94)

Posterior femur long, at least twice or more as length of pronotum; apex of posterior femur extending greatly beyond apex of abdomen. Ovipositor of female curved upward. Titillators of male genitalia with only 2 arms.....12

12. Small species, prosternal spines widely separated by the distance more than twice the length of one spine (each spine is only a small triangular projection). Tegmen of female slightly extending from beneath posterior of pronotum. Ovipositor of female noticeably shorter than posterior femur, often only half that length.....*Eremopedes* (in part) (p. 114)

Larger species, prosternal spines narrowly separated, the distance less than the length of one spine (each spine is a conspicuous projection). Tegmen of female often not projecting from posterior of pronotum. Ovipositor of female frequently longer than posterior femur.....*Pediodectes* (p. 103)

13. Wings evident, deep black, used in defensive display.....*Plagiostira* (p. 92)

Wings frequently not present, if so not black and not normally displayed in life.....14

14. Dorsum of pronotum densely punctate.....*Peranabrus* (p. 108)

Dorsum of pronotum smooth or slightly rugulose, not at all punctate.....15

15. Tegmen of male longer than the length of the pronotum. Ovipositor of female much longer than the hind femur.....16

Tegmen of male shorter than the length of the pronotum, frequently concealed beneath it. Ovipositor of female no longer than hind femur (except in females of *Steiroxys strepens*).....17

16. Tegmen of male abruptly narrowed in lateral posterior portion (Fig. 3), that of female projecting for a distance of more than half the pronotal length. Male

without sclerotized titillators. Ovipositor of female distinctly curved upward. Found only at higher altitudes of Sierra Nevada of California.....
.....*Acrodectes* (p. 126)

Tegmen of male not abruptly narrowed in lateral posterior portion, that of female projecting slightly beyond pronotum. Male with sclerotized titillators. Ovipositor of female straight or turned lightly downward. Widespread from Idaho to southern Nevada and westward, not found at such high altitudes as above.....
.....*Idiostatus* (in part) (p. 123)

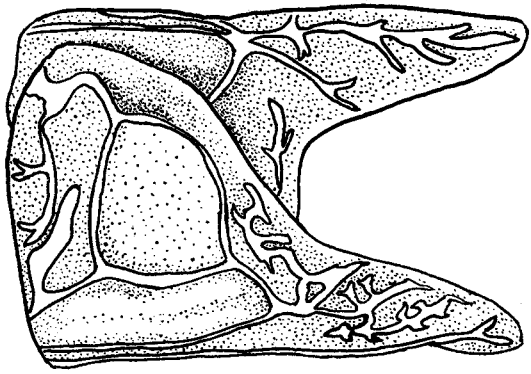

Fig. 3. Dorsum of tegmina of *Acrodectes*

17. Pronotum with lateral carinae indicated on at least anterior half, although frequently present on posterior fourth.....18

Pronotum without indications of lateral carinae on anterior half, although frequently present on posterior fourth.....21

18. Tegmina of females widely separated, often by more than the width of a tegmen.....19

Tegmina of females overlapping or narrowly separated.20

19. Lateral carinae of pronotum parallel or nearly so. Tegmina of female projecting beyond posterior margin of pronotum.....*Steiroxys* (p. 144)

Lateral carinae of pronotum convex, converging anteriorly. Tegmina of female not projecting beyond posterior margin of pronotum.*Neduba* (in part) (p. 38)

20. Lateral carinae of pronotum nearly parallel, slightly converging anteriorly, not widely separated. California, west of the crest of the Sierra Nevada.....
.....*Clinopleura* (p. 146)

Lateral carinae of pronotum convex, abruptly converging anteriorly. Southern Oregon, central and northern California west of the crest of the Sierra Nevada..... .....*Idionotus* (p. 127)

21. Size larger, often blackish forms. Tegmina of female attingent or nearly so, projecting slightly from beneath the pronotum or entirely concealed by it. Ovipositor of female as long or longer than the length of the posterior femur. Found over much of the Great Basin.....*Anabrus* (p. 106)

Size smaller. Tegmina of female greatly separated, often completely concealed by pronotum. Ovipositor of female much shorter than the length of the hind femur.22

22. Lateral lobes of pronotum very short in dorso-ventral height. Sonoran Desert...*Ateloplus* (p. 119)

Lateral lobes of pronotum of usual dorso-ventral height. (Figs. 34D, 34G, 35B, 35E, 35I; 36E, 36I).....23

23. Apex of hind femur with a single dark, distinct annulus (Fig. 36D, 36E). Pronotum without lateral carinae (Fig. 25C). Ovipositor of female nearly straight (Fig. 36E). Ventral margins of all femora spined. Body unicolorous pallid yellow and glossy or appearing polished. Known only from near Westgard Pass, Inyo County, California.....*Inyodectes pallida* (p. 109)

Apex of high femur without a distinct annulus; without the above combination of characters.....24

24. Tegmen of male projecting from beneath the pronotum for a distance greater than half its length. Ovipositor of female more than half as long as posterior femur..... .....*Idiostatus* (in part) (p. 123)

Tegmen of male projecting from beneath the pronotum for a distance less than half its length.....25

25. Size very small (see Table 7). Ovipositor of female more than half as long as posterior femur. White Mountains of Inyo County, California..... .....*Oreopedes* (p. 113)

Size larger than above. Ovipositor of female no more than half as long as posterior femur. If longer, then outer pagina of high femur with 2 longitudinal stripes (*E. subcarinata* (Caudell))..... .....*Eremopedes* (in part) (p. 114)

Genus *Capnobotes* Scudder

1872. *Locusta* Thomas, Ann. Rept. U. S. Geol. Surv. Terr., 5: 443.
1897. *Capnobotes* Scudder, Canad. Ent., 29:74.
1904. *Drymadusa* (in part), Rehn, Proc. Acad. Nat. Sci. Phila.,:573.
1907. *Anoplodusa* Caudell, Proc. U. S. Nat. Mus., 32: 318.

Type of the genus: *Capnobotes fuliginosus* (Thomas), selected by Kirby in 1906.

Capnobotes was formerly thought to be a desert genus; hence it is of great interest that specimens have turned up in central and northern California west of the Sierra Nevada. Critical examination reveals that several are new species which are herein described. It is unfortunate that more specimens are not available for study because close similarity of some of the new species suggests that a problem of subspeciation may exist, but until large series of specimens are assembled, this cannot be determined.

Members of *Capnobotes* are possibly the most aggressive in the subfamily in North America. Specimens can inflict a painful bite when collected and readily accept live grasshoppers as food. Tinkham (1944) described and photographed *C. fuliginosus* in fighting posture. Only a few other decticines (*Zacycloptera, Plagiostira*) display the wings when annoyed.

The genus *Anoplodusa* is placed into synonymy with *Capnobotes* after serious thought and consideration of the characters involved.

Key to the Species of *Capnobotes*

1. Prosternal spines absent. Hind femur without spines on outer ventral margin. Cercus and titillators (Fig. 4A, 4B). Sonoran Desert (Figs. 5, 12).....
.....*Capnobotes arizonensis* (Rehn) (p. 21)

   Prosternal spines present. Hind femur with spines on outer ventral margin or indicated by color.....2

2. Tegmen of nearly uniform width throughout (Fig. 10C, 10F), not greatly expanded basally.....3

   Tegmen expanded in basal portion, abruptly narrowing to apex (Figs. 33A, 35B, 33D, 33E).....4

3. Wing opaque, hardly translucent (Fig. 33F). Cercus of male with apical tooth and subapical tooth of nearly same length (Fig. 10). Titillators of male genitalia (Fig. 10C) with spines along entire length of arm, apex

but slightly bulbate. Base of titillators at right angles and in same plane as arm. Shaft of cercus elongate. Projection of last abdominal segment elongate, as long as cercus. Sonoran Desert (Figs. 11, 12).....
.....*Capnobotes fuliginosus* (Thomas) (p. 36)

Wing fully translucent, only slightly darkened (Fig. 33). Cercus of male with apical tooth hardly produced, subapical tooth longer than apical tooth (Fig. 6A). Shaft of cercus short. Titillators of male genitalia with apex bulbate, spines concentrated on apex (Fig. 6B). Projection of last abdominal segment short, shorter than cercus. Great Basin (Figs. 7, 12).....
.....*Capnobotes occidentalis* (Thomas) (p. 23)

4. Cercus of male platyform, subapical tooth widely separated from apical tooth (Fig. 8A, 8C). Titillators of male genitalia short, robust (Fig. 8B, 8D). Small species (Fig. 33). Monterey, San Benito, Santa Clara Counties, California (Fig. 12).....
.....*Capnobotes granti* Rentz and Birchim, new species (P. 26)

Without the above combination of characters.....5

5. Cercus with single tooth, subapical in position. Apex of cercus blunt (Fig. 9C). Titillators (Fig. 9D). Moderately sized species. Lake, Siskiyou Counties, California (Fig. 12).....*Capnobotes unodontus* Rentz and Birchim, new species (p. 33)

Without the above combination of characters.....6

6. Small, more robust (Fig. 33). Cercus of male with subapical tooth of nearly same length as apical tooth. Titillators of male genitalia with arms with apex spatulate, slightly serrated on outer margin (Fig. 10A). Tehama County, California (Fig. 12).....
.....*Capnobotes spatulatus* Rentz and Birchim, new species (p. 35)

Large, attenuate (Fig. 33D, 33E). Subapical tooth of cercus of male longer than apical tooth (Fig. 9A)....7

7. Size smaller (Table 1), more slender (Fig. 33D). Tegmen very slender. Grey phase only known. Mt. Diablo, Contra Costa County south to Tulare County, California
.....*Capnobotes attenuatus* Rentz and Birchim, new species (p.28)

Size larger (Table 1), form more robust. Tegmen

broader (Fig. 33E). Grey, green and brown phases known. Kern, Los Angeles, Santa Barbara Counties, California (Fig. 12).....*Capnobotes bruneri* Scudder (p. 30)

Capnobotes arizonensis (Rehn) new combination (Figs. 4A, 4B, 5, 12)

1904. *Drymadusa arizonensis* Rehn, Proc. Acad. Nat. Sci. 573.
1907. *Anoplodusa arizonensis*, Caudell, Proc. U. S. Nat. Mus., 32: 318.

Type locality: Florence, Pinal County, Arizona

After serious consideration the authors believe this species is properly placed in *Capnobotes* rather than in *Anoplodusa* which was proposed for it by Caudell (1907). The characters used were the absence of prosternal spines and the posterior femora being without ventral spines. Critical study shows that these are most likely specific characters.

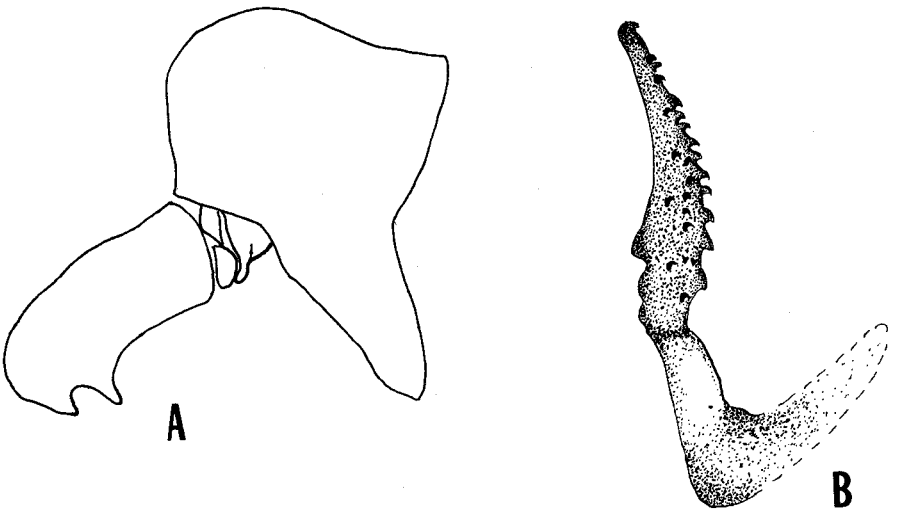

Fig. 4. Left cercus and last abdominal segment of *Capnobotes arizonensis*. B, right portion of titillator of *C. arizonensis*.

It has been found that prosternal spines may be present or absent within certain genera. *Eremopedes* shows this, as does *Neduba* (both subgenera). *Neduba ovata* shows either the full development of prosternal spines or the complete absence of them in specimens from a single locality. The spination of the outer ventral margin of the hind femora has been found variable within *Capnobotes* (sensu strictu). Some specimens of *C. fuliginosus* lack the spines but have

the area indicated by color. The titillators and cerci of *C. arizonensis* also show strong affinities with those of species of *Capnobotes*. It therefore seems better to place *arizonensis* in *Capnobotes*.

RECORDS. CALIFORNIA. INYO COUNTY: Lone Pine, 6 mi. W., 23-VII-1965 (D. C. Rentz, J. D. Birchim, 2 males, DCR). MONO COUNTY: Benton Station, 7 mi. S., 9-VIII-1963 (G. M. Buxton, T. Kono, 2 males, CDA). SAN BERNARDINO COUNTY: Daggett, 16-VI-1966 (D. C. Rentz, W. W. Middlekauff, 8 males, DCR). NEVADA. WASHOE COUNTY: Wadsworth, 3-VII-1963, VI-1965 (G. I. Stage, 1 male, 1 female, DCR).

DISCUSSION. Much has been written about this species. Tinkham (1942) presented extensive biological notes on a large collection of *C. arizonensis* from Arizona. He (1944) noted two California records: Mojave, Yermo, but both he and La Rivers (1951) believed that the specimens probably came from Arizona. We now know the species is actually an inhabitant of California. The geographic limits of *C. arizonensis* can now be further defined (Fig. 5). La Rivers (1951) recorded a female from Stillwater, Churchill County, Nevada and the specimens here recorded from Wadsworth, Washoe County, Nevada give the northernmost records. The Mono and Inyo County records are the westernmost limits of the species. Pinal County, Arizona is both the southern and eastern limit known for the species. It can be seen that the species is not entirely restricted to the Sonoran Desert but penetrates into the Great Basin to some extent.

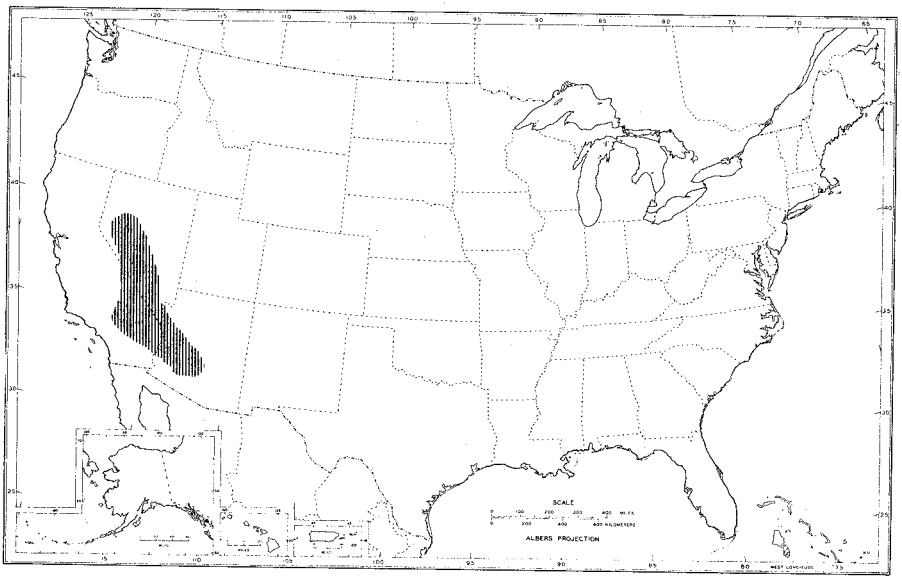

Fig. 5. Known distribution of *Capnobotes arizonensis*.

Coloration of the California specimens is a faded yellow brown with the spots on the tegmina dull white. The coloration of certain individuals of this species is very similar to that of green and brown phases of *C. occidentalis*, even to the degree and size of the white, ovoid spots on the median of the tegmina.

The stridulation of *C. arizonensis* is so nearly identical to that of *C. occidentalis* that it is almost impossible to separate the two in the field. It is interesting to note that three species of the genus, *C. arizonensis*, *C. fuliginosus*, *C. occidentalis*, were all collected together at the Lone Pine, California, locality.

Barnum (1964) believed that *C. arizonensis* was protectively colored to match its host plant, the Creosote bush (*Larrea divaricata*). Tinkham (1942) also felt that the species was closely associated with Creosote bush. However, this plant was absent at both the California localities and none is known to exist for many miles. The closest known stand to the Lone Pine locality is in the Mazourka Canyon area which is on the extreme southeastern border of the Owens Valley. The authors feel that *C. arizonensis* is not as closely associated with Creosote bush as previously thought, but instead it is most likely a general feeder, omnivorous in food habits, as are most of the North American Decticinae. It likely feeds on Creosote bush and has been found on it simply because it is the dominant plant throughout most of its range, but the records show that its distribution is not entirely correlated with that of the plant.

One of the adult males from Lone Pine became sluggish after a month in the laboratory. Several maggots emerged, buried themselves in soil, and later emerged as adult flies in the family Tachinidae. They were determined to be in the genus *Euphasiopteryx* by Dr. Paul H. Arnaud, Jr. of the California Academy of Sciences. The fly is nocturnal like its host. Many specimens of the fly have been collected at black light in the Owens Valley and it seems probable that it parasitizes some species besides *C. arizonensis* which is rather rare. Perhaps it parasitizes other species of *Capnobotes*.

Capnobotes occidentalis (Thomas)
(Figs. 6A, 6B, 7, 12, 33C, Table 1)

1872. *Locusta occidentalis* Thomas, Ann. Rept. U. S. Geol. Surv. Terr., 5: 444, Pl. 2, Fig. 16.
1897. *Capnobotes occidentalis*, Scudder, Canad. Ent., 29: 74.
1904. *Capnobotes occidentalis* variety *viridis* Cockerell, The Entomologist, 37: 180. Type locality: Pecos, New Mexico.

1907. *Capnobotes occidentalis* variety *uniformis* Caudell, Proc. U. S. Nat. Mus., 32: 317. Type locality: Los Angeles County, California.

Type locality: California

C. occidentalis is the commonest and has the most extensive range of any species in the genus. It occurs in a variety of color phases and, as pointed out by La Rivers (1948), greyish forms are found on green vegetation such as cottonwood. At a locality 4 miles west of Big Pine, Inyo County, California the senior author collected the three color phases, each on similarly colored backgrounds. Grey specimens were taken from sagebrush, while the brownish specimens were found on *Eriogonum* stalks and the specimens of the green phase, which were remarkably like green specimens of *C. arizonensis*, were found exclusively on the green foliage of cottonwood trees growing in a creek bottom.

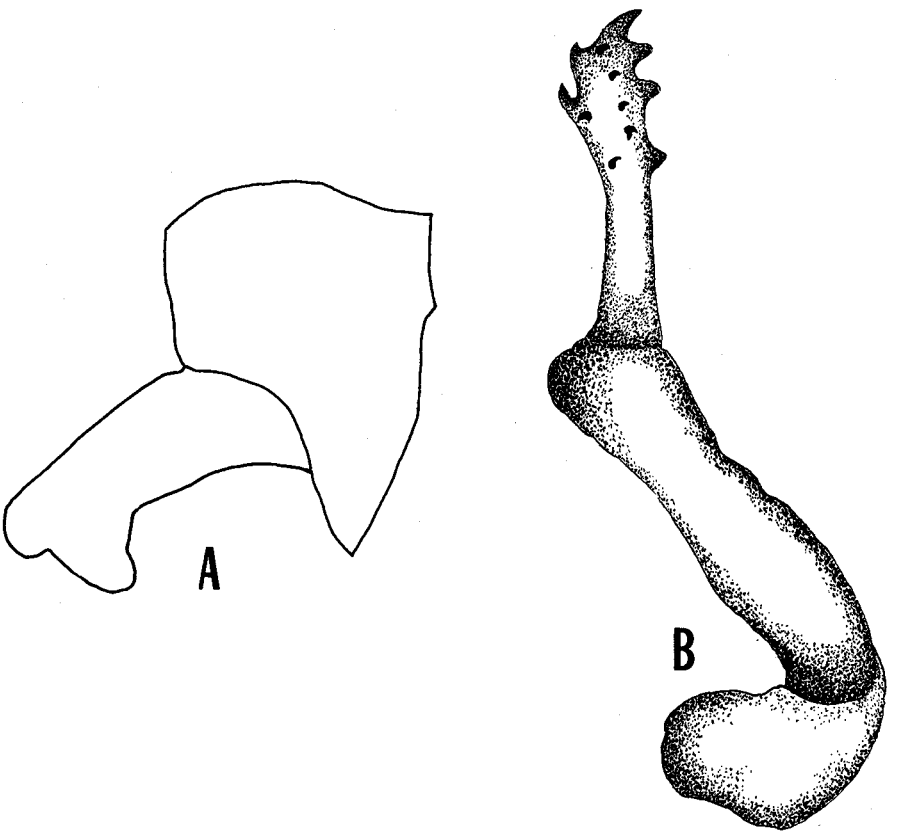

Fig. 6. A, cercus and last abdominal segment. B, right half of titillator of male *Capnobotes occidentalis*.

Table 1. Size variation in species of *Capnobotes*. The size (N) of the sample is listed first, followed by the range (R). Means (M) are based on original values. All measurements in millimeters as measured with an ocular micrometer.

Species		*C. attenuatus*		*C. bruneri*		*C. fuliginosus*		*C. granti*
		Male	Female	Male	Female	Male	Female	Male
Total length	N	3	4	1	1	5	2	3
	R	20-29	27-37	32	29	30-34	33-35	25-26
	M	24.33	29.75			31.4	34	25.33
length pronotum	N	3	5	1	1	5	2	3
	R	5.2-5.8	5.8-6.5	6	8.2	7-7.5	7.8-8.5	6.5-6.8
	M	5.2	6.14			7.3	8.15	6.6
width pronotum	N	3	5	1	1	5	2	3
	R	3.6-4	3.8-4.7	4	5	4.6-5	5.5-5.7	4.3-4.5
	M	3.86	4.12			4.84	5.6	4.43
length posterior femur	N	3	5	1	1	5	2	3
	R	21-26	26-29	25	30	29-31	36-37	24-27
	M	23.33	27.5			29.8	36.5	25.33
length anterior wing	N	3	5	1	1	5	2	3
	R	41-43	47-51	48	47	50-55	65-66	29-37
	M	41.66	47.8			54.2	65.2	33.66
length ovipositor	N		4		1		2	
	R		29-32		33		31-33	
	M		29.75				32	

Table I (Continued)

Species		*C. occidentalis* Male	*C. occidentalis* Female	*C. spatulatus* Male	*C. spatulatus* Female	*C. unodontus* Male
Total length	N	5	5	1	1	5
	R	26-30	38-31	20	28	24-26
	M	27.2	29.4			24
length pronotum	N	5	5	1	1	5
	R	6.2-6.6	6.8-7.2	6.3	6.5	6-6.7
	M	6.38	6.98			6.34
width pronotum	N	5	5	1	1	5
	R	4-4.2	4.2-4.6	4.5	4.5	4-4.5
	M	4.08	3.32			4.10
length posterior femur	N	5	5	1	1	5
	R	29-30	29-30	22	25	23-24
	M	26.6	29.4			23.46
length anterior wing	N	5	5	1	1	5
	R	49-54	49-54	37	47	39-43
	M	45.6	51.8			40.3
length ovipositor	N		5		1	
	R		26-28		28.5	
	M		27.5			

RECORDS. CALIFORNIA: INYO COUNTY: Big Pine, 4 mi. S. 24-VII-1964 (J.D. Birchim, 1 male, DCR), 4-VII-1965 (J.D. Birchim, 1 male, 2 females, DCR); 4 mi. W., 3-VII-1961 (D.C. Rentz, 2 males, 4 females, DCR). Independence Creek, 27-VI-1965 (Mannat, 1 female, DCR), 20-VI-1965 (J.D. Birchim, 1 female, DCR), 30-VI-1965 (J.D. Birchim, 2 females, DCR),

28-VII-1964 (J.D. Birchim, 1 male, DCR). Independence, 6 mi. W., 24-VIII-1965 (J.D. Birchim, 1 female, DCR), 12-VII-1965 (J.D. Birchim, 1 female, DCR), 24-VII-1965 (D.C. Rentz, 4 males, 2 females, DCR). Lone Pine, 9 mi. N., 9-VII-1964. (D.C. Rentz, 3 males, DCR); 11 mi. W., 6-VII-1961 (D.C. Rentz, 2 males, 3 females, DCR), 3-VII-1965 (J.D. Birchim, 1 male, DCR); 9 mi. W., 3-VII-1965 (J.D. Birchim, 1 male, DCR). Plant 4, 8 mi. SW. Bishop, 13-VII-1964 (J.D. Birchim, 2 males, 1 female, DCR). Westgard Pass, 26-VII-1962, 7,200 feet elevation (D.C. Rentz, 1 male, DCR), 9-IX-1966 (D.C. and K.A. Rentz, 3 males, 2 females, DCR); 5 mi. W., 26-VIII-1965 (J.D. Birchim, 2 males, DCR). MONO COUNTY: Benton Station, 5-VIII-1960 (R. P. Allen, 1 male, CDA). Paradise Valley, 17-VII-1965 (J.D. Birchim, 1 male, JDB). Tom's Place, 1 mi. W., 9-VIII-1959 (D.C. Rentz, 1 male, DCR). Topaz Lake, 17-VII-1951 (S.M. Kappes, C.A. Downing, 4 males, UCD). SAN BERNARDINO COUNTY: New York Mts., 12-VIII-1964 (J.D. Birchim, 1 male, DCR). NEVADA: WASHOE COUNTY: Pyramid Lake, 10-IX-1945 (A.T. McClay, 1 female, UCD); 29-VII-1957 (D.C. Rentz, 1 male, DCR). UTAH: MILLARD COUNTY: Oak City, 9 mi. E., Oak Creek Camp, 2-IX-1963 (D.C. and K.A. Rentz, 1 male, 6 females, DCR).

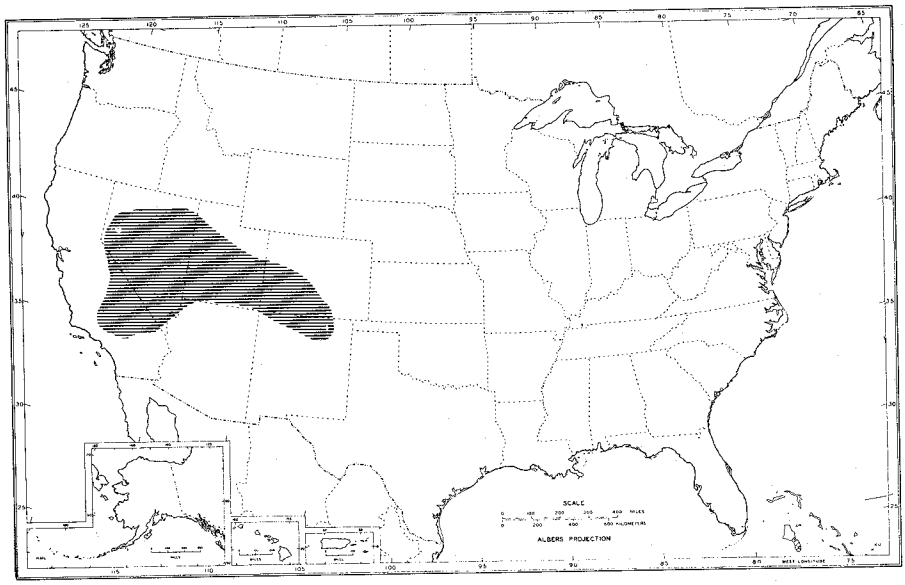

Fig. 7. Known distribution of *Capnobotes occidentalis*.

DISCUSSION. The titillators of the male genitalia and the shape of the cercus are characteristic for the species and vary but little from one locality to another. The specimens from Utah agree remarkably well with the specimens from California. All of the Utah specimens were collected by traveling slowly on little-traveled roads at night.

Capnobotes granti Rentz and Birchim, new species
(Figs. 8A, 8B, 8C, 12, 33A, Table 1)

DIAGNOSIS. Male only known. Size small for genus. Tegmina short. Cercus platyform (Fig. 8A, 8C), teeth widely separated. Three color phases known: brown, green, grey.

TYPE LOCALITY: 4 miles east of junction of Clear Creek and Coalinga Roads, (Road to Idria), San Benito County, California.

DEPOSITION OF TYPE. The holotype is to be deposited in the United States National Museum.

HOLOTYPE MALE. Size small for genus, form robust. Fastigium of vertex not as produced as in other species, except for *C. unodontus* Rentz and Birchim new species, not as deeply excavate. Fastigium half as broad as first antennal segment, no frontal costa, ovoid white area distinct, eyes ovoid, moderately bulging.

Pronotum in lateral profile much higher in posterior, concave in median portion. Lateral carinae of pronotum present only on posterior 1/5. Single, moderately defined, transverse sulcus present on anterior 1/5. Lateral lobes of pronotum moderately produced, more than half as deep as the length of pronotum. Anterior margin of lateral lobe of pronotum broadly acute. Ventral posterior angle of lateral lobe broadly rounded. Ventral margin of pronotum convex. Pronotum armed with a pair of widely separated, short spines.

Tegmen broadest at basal 1/3, narrowing to apex. Width of apex of tegmen much less than half as broad as broadest portion of tegmen. Wing highly translucent, slightly darkened on anterior margin.

All femora armed on inner and outer ventral margins with many spines. Fore tibia armed on dorsal posterior margin with 2 widely separated spines, anterior ventral margin spineless. Ventral margins of fore tibia with 5-6 spines on posterior and anterior margins. Middle tibia armed on anterior dorsal margin with 2-3 spines, posterior dorsal margin with 4 spines. Posterior tibia armed with 4 apical ventral spurs, the inntermost pair half as long as outermost pair.

Abdominal tergum 10 with shallow, broad excavation in

median portion. Latero-posterior angles of tergum 10 acute, digitiform, extending to subapical tooth of cercus. Cercus elongate, dorso-ventrally flattened. Subapical tooth of cercus well produced, widely separated from apical tooth, at right angles to shaft. Apical tooth greatly curved inward to a distance equal to that of subapical tooth. Subgenital plate with moderate incision, styles elongate more than 6 times basal width.

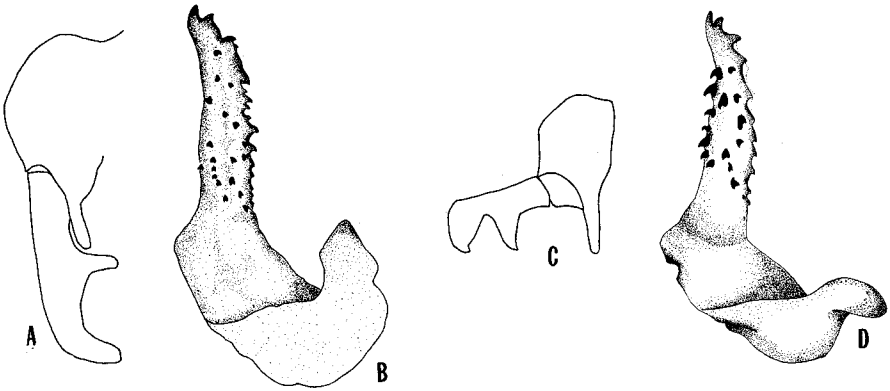

Fig. 8. Variation in *Capnobotes granti*. A, B, paratype male from San Benito County, California. C, D, paratype male from Mt. Hamilton, Santa Clara County, California. A, C, left cercus and portion of last abdominal segment. B, D, right portion of titillator.

Titillators of male genitalia (Fig. 8B, 8D) with basal portion curved inward. Arm of titillators with teeth continuous on entire length.

Coloration of species variable. Green phase with yellow-brown legs and pronotum; brown of uniform color throughout; grey phase as in *C. occidentalis*.

DERIVATION OF NAME. We take pleasure in naming this species for the late Harold J. Grant whose tragic death on 27 February 1966 terminated the career of one of the most active workers in the field of orthopterology.

SPECIMENS STUDIED. 4; holotype, 2 paratypes, and 1 nymph.

RECORDS. ALL CALIFORNIA: MONTEREY COUNTY: Jamesburg, VII-1958 (C. Cushner, 1 immature female, DCR). SAN BENITO COUNTY: Clear Creek and Coalinga Rds., 4 mi. E. of junction (road to Idria), 14-VIII-1958 (D. C. Rentz, 1 male, holotype,

grey phase). Idria, 8 mi. SW., 25-VIII-1962 (D. C. Rentz, E. W. Kirschbaum, 1 male, paratype, brown phase). SANTA CLARA COUNTY: Mt. Hamilton, summit, 4,213 feet elevation, 3-IX-1964 (D. C. & K. A. Rentz, 1 male, paratype, green phase).

DISCUSSION. At the San Benito County localities, which are not widely separated, *C. granti* was collected on chaparral brush at night. Males stridulated loudly and many were heard high in pine trees. *Capnobotes* presumably of this species were heard at Pinnacles National Monument on many occasions during the summer months of 1964, 1965. All specimens were stridulating high in oaks and pines.

The single male from Mt. Hamilton has the legs slightly longer than the other specimens and the tegmina are somewhat shorter. The cerci and titillators are also slightly different. The specimen was collected on the west part of the summit late at night and high on a manzanita. The specimen made no attempt to fly even after it was thrown in the air. The robust appearance of members of this species suggests that they do not fly readily, if at all.

Capnobotes attenuatus Rentz and Birchim, new species
(Figs. 9A, 9B, 12D, 33D, Table 1)

1934. *Capnobotes bruneri*, Caudell (not of Scudder, 1900), Pan-Pac. Ent., 10: 151.

DIAGNOSIS. Nearest relatives *C. occidentalis*, *C. unodontus*, *C. bruneri*. Differs from these species in slender, more graceful appearance and characters found in key. Tegmina slender, widest basally, narrowed abruptly. Latero-posterior angles of tergum 10 similar to those of *C. unodontus*, shorter than those of *C. occidentalis*. Subapical tooth of cercus only as long as or slightly longer than apical tooth (Fig. 9A). General coloration uniform light grey, no green form known, with lighter tessellations along the dorsum of the tegmina. Titillators with proximal portion upturned, arms gradually narrowing to apex. Teeth located on nearly entire arm of titillator.

TYPE LOCALITY. Mt. Diablo State Park, road to summit, Contra Costa County, California.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the United States National Museum.

HOLOTYPE MALE. Size medium for genus, form slender. Tegmen extending greatly beyond apex of abdomen. Fastigium of vertex narrow, its surface greatly concave, little more than half as broad as first antennal segment. Frontal costa obsolete, ovoid white area present ventrad of fastigium,

shorter in size than second antennal segment.

Pronotum slightly shorter than in other species, disk concave in median portion. Lateral carinae present only on posterior 1/5. Single weakly defined, transverse sulcus present on anterior 1/5 of pronotum. Median portion of transverse sulcus weakly bowed posteriorly. Lateral lobes of pronotum weakly declivent, depth more than half dorsal length of pronotum. Anterior margin of lateral lobe acutely pointed, posterior lobe broadly rounded; ventral margin of lateral lobes of pronotum of greater depth at posterior, thence gradually decreasing anteriorly. Prosternum armed with a pair of widely separated, short spines the length of one of which is less than basal width.

Tegmen broadest in basal quarter, gradually narrowing to apex. Width of apex of tegmen much less than half the width of broadest portion of tegmen. Wing highly translucent, noticeably darkened on anterior border.

Fore and middle femora armed on anterior and posterior ventral margins with 5-6 spines. Fore and middle tibia armed posterior and anterior ventral margins with 6 spines. Dorsal margin of fore tibia with 2-3 spines anterior and 0-1 spine on posterior margin.

Middle tibia armed on anterior dorsal margin with 2 spines, posterior margin with 4 spines. Hind femur armed on anterior and posterior ventral margins with 8 distinct spines. Hind tibia with 4 apical spurs on ventral margin, inner pair half the length of outer spurs.

Tergum 10 excavate in median portion, latero-posterior angles extending to base of cercus, turned ventrally. Cercus moderately short for genus, less than three times as long as basal width. Inner tooth on posterior 1/4, slightly longer than apical tooth. Subgenital plate with V-shaped median incision 1/5 as deep as plate. Styles of subgenital plate half as long as lateral margin of incision.

Titillators of male genitalia (Fig. 9B) with basal portion upturned, not greatly twisted. Arm of titillator as long or longer than base, of nearly uniform width throughout, not expanded distally, dorso-ventrally compressed, serrated on outer margin in distal 1/2 to 3/4. Titillators dark black in basal portion, arms light brown.

Coloration grey with purplish overcast. Tegmina with few elongate, black tessellations. No green or brown forms known.

ALLOTYPE FEMALE. - Differs from holotype in following features: ovipositor longer than hind femur, nearly straight, slightly curved downward. Subgenital plate with incision half length of plate.

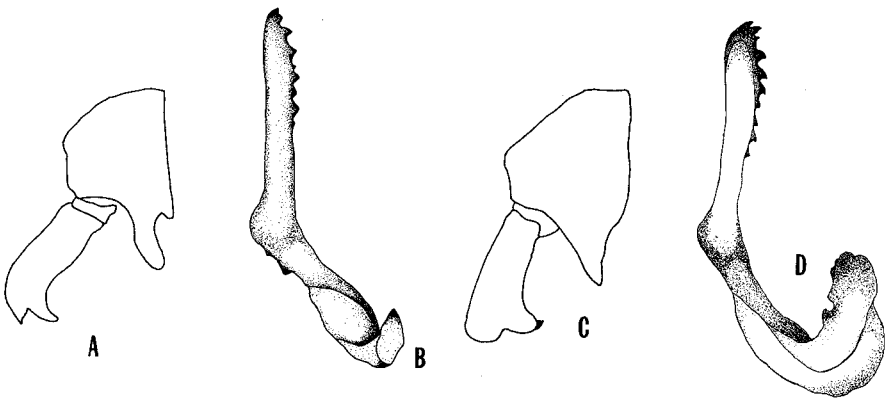

Fig. 9. Left cercus and portion of last abdominal segment of male *Capnobotes attenuatus*. B, right portion of titillator of male *C. attenuatus*. Left cercus and portion of last abdominal segment of male *C. unodontus*. D, right portion of titillator of male *C. unodontus*.

DERIVATION OF NAME. This species is named for its slender appearance.

SPECIMENS STUDIED. 7: holotype, allotype, 3 paratypes.

RECORDS. All CALIFORNIA: CONTRA COSTA COUNTY: Mt. Diablo State Park, Juniper Camp, 13-VIII-1965, 2,900 feet elevation (D. C. & K. A. Rentz, holotype, allotype, 1 female paratype); 14-VIII-1965, summit 3,849 feet elevation (D. C. & K. A. Rentz, 1 male, 1 female paratypes). TULARE COUNTY: Johnstonville, 5-VI-1951 (C. I. Johnston, 1 male, CIS). YOLO COUNTY: Davis, 15-IX-1032 (F. H. Wymore, 1 female, USNM).

DISCUSSION. Specimens from the type locality were all collected along the main road from the entrance to the summit. The species is apparently quite common and stridulating males can be heard in chaparral areas of the park throughout the summer. Specimens were collected from Chamies (*Adenostoma fasciculatum*) and Digger Pine (*Pinus sabiniana*). The stridulation is somewhat similar to that of *C. occidentalis*. A female was found late at night on the asphalt road attempting to oviposite.

Capnobotes bruneri Scudder
(Figs. 12, 33E, Table 1)

1897. *Capnobotes bruneri* Scudder, Canad. Ent., 29: 74.

Type locality: Tepusquet Peak,Santa Barbara County, California.

Distinguishable by features found in the key. *C. bruneri* superficially resembles *C. occidentalis* in coloration and body form but it can be readily distinguished from it by the shape of the tegmen and (Fig. 10E) coloration. The titillators of the male genitalia are also distinctive. Tinkham (1944) gave a vivid account of the capture of the first male of the species. Caudell (1934) incorrectly placed a female from Davis, California in this species; it actually represents *C. attenuatus*.

RECORDS. ALL CALIFORNIA: KERN COUNTY: Paradise Valley, Tehachapi Mts., 7-VIII-1931 (E. R. Tinkham, 1 male, ANSP). LOS ANGELES COUNTY: Wrightwood, 10-X-1958 (P. Paige, 1 female, DCR).

Capnobotes unodontus Rentz and Birchim, new species
(Figs. 9C, 9D, 12, Table 1)

DIAGNOSIS. Size medium for genus. Occurs in grey or green color phases. Tegmina broader basally. Anterior margin of wing conspicuously darker than rest of wing. Cercus of male with a large subapical tooth. Ovipositor of female short, distinctly curved downward.

TYPE LOCALITY: West of Lakeport, Lake County, California.

DEPOSITION OF TYPE. The holotype is to be deposited in the United States National Museum.

HOLOTYPE MALE. - Size medium for genus, form moderately robust. Tegmina extending greatly beyond apex of abdomen. Fastigium of vertex not as well produced as in *C. attenuatus*, deeply cleft as in that species. Fastigium of vertex less than half as broad as first antennal segment, no frontal costa; ovoid white area indistinct. Eyes prominent.

Pronotum more similar to that of *C. attenuatus* than of other species. Surface of disk but slightly concave in median portion. Lateral carinae of pronotum present on posterior portion only. Single, well defined, transverse sulcus present on anterior 1/5 of pronotum. Lateral lobes of pronotum weakly declivent, depth little more than half the length of pronotum. Anterior margin of lateral lobe broadly rounded. Ventral margin of lateral lobe sinuous. Prosternum armed with a pair of widely separated, well developed spines.

Tegmen broadest in basal half, narrowing to apex. Width of apex much less than width of broadest portion of tegmen. Wing only slightly translucent, not opaque as in

C. fuliginosus but darker than other species. Anterior margin of wing conspicuously darker than rest of wing.

All femora well spined on anterior and posterior ventral margins with many spines. Fore tibia armed on dorsal posterior margin with 3 spines, anterior margin spineless or with single spine on foramina. Ventral margins of fore tibia with 6 spines on anterior and posterior margins. Middle tibia armed on anterior dorsal margin with 4 spines. Posterior tibia armed with 4 apical spurs, ventral in position, the inner pair half the length of the outer pair.

Tergum 10 with a deep V-shaped excavation in median portion. Latero-posterior angles acute, projecting slightly behond base of cercus. Cercus elongate, apex broadly rounded. Subapical tooth well developed, apex sharply pointed. Subgenital plate with incision developed, to greater degree than other species. Styles elongate, more than 5 times basal width.

Titillators of male genitalia (Fig. 9D) with basal portion turned laterally, not as in *C. attenuatus*. Arm of titillator with teeth on lateral outer margin for nearly entire length. Titillators black in basal portion, arms light brown.

Coloration of species predominantly grey brown. Row of 6-10 spots on dorsum posterior of tegmen. Wing smoky black, darker on anterior margin. A single green male has been seen from 8 miles north of Yreka, California. It lacks the light spots on the tegmina. The wing is light green but darker on anterior margin.

DERIVATION OF NAME. The species is named with reference to the single tooth of the cercus.

SPECIMENS STUDIED. 4; holotype, 3 paratypes.

RECORDS. ALL CALIFORNIA: LAKE COUNTY: West of Lakeport, 19-VII-1962 (J. B. Snell no. 264, holotype). SISKIYOU COUNTY: Yreka, 8 mi. north, 1-IX-1961 (J. S. Buckett, 3 males, paratypes, UCD, JRH). QUESTIONABLE PLACEMENT: CONTRA COSTA COUNTY: Mt. Diablo, 19-IX-1959 (J. R. Helfer, 1 female, JRH).

DISCUSSION. Nothing is known of the habits of this species. It likely inhabits chaparral areas and can be found on vegetation at night. A single female from Mt. Diablo which is definitely not *C. attenuatus* may be this species, but no comparative material is available. This species shows superficial resemblance to *C. spatulatus* and may actually be a race of it or another species, but more specimens are needed to correctly determine this.

Capnobotes spatulatus Rentz and Birchim, new species
(Figs. 10, 12, 33B, Table 1)

DIAGNOSIS. Size small, form slender. Tegmen broader basally, narrowing to apex, inner margin concave (Fig. 33B). Cercus of male (single specimen damaged) with single subapical tooth of same length apical tooth, similar to that seen in *C. fuliginosus*, *C. arizonensis*. Titillators of male genitalia spatulate (Fig. 10) in apical portion.

TYPE LOCALITY. Red Bluff, Tehama County, California.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the United States National Museum through the permission of the Bureau of Entomology, California State Department of Agriculture.

HOLOTYPE MALE. - Size small for genus, form slender. Fastigium of vertex broad, similar to that as described for *C. attenuatus* and *C. unodontus*, but without deep sinus. Fastigium of vertex more than half as broad as first antennal segment, frontal costa obsolete.

Pronotum appearing shorter than in other species. Lateral lobes more deeply produced. Surface of disk not concave. Lateral carinae of pronotum well developed on posterior only. Anterior margin of lateral lobe slightly concave. Ventral anterior angle acutely pointed. Ventral portion of lateral lobe straight. Prosternum armed with a pair of widely separated, short, knoblike spines.

Tegmen broadest in basal portion (Fig. 10B), narrowing to apex. Width of apex much less than width of broadest portion of tegmen. Posterior margin of tegmen greatly concave. Wing greatly translucent, similar to that of *C. unodontus*. Anterior margin of wing conspicuously darkened.

All femora well spined on posterior and anterior ventral margins with many spines. Fore tibia armed on anterior dorsal margin with 2 spines, anterior margin with 3 spines. Posterior tibia with 4 apical ventral spurs, innermost pair half as long as the outermost ones.

Tenth tergum (holotype partially damaged) deeply incised, latero-posterior angles well produced. Cercus moderately elongate with apical and subapical tooth of equal lengths. Subgenital plate with incision shallow, styles short.

Titillators of male genitalia (Fig. 10A) spatulate at apex, resembling *C. occidentalis* to lesser degree. Arms of titillators serrated only on spatulate portion.

Coloration of species as described for *C. unodontus* with exception that green form is unknown.

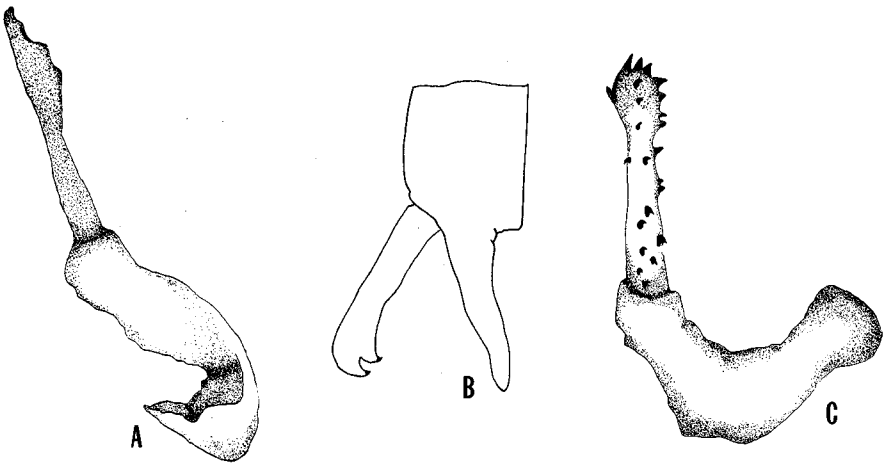

Fig. 10. A, right portion of titillator of male *C. spatulatus*. B, left cercus and portion of last abdominal segment of male *C. fuliginosus*. C, right portion of titillator of male *C. fuliginosus*.

ALLOTYPE FEMALE. - Similar to male with following exceptions: ovipositor noticeably shorter than in *C. attenuatus*, more abruptly curved downward. Subgenital plate not as deeply incised as in *C. attenuatus*.

DERIVATION OF NAME. The name for this species has reference to the spatulate form of the titillators of the male genitalia.

SPECIMENS STUDIED. 2; holotype, allotype.

RECORDS. CALIFORNIA: TEHAMA COUNTY: Red Bluff, VIII-1964 (E. Dietz, holotype, allotype, "under yard light").

DISCUSSION. This species is most closely related to *C. unodontus*. The titillators seem to show similarities with *C. occidentalis*. Nothing is known of its habits other than it can likely be attracted to light.

Capnobotes fuliginosus (Thomas)
(Figs. 10B, 10C, 11, 12, 33F, Table 1)

1872. *Locusta fuliginosa* Thomas, Ann. Rept. U. S. Geol. Surv. Terr., 5: 443, Pl. 1, Fig. 9.
1897. *Capnobotes fuliginosus*, Scudder, Canad. Ent., 29: 74.

Type locality: Northern Arizona.

This is by far the largest species in the genus. It is very aggressive and will readily accept and rapidly eat live grasshoppers, other katydids and moths. Individuals in captivity will live for many months entirely on vegetation, apparently indicating an omnivorous habit. This species occurs only in the grey phase. Most other species in the genus are variable with regard to color.

The call of *C. fuliginosus* is low and vascillating. Specimens fly readily when approached. Tinkham (1944) gave detailed notes pertaining to the biology of this species. La Rivers (1948) added comments with reference to Nevada specimens. The species is known from Texas, New Mexico, Nevada, Arizona, California.

Alexander and Rodeck (1952) reported on a collection of specimens of this species from Dinosaur National Monument. This is a most unusual record and suggests that the species possibly has a broader range that here indicated but no further material has been collected.

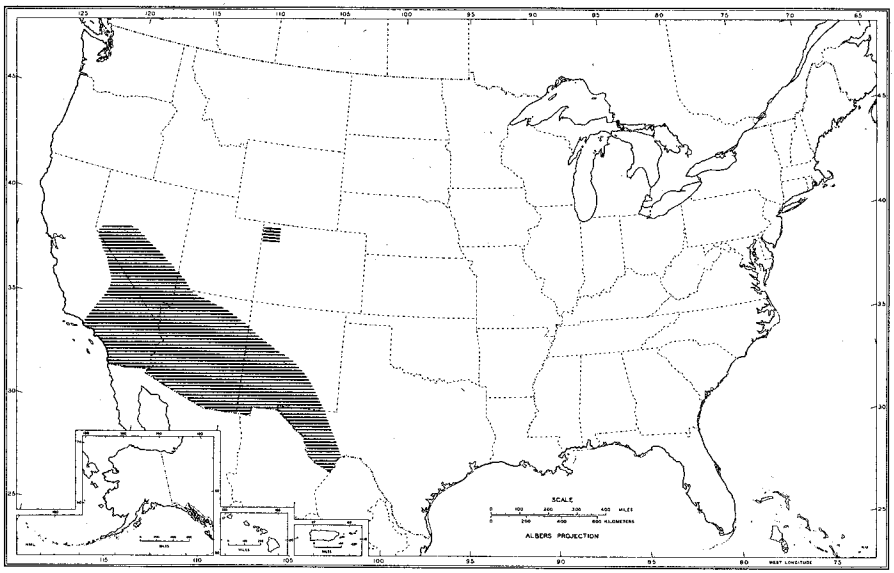

Fig. 11. Known distribution of *Capnobotes fuliginosus*.

RECORDS. ARIZONA: COCHISE COUNTY: Cochise Stronghold, 25-VII-1954 (H. E. Cott, 1 female, UCD). Hereford, 14-VIII-1958 (P. R. Luther, 1 male, UCD). GRAHAM COUNTY: Mt. Graham, Snowline Ranch, 30-VII-1952 (E. J. Taylor, 1 male,

1 female, UCD). PIMA COUNTY: Sabino Canyon, 25-VI-1963 (F. D. Parker, 1 female, UCD). Santa Catalina Mts., Molino Basin, 3-IX-1965 (C. W. O'Brien, 2 males, DCR). CALIFORNIA: INYO COUNTY: Big Pine, 7 mi. S., 30-VII-1964 (J. D. Birchim, 4 males, DCR). Independence, 25-VII-1964 (J. D. Birchim, 1 male, DCR). Lone Pine, 6 mi. W., 23-VII-1965 (D. C. Rentz, 5 males, DCR). Mazourka Canyon Road, 13-VII-1964 (J. D. Birchim, 3 males, DCR). Westgard Pass, 4-VII-1965 (J. D. Birchim, 3 males, DCR). KERN COUNTY: Mojave, 14 mi. NNE., 13-IV-1962, matured VII-1962 (D. C. Rentz, C. D. MacNeill, 2 males, DCR). RIVERSIDE COUNTY: Magnesia Canyon, 20-VII-1952 (E. M. Evans, 5 males, 3 females, UCD). Palm Desert, 2-VII-1958 (C. Cushner, 2 females, DCR), 25-VII-1964 (J. D. Birchim, 1 male, DCR). Palm Springs, 30-V-1954 (Menke & Stange, 1 female, UCD).

Genus *Neduba* Walker

1869. *Neduba* Walker, Cat. Derm. Salt. Brit. Mus., 2: 250.
1874. *Arytropteris* Herman, Verh. Zool.-Bot., Ges. Wein, 24: 204. (in part)
1893. *Tropizaspis* Brunner, Ann. Mus. Civ. Stor. Nat. Geneva, 33: 187. (Invalid, no species included).
1899. *Tropizaspis* Scudder, Proc. Amer. Acad. Arts and Sci., 25: 83.
1907. *Aglaothorax* Caudell, Proc. U. S. Nat. Mus., 32: 290.

Type of the genus: *Neduba carinata* Walker, by monotypy.

DISCUSSION. In 1907 when *Aglaothorax* was described, it was chiefly distinguished from *Neduba* by the broad, oval thorax and the short posterior femora of "most" species. Caudell indicated the similarity of the genera in 1907 when he stated, concerning *Aglaothorax diabolica:* "*A. diabolica* has the long posterior femora of *Neduba*, but the form of the pronotum and general appearance serve to locate it in this (*Aglaothorax*) genus." In 1934 he placed the species in *Neduba*. Tinkham (1944) in his key to the decticine genera of the North American deserts noted that in *Neduba* there are "pseudocerci without a subapical tooth in the larger species." The exception was the small *Neduba morsei* Caudell which has very elongate infracercal plates (pseudocerci) with a small subapical tooth, a condition found in most forms of *Aglaothorax*. The 10th tergum (supra-anal plate) was found to be rounded and not truncate in development as usual in *Neduba*, but in other respects, for example, pronotum and coloration, *morsei* resembles *Neduba*.

Evidence now at hand indicates that *Neduba* and *Aglaothorax* are congeneric, with the "gap" between the two being bridged by at least three species. On the basis of external facies, *N. morsei* Caudell and *N. diminutiva* Rentz and Birchim, new species seem referable to *Neduba* "sensu strictu". But when the external genitalia and titillators were

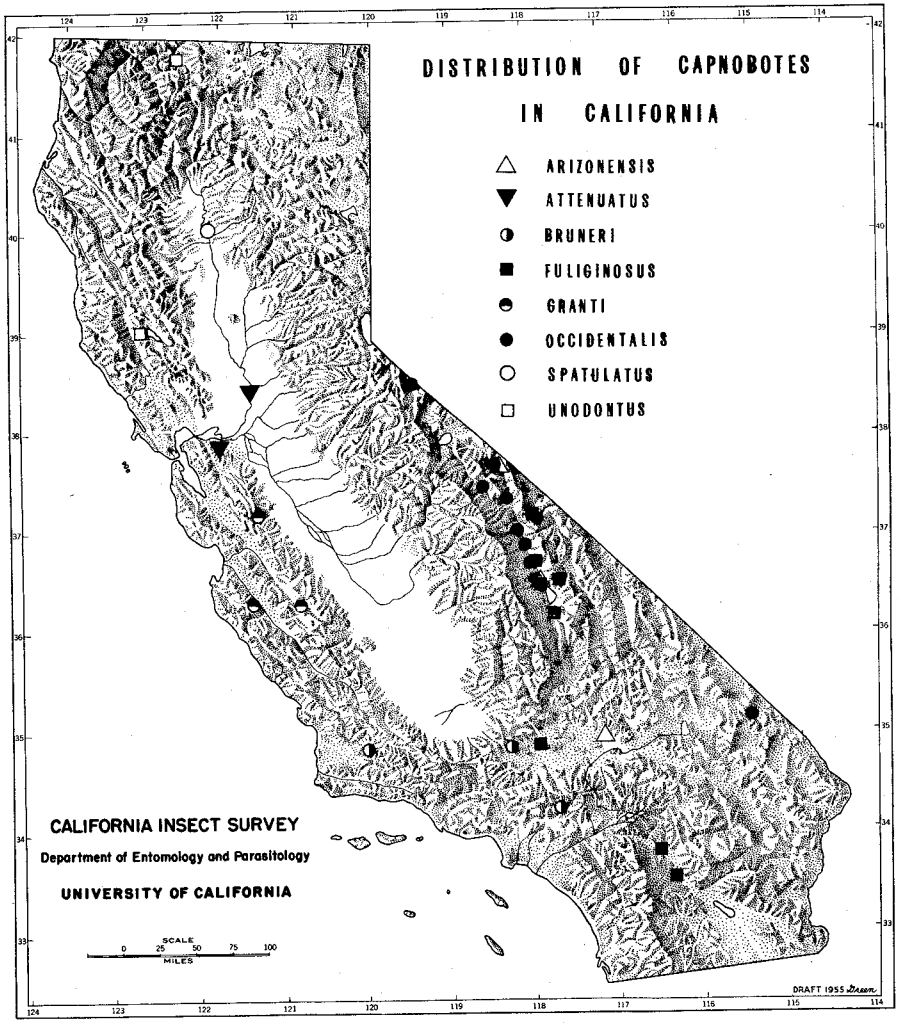

Fig. 12. Distribution of *Capnobotes* in California.

examined, it was found that they most closely resembled those found in *Aglaothorax*. The same situation was found, but in reverse, *N. castanea* (Scudder). Paratypes of this species sent from the U. S. National Museum have been examined and show that in general facies *N. castanea* resembles *Aglaothorax*, however, its genitalia are of the *Neduba* type.

Stridulation also shows a convergence between the two genera. As described by Tinkham for *A. segnis* Rehn and Hebard (here the subspecies *A. ovata gigantea* Rentz and Birchim, new species), *Aglaothorax* possesses a zic-zic-zic

type of stridulation. *Neduba carinata* (Walker), on the other hand, sings with a zwee-zwee-zwee sound. However, there are certain forms of uncertain placement, possibly *N. diabolica*, morphologically resembling *N. carinata* which possess a chu-chu-chu call not greatly unlike that of *Aglaothorax*.

It seems best at this point in our knowledge to synonymize the two genera, retaining the name *Neduba* by priority. Since the extremes of the genus are very different forms, we propose that subgenera be retained, *Aglaothorax* for *ovata* and the species with similar genitalic development including *morsei, diminutiva, gurneyi*. The nominate *Neduba* comprises *carinata, castanea, diabolica, sierranus, convexa, steindachneri, macneilli*.

Neduba is one of the few decticine genera possessing a toothed ovipositor. Although no observations on oviposition have been made, we believe that this genus places its eggs in wood or other plant tissue rather than directly into the ground as do many genera.

DESCRIPTION OF GENUS. - Size small (*N. diminutiva* Rentz and Birchim, new species) to moderately large (*N. ovata gigantea* Rentz and Birchim, new subspecies) for the Decticinae; form very robust. Body surface shining in many species, dull in others. Head with vertex well produced, occupying most of the area between the base of the antennae. Vertex diamond-shaped to rounded.

Pronotum elongate, approximately half as long as the head and body combined. Disk of pronotum with apex rounded (males) to truncate (some females). Lateral carinae of pronotum parallel to slightly converging anteriorly to greatly converging in anterior portion. Lateral lobes of pronotum longer than deep, the ventral margin gently declivent posteriorly in some forms to produced as a flap on the anterior margin covering the front coxa. Tegmina concealed by the pronotum, extremely minute vestiges in females. Prosternum spined or unspined.

Dorsal surface of abdomen smooth, shining, with mediolongitudinal carina broken on the distal tergites. Tergum 10 of male (supra-anal plate) specialized, tongue-shaped to laterally produced with sinuous, truncate apex. Pseudocerci broad, untoothed flanges to narrow appendages toothed apically or subapically. Cerci short, broad or elongate, never greatly developed as in other Decticinae. Ovipositor of female elongate, curved upward as long or longer than the posterior femur; surface of ovipositor smooth, polished anteriorly, serrated dorsally on posterior 1/4, ventrally serrated on anterior 1/6. Subgenital plate of female simple, rounded with medial indentation in some forms to lobed with spiniform finger laterally produced.

General coloration from brown to green with splotches of white on dorsum of abdomen. Dorsum of pronotum often shining, streaked with black or rimmed with it.

Key to the Subgenera of *Neduba*

Male with supra-anal plate rounded as a tongue held over the pseudocerci (Figs. 19A, 19C, 20A, 21A, 21C, 21E, 21G, 21I, 21K). Subgenital plate of female produced laterally as subparallel, spiniform appendages resting along ventral base of ovipositor (Fig. 13A). Titillators of male genitalia with arms sinuous, apices diverging (Figs. 12A, 19D, 20B, 21B, 21D, 21F, 21H, 21J, 21L). Species frequently with green color phases. Usually inhabitants of desert regions .....subgenus *Aglaothorax* (p. 59)

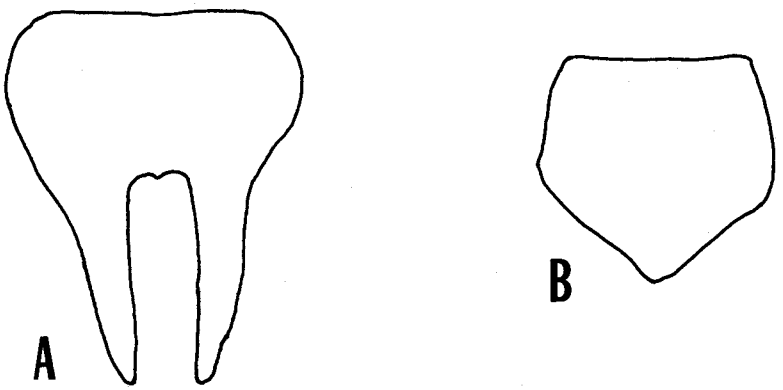

Fig. 13. A. subgenital plate of female *Aglaothorax*. B, subgenital plate of female *Neduba*.

Male with supra-anal plate quadrate, apices of plate acute angled (Figs. 14A, 15A, 16A, 17A, 18A, 18B). Subgenital plate of female not produced, rounded (Fig. 13B). Titillators of male genitalia with arms parallel, apices upturned (Figs. 14C, 15C, 17B, 18C, 18D). Mostly brown species, no green phases known. Species most commonly found along Pacific Slope in Oak Woodland habitats. .....subgenus *Neduba* (p. 38)

Subgenus *Neduba*

DIAGNOSIS. No green forms known. Pronotum often not as extensive in covering the abdomen as found in *Aglaothorax*, apex broadly rounded. Lateral lobes of pronotum with black present on shoulders. Anterior tibia armed dorsally with one or more than one spine. Middle tibia armed apically with one or two spines ventrally. Supra-anal plate of male (Figs. 14A, 15A, 16A, 17A, 18A, 18B), truncate, not rounded. Pseudocerci simple, elongate plates, untoothed. Titillators of male genitalia (Figs. 14C, 15C, 17B, 18C, 18D) with arms parallel, apices upturned. Subgenital plate of female simple, rounded, often with medial indentation. Lateral portion of plate without finger-like projections. Fore and middle femora armed on inner and outer margin with 7 to 8 spines; fore tibia armed above with 1 or 2 spines; posterior tibia with 2 apical spurs, the inner spine twice as long as outer spur.

Key to Species of Subgenus *Neduba*[1]

1. Dorsal margin of fore tibia with apical spine on posterior margin only.....2

   Dorsal margin of fore tibia with an apical spine on both anterior and posterior margins.....4

2. Prosternum armed with a pair of spines..... .....*Neduba (Neduba) sierranus* Rehn and Hebard (p. 47)

   Prosternum unarmed.....3

3. Outer pagina of hind femur with a distinct longitudinal stripe. Subgenital plate of male with styles indicated only as slight swellings. Arms of titillators of male genitalia with apices bluntly pointed (Fig. 16C). East side of Sierra Nevada from Mono Lake to Lone Pine, California.....*Neduba (Neduba) macneilli* Rentz and Birchim, new species (p. 49)

   Outer pagina of hind femur with dark blotches, not a distinct stripe. Subgenital plate of male without indications of styli. Arms of titillators of male sharply pointed, tapering to apex (Fig. 14C). Los Angeles, Kern, San Bernardino Counties, California..... .....*Neduba (Neduba) castanea* (Scudder) (p. 43)

[1]Excluding *N. steindachneri* from Puget Sound, Washington.

4. Pronotum usually with whitish markings, especially on posterior (Fig. 34C). Pronotum proportionately shorter, covering less of abdomen. Cascade Mountains to west side of northern and central Sierra Nevada, California .....*Neduba (Neduba) convexa* Caudell (p. 58)

Without above combination of characters.....5

5. Pronotum proportionately longer (Fig. 34F, 34G). Known only from Fremont Peak, San Benito County, California.. .....*Neduba (Neduba) carinata* Walker (p. 52)

Pronotum shorter, broader (Fig. 34C, 34E). (May actually represent a complex of closely related species. Specimens from many counties along the coast and central part of California.).....*Neduba (Neduba) diabolica* (Scudder) (p. 55)

Neduba (Neduba) castanea (Scudder)
(Figs. 14A, 14B, 14C, 34A, Table 1)
New combination

1899. *Tropizaspis castanea* Scudder, Proc. Amer. Acad. Arts and Sci., 35(5): 84.
1907. *Aglaothorax castanea*, Caudell, Proc. U. S. Nat. Mus., 32: 293, Figs. 4, 5.

Type locality: Los Angeles County, California.

DIAGNOSIS. *Aglaothorax*-like in general appearance. Interspace between vertex of head and face equal. Second antennal segment without swelling. Prosternum unarmed. Supra-anal plate of male with corners extremely acute. Subgenital plate of male without styli. All femora with subapical annuli. Titillators of male with arms parallel, elongate, more than half again as long as the bases, apices gently upturned. Ventral sclerites with finger-like projections elongate, serrated on inner and outer margins (Fig. 14B). Ovipositor of female nearly as long as the posterior femur.

DESCRIPTION OF SPECIES. Size moderate for genus, form robust. Pronotum well produced, greatly cucullate. Head well seated in pronotum. Interspace between vertex of head and face narrow, distinct, equal. Fastigium of vertex well produced, slight median depression. Eyes dorso-ventrally elongate, bulging. First antennal segment half the length of the eye; second segment without swelling, third segment of equal length with the second. Antennae with narrow white and brown annulations.

Pronotum with greatest dorsal length more than half the

length of the hind femur. Dorsal outline of pronotum with lateral margins nearly parallel, slightly convex, convergent on anterior 1/5. In profile, pronotum with but a slight bulge in posterior portion. Cephalic margin of pronotum straight. Lateral lobes of pronotum normal for genus; anterior portion straight in ventral portion, angle broadly acute. Anterior margin of lateral lobe slightly convex; posterior portion of lobe with angle produced, declivent. Surface of lateral lobes slightly rugulose. Median carina of pronotum well indicated throughout the entire length of pronotum. Weak transverse sulcus present in anterior 1/6 of pronotum. Slight oblique depressions present in anterior 1/4 of pronotum. Tegmina well concealed by pronotum. Prosternum unarmed.

Fore tibia armed dorsally with a single spine on foramina, an apical spine on outer margin. Middle tibia armed dorsally with 1-4 spines on anterior and posterior margins, a single apical spine on dorsal posterior margin. Hind tibia armed dorsally with fewer spines than seen in other species, of alternating lengths, armed ventrally with several scattered, widely separated spines. Ventral margin with a single apical spur on inner and outer margin, the inner spur slightly longer than the outer one. All femora armed dorsally with scattered spines of greater lengths than in other species. Ventral portion of posterior femora with 1-3 scattered spines on internal and external margins.

Abdomen slender, median carina well indicated. Cercus slender, gradually narrowing from base. Cercus 1/4 the length of the pseudocercus, more than half the length of the supra-anal plate. Pseudocerci slightly broader than the supra-anal plate, attenuate. Supra-anal plate of male broad becoming narrow distally, lateral supra-anal plate concave in lateral portions, produced in median portion. Supra-anal plate of female much as in male, lateral margins not as convex. Subgenital plate of male scoop-shaped with a slight median excavation on posterior margin. No styli present at all on subgenital plate of male; subgenital plate of female normal for subgenus, apex broadly acute. Ventral portion with median sulcus. Ovipositor as long as posterior femur and distinctly upcurved, teeth on posterior 1/4, twinned dorsally.

Titillators of male genitalia more similar to those of *N. macneilli* than *N. diabolica* or *N. convexa*. Arms much more than half the length of the base, parallel and gradually upturned at apex. Arms but slightly constricted in basal quarter. Dorsal sclerites with lateral projection on external margin. Distal portion projecting as a finger-like projection serrated on both internal and external margins. Scattered tubercles present near apex of sclerites.

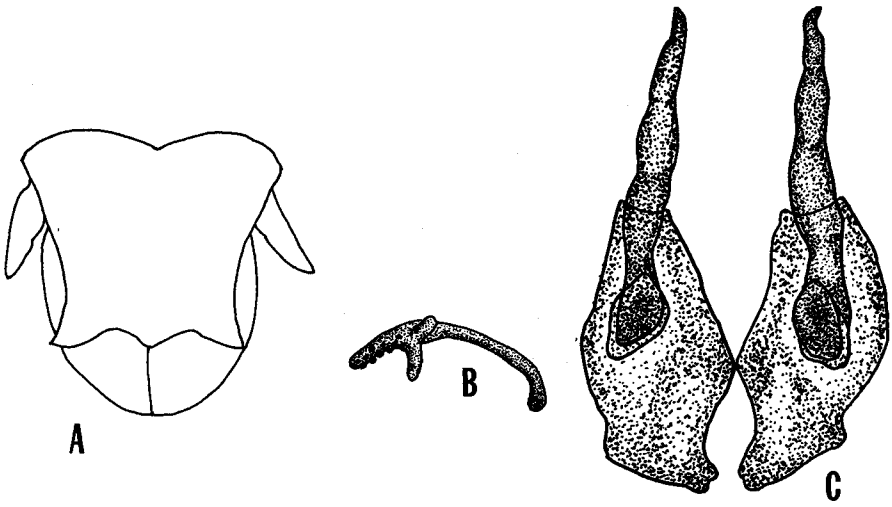

Fig. 14. A, dorsal view of terminalia of male *Neduba castanea*. B, ventral sclerite of titillator. C, titillators of male paratype *N. castanea*.

Coloration light brownish tan with darker longitudinal markings on dorsum of abdomen. All femora with dark brown subapical annuli. Outer pagina of posterior femora without black longitudinal stripe but with area of broken black blotches in median portion. Disk of pronotum light tan in color, unmarked except on posterior apex which is with spaced black markings.

RECORDS. ALL CALIFORNIA: KERN COUNTY: Walker Pass, 20-IX-1960 (J. R. Helfer, 1 male, DCR). LOS ANGELES COUNTY: (Coquillette, 1 male, 1 female, paratypes, USNM). SAN BERNARDINO COUNTY: Desert Springs, 22-VII-1954, 4,000 feet elevation (G. H. Nelson, 1 male, UMMZ).

Table 2. Size variation in subgenus *Neduba*. The size (N) of the sample is listed first, followed by the range (R). Means (M) are based on original values. All measurements in millimeters as measured by an ocular micrometer.

Species		*carinata*	*castanea*		*convexa*	
		Male	Male	Female	Male	Female
total length	N	8	3	1	6	2
	R	16-20	18-23	20	18-21	19-22
	M	17.62	21		19.5	20.5

Table 2 (continued)

Species		*carinata*	*castanea*		*convexa*	
		Male	Male	Female	Male	Female
length pronotum	N	8	3	1	6	2
	R	9.5-11	12-13	12	9-10.5	8-9
	M	10.12	12.5		9.41	8.5
width pronotum	N	8	3	1	6	2
	R	6.1-6.7	7.8-8.8	7.6	6-6.7	5.5-5.8
	M	6.45	8.13		6.46	5.56
length posterior femur	N	8	3	1	6	2
	R	19-23	20	20	17-20	18.5-22.5
	M	21.18	20		16.61	20.5
length ovi-positor	N			1		2
	R			19.5		16.5-18
	M					17.25

Species		*diabolica*		*macneilli*		*sierranus*	
		Male	Female	Male	Female	Male	Female
total length	N	2	2	24	6	1	1
	R	24-25	23-28	18-23	22-23	20	21
	M	24.5	25.5	21.95	22.16		
length pronotum	N	2	2	24	6	2	1
	R	9.5-10	9.2-10.2	9.25-11.5	10.5-12	9-9.5	11
	M	9.75	9.7	10.7	11.33	9.25	
width pronotum	N	2	2	24	6	2	1
	R	6.3-6.5	6-6.3	6.1-7.7	6.4-7.5	5.5-6.2	7
	M	6.4	6.15	7.06	7.1	5.35	
length posterior femur	N	2	2	24	6	2	1
	R	20-20.5	24-26	17-21	21-24	22-26	28
	M	20.25	25	18.95	22.5	24	
length ovi-positor	N		2		6		1
	R		16.5-17.5		16.25-18		16
	M		17		17.45		

Neduba (Neduba) sierranus (Rehn and Hebard)
(Figs. 15A, 15B, 15C, Table 2)

1910. *Aglaothorax sierranus* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila.: 476, Figs. 15-19.

1912. *Neduba sierranus*, Rehn and Hebard, Proc. Acad. Nat. Sci. Phila.: 108.

Type locality: Yosemite Valley, Mariposa County, California 4,000 feet elevation.

This species was placed in synonymy with *N. diabolica* by Caudell in 1934, but is here considered different from it and probably is a fully distinct species in itself. In general appearance it is of the size of *N. castanea* but the titillators greatly resemble those of *N. macneilli* Rentz and Birchim new species.

DIAGNOSIS. Allied with *N. diabolica* but larger, more robust. Pronotum more elongate. Ovipositor of female abruptly upturned, teeth more elongate. Titillators (Fig. 15B, 15C) with arms straight, elongate, projecting beyond apices of base for a distance greater than half the length of the base, apices abruptly upturned, slightly twisted. Ventral sclerite as described for *N. macneilli* but here with a lateral projection (Fig. 15B).

DESCRIPTION OF SPECIES. Size moderately large, form robust. Head well seated in the pronotum. Interocular space very broad and mesad with a pair of more or less distinct converging rugae which unite with the lateral margins of the fastigium. Fastigium equal to width of first antennal segment, narrow depression on dorsal surface. Eyes small, ovoid, prominent for their size. Antennae exceeding the length of the body. Pronotum with greatest width about 1.5 the length. Anterior margin of pronotum slightly arcuate to subtruncate, posterior margin strongly arcuate. Lateral carinae hardly indicated in anterior position, strongly indicated in median and posterior portion, more noticeable in male. Greatest width of mesozona over twice the width of the anterior of the same portion. Median carina precurrent, weakly indicated. Posterior portion of metazona shallowly rugulose; prozona one quarter the length of the metazona. Transverse sulcus very shallow but distinct, not cutting the median carina. Lateral lobes with greatest dorsal length half again as much as the depth, the caudal margin hardly or slightly sinuate. Tegmina of male projecting from beneath the pronotum but little. Prosternum armed with a pair of moderately spaced, well developed spines.

Abdomen inflated, dorsal keel present. Supra-anal plate with lateral margins subparallel, posterior margin nearly truncate. Cerci elongate, more than half the length

of the pseudocerci. Subgenital plate of male scoop-shaped, with slight medial depression, styles short, twice as long as the basal width. Ovipositor of female much shorter than the length of the hind femur, well spined on posterior quarter, distinctly upcurved. Subgenital plate of male with apex broadly obtuse.

Tibiae and femora spined as in most other species of subgenus but fore tibia with but a single apical spur on outer (posterior) margin as in *N.macneilli*.

Coloration apparently not distinctive as in other species such as *N macneilli* Rentz and Birchim, new species but due to lack of properly preserved specimens, this cannot be adequately described.

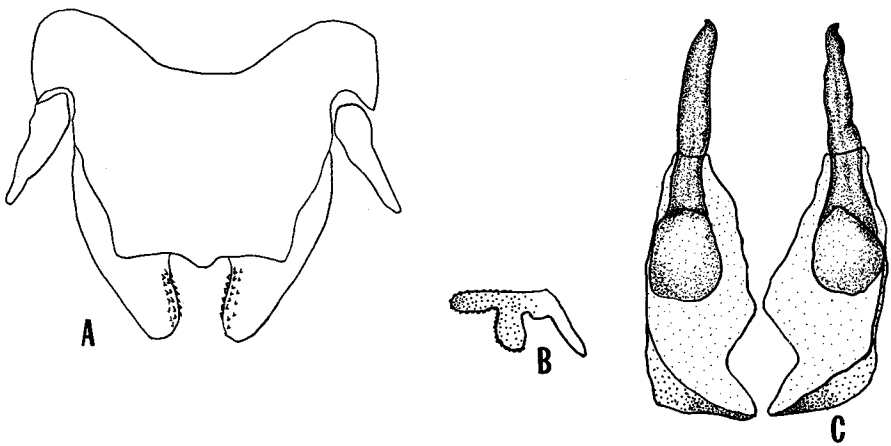

Fig. 15. A, terminalia of male *Neduba sierranus*. B, ventral sclerite of titillator of male *N. sierranus*. C, titillators of male *N. sierranus*.

RECORDS. "From a teacher in Lindsay, California, received VI-1931." (2 males, 1 female, USNM, see Caudell, 1907). KERN COUNTY: Dougherty Crk., Kern River Cyn., 9-VI-1961 (E. L. Kessel, 4 males, 2 females, DCR). MARIPOSA COUNTY: Yosemite Nat'l Park, 15-VIII-1927 (W. B. Cartwright, 1 male, USNM). TULARE COUNTY: Sequoia Nat'l Park, Cedar Grove, 22-VII-1955 (S. Elems, 1 female, DCR).

DISCUSSION. This species shows characters resembling *N. castanea, macneilli, diabolica*. The pronotum of this species is proportionately smaller and less expanded caudad; it is less carinate than seen in other forms. The posterior femur here shows only faint subapical annulus. The

titillators of the male genitalia (Fig. 16B) serve to separate it from the above species.

Neduba macneilli Rentz and Birchim, new species
(Figs. 16A, 16B, 16C, 34B, Table 2)

1944. *Neduba carinata*, Tinkham (not of Walker 1869), Amer. Midl. Nat., 31: 293.

DIAGNOSIS. Titillators (Figs. 16B, 16C), measurements (Table 2). Most easily recognized species in the subgenus. Vertex of head with slight depression. Prosternal spines absent. Styles of subgenital plate indicated only as slight swellings. Titillators of male stout, constricted at apex of base, broadened, tapered to apex; arms not abruptly upturned. Ventral sclerites with bases narrow (Fig. 16B), apices elongate, produced as finger-like projections serrated on outer margins. Coloration uniform dark brownish, sides of abdomen bluish in life, purple on ventral surface of abdomen.

TYPE LOCALITY. 1 mile west of Tom's Place, Mono County, California.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. - Size medium for subgenus, form robust. Head moderately seated in pronotum. Fastigium of vertex in contact with costa of face, a narrow sulcus cutting across them at dorsal base of antennae; fastigium of vertex with slight median depression. Eyes ovo-elliptical, slightly pointed ventrally, directed toward base of antennae. Eye moderately bulging.

Pronotum covering only first two segments of abdomen, its apex surpassing the base of the hind legs when viewed dorsally, approximately half as long as the length of the hind femur. Anterior margin of pronotum concave in median portion. Lateral carinae of pronotum convex, apex pointed, not truncate. Lateral lobes of pronotum with anterior margins straight, posterior portion declivent to median portion thence broadly upturned to anterior margin. Ventro-anterior portion of lateral lobe of pronotum broadly rounded. Dorsum of pronotum with lateral carinae greatly constricted in anterior 1/5 and cut at that point by a shallow sulcus. Sini present in median portion of pronotum which is elevated from that point posterior. Outline of pronotum in profile slightly bulging in posterior portion. Median carina of pronotum continuous from transverse sulcus to apex but not well indicated. Pronotum with 3-5 oblique punctures anterior of sini. Dorsal surface of pronotum smooth, lateral

lobes of pronotum with some elevated areas. Tegmina well concealed by pronotum. Prosternum unspined.

Fore and middle femora short, robust, with scattered spines dorsally, no spines ventrally. Posterior femora with scattered spines of moderate size dorsally, no spines in ventral portion. Fore tibia with 6 spines on anterior margin, 6-7 on posterior margin; dorsal surface with 1-2 spines on foramina; single apical spur on outer margin of tibia. Middle tibia with 8 spines on anterior and posterior margins. Dorsum of middle tibia armed on posterior and anterior margins with 1-4 spines. Hind tibia with dorsal spines alternating in length, every other spine half again as long as the spine before it. Dorsal surface of posterior femur with 4 apical spurs, the inner pair half as long as the external ones.

Abdomen similar to that of other species in subgenus with following exceptions: supra-anal plate with lateral margins concave to latero-posterior angles which are well pointed. Supra-anal plate with apex slightly produced in median portion. Pseudocercus concealed by supra-anal plate, apex slightly extending beyond posterior margin of plate. Cercus a little less than half the length of the supra-anal plate, elongate, not greatly swollen basally. Subgenital plate scoop-shaped, but slightly notched in median portion. Styles of subgenital plate indicated only as slight swellings.

Titillators with arms projecting beyond apex of base for a distance greater than half the length of the base. Arms of titillators rather stout, constricted at apex of base, thence broadened, tapering to apex; arms not abruptly upturned. Ventral sclerites with bases narrow (Fig. 16B elongate apices produced as finger-like projections serrated on external margins.

Coloration very distinctive for species, of little variability. Head and face brown with whitish speckles. Spot on costa of face dorso-ventrally elongate. First two segments of antennae of same color as head and face, next two segments whitish, thence black alternating with every other segment. Pronotum varying from light brown to dark brown with either no markings at all or blackish markings as streaks (Fig. 18B). Lateral lobes of pronotum black at shoulders, of same color as head and face in ventral portion. Tegmina with apex black with extreme margins whitish. Abdomen brownish with white speckling. Faint indication of markings present on dorsum of abdomen. Sides of abdomen, in life, bluish, fading after death. Ventral surface of abdomen and subgenital plate reddish purple. All femora with a black subapical annulus preceeded by a broad, lighter area. Outer face of hind femur with black longitudinal stripe in median portion.

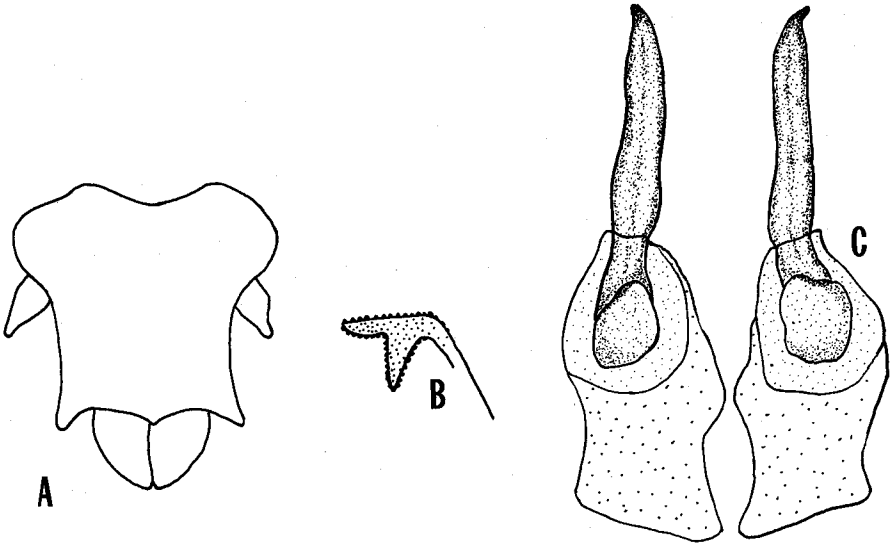

Fig. 16. A, terminalia of male *Neduba macneilli*. B, ventral sclerite of titillator of *N. macneilli*. C. titillators of male *N. macneilli*.

ALLOTYPE FEMALE. - Differs from male in following characters: pronotum more robust, broader. Supra-anal plate tongue-shaped, latero-posterior angles rounded, apex truncate. Cercus nearly as long as supra-anal plate. Subgenital plate with apex pointed, not notched. Ovipositor greater than half the length of the hind femur, distinctly upcurved, spines in posterior one quarter. Spines on dorsum of ovipositor twinned in apical 2/3. Apical spine of ovipositor distinctly upturned.

DERVIATION OF NAME. We take pleasure in naming this species in honor of our friend Dr. C. Don MacNeill of the Oakland Museum who has given much advice and who helped collect this species.

SPECIMENS STUDIED. 54; holotype, allotype, 52 paratypes.

RECORDS. CALIFORNIA: INYO COUNTY: Big Pine, 10 mi. E., Sage Flat Camp, 20-VII-1964 (D. C. & K. A. Rentz, 4 males, 2 females, paratypes, DCR). Lone Pine, 11 mi. W., 6-VIII-1961 (D. C. Rentz, 7 males, 3 females, paratypes,

DCR); 9 mi. W., 8-VII-1961 (J. S. Buckett, 1 male, paratype, JRH), 8-IX-1966 (D. C. & K. A. Rentz, 1 female, paratype, DCR). MONO COUNTY: Tom's Place, 1 mi. W., 10-VIII-1959, 9-VII-1961 (D. C. RENTZ, C. D. MacNeill, M. R. Lundgren, 14 males, 2 females, paratypes, DCR), 6-IX-1960 (D. C. Rentz, holotype, allotype), 10-IX-1966 (D. C. & K. A. Rentz, 15 males, paratypes, DCR).

DISCUSSION. This is the most distinctive species of the subgenus. It can readily be recognized by the absence of the prosternal spines, brownish coloration with bluish sides of the abdomen, subapical band on posterior femora and scoop-shaped, slightly notched subgenital plate of the male and single apical spine on posterior margin of fore tibia. This species is apparently restricted to the east side of the Sierra Nevada of California and adjoining desert foothills from Mono Lake south to Lone Pine. It occurs with *Neduba (Aglaothorax) ovata gigantea* Rentz and Birchim, new subspecies, in the Lone Pine and Big Pine areas. It has been collected on many different plants at night and likely is a general feeder. A pair of specimens collected at Sage Flat Camp, Inyo County had apparently completed mating prior to capture since a large white spermatophore was found attached to a female which was on the same branch with a male.

The song of *N. macneilli* is of the "zwee-zwee-zwee" type and readily identified as similar to that of other members of this subgenus.

Neduba (Neduba) carinata Walker
(Figs. 17A, 17B, 34F, 34G, Table 2)

1869. *Neduba carinata* Walker, Cat. Derm. Salt. Brit. Mus., 2: 194.

Type locality: California

This species, or complex of species or subspecies, presents the most perplexing problem in the systematics of North American Decticinae. Described from "California," many distinctive populations have been given the same name. Tinkham (1944) believed the herein described *N. macneilli* was *carinata* and other orthopterists have placed any *Neduba*-looking katydid in this species.

Through the courtesy of Dr. David R. Ragge and Mr. John Huxley of the British Museum (Natural History) we have been able to obtain photographs and notes on the holotype of *N. carinata*. It seems now that the type represents a species which we have seen only from a single locality, Fremont Peak State Park, San Benito County, California. Specimens of this genus found commonly along the Pacific Coast are referable to *N. diabolica* or other species. We

here remove the long-considered synonym *N. steindachneri* Herman from synonymy. Described from Puget Sound, Washington, we feel it certainly represents another species.

The authors strongly believe that detailed study of the calls of various species will greatly elucidate the present picture. It seems that some of the "species" under consideration here may actually be found to be subspecies of one or two widespread species, but evidence for this is not now at hand.

DESCRIPTION OF MALE SEX. - Titillators (Fig. 17B), measurements (Table 2). Size moderate for subgenus, form more attenuate (Figs. 34F, 34G) than other forms. Head moderately seated in the pronotum. Fastigium of vertex and face in contact, a shallow sulcus cutting across at base of antennae. Base of fastigium of vertex broader than first antennal segment. Fastigium of vertex without dorsal depression. Eyes dorso-ventrally elongate, side near antennal bases straight. Eyes showing moderate bulge.

Pronotum covering first three to four segments of abdomen, its apex greatly surpassing base of hind legs when viewed dorsally. Pronotum slightly less than half the length of hind femur. Anterior margin of pronotum straight to slightly concave, lateral carinae greatly divergent from anterior to posterior. Apex of pronotum rounded, not truncate. Dorsum of pronotum with lateral carinae greatly constricted in anterior 1/5, cut at that point by weak, shallow sulcus. Sini absent from pronotum, no dorsal punctures present. Surface of pronotum smooth, median carina well indicated throughout. Lateral lobes with anterior margin straight, posterior portion abruptly declivent to median portion where it is angularly enlarged to anterior. Ventro-anterior portion of lateral lobes of pronotum subequal, broadly rounded. Lateral outline of pronotum moderately bulging. Tegmina well concealed by pronotum. Prosternum armed with 2 widely separated, well developed spines.

Fore and middle femora more attenuate than other species, with scattered spines dorsally, unspined ventrally. Posterior femora with many scattered spines of moderate length dorsally, no spines ventrally. Fore tibia with 6 spines on anterior and 7-8 spines on posterior margin. Dorsal surface with a single spine near foramina, apical spines on anterior and posterior margins. Middle tibia with 4-5 anterior and posterior spines, two of these apical. Hind tibia with dorsal spines of alternating lengths.

Abdomen similar to that of other species in the subgenus but slightly more attenuate. Supra-anal plate with lateral margins convex, apices acute, produced. Apex of supra-anal plate concave in lateral portion; median portion produced, convex. Pseudocerci as broad as supra-anal plate, their apices extending beyond apex of supra-anal plate for

a distance one quarter their length. Subgenital plate scoop-shaped, not notched. Styles of subgenital plate well developed. Cerci not greatly swollen basally, longer than supra-anal plate.

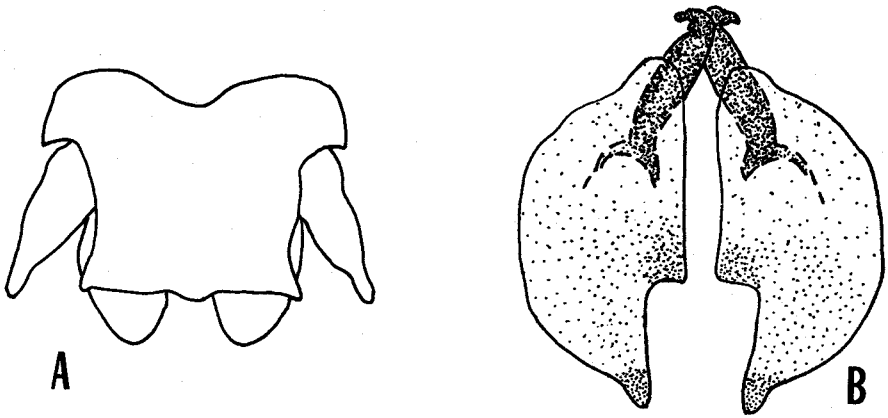

Fig. 17. A, terminalia of male *Neduba carinata*. B. titillators of male *N. carinata*.

Titillators of male genitalia with arms projecting beyond apex of base for a distance less than half the length of the base. Arms of titillators abruptly upturned, apices sharply pointed. Ventral sclerites with bases broadened, apex not produced, with many short tuberculations.

Coloration not distinctive for the species, greatly variable with following exceptions: lateral lobes of pronotum with humeral angle black, with whitish spot on posterior margin of lateral lobe. Pronotum uniform light brown or dark brown, no black streaking or darkening at all. Abdomen either uniform light or dark brown, with or without dark markings laterally. Tegmina with apices black.

DISCUSSION. This species has been taken at the Fremont Peak locality in stridulation in the early evening. The stridulation was of the raspy "chu-chu-chu" variety, not the "zwee-zwee-zwee" of *N. macneilli* or *N. convexa*. Males were found on the ground or in grass on slopes against *Baccharis* bushes and oaks. No females could be located.

Fremont Peak could possibly have been the original locality. Early collectors could likely have been in the area since Monterey occupied an important position in the early history of California and was once its capital. Much commerce was carried out in Monterey and Salinas, which are

not far from Fremont Peak. Collectors might naturally be expected to venture to the prominent peaks easily accessible to them.

RECORDS. CALIFORNIA: SAN BENITO COUNTY: Fremont Peak State Park, 10-VII-1964 (D. C. & K. A. Rentz, 10 males, DCR).

Neduba (Neduba) diabolica (Scudder)
(Figs. 18A, 18D, 18E, 20A, 20D, 20E, 34D, Table 2)

1899. *Tropizaspis diabolica* Scudder, Proc. Acad. Arts and Sci., 35: 86.
1899. *Tropizaspis picturata* Scudder, Proc. Amer. Acad. Arts and Sci., 35: 85. Type locality: Northwestern boundary survey, Kennerly collector.
1907. *Aglaothorax diabolicus*, Caudell, Proc. U. S. Nat. Mus., 32: 295.
1934. *Neduba diabolica*, Caudell, Pan-Pac. Ent., 10: 158.

Type locality: Mt. Diablo, California.

DIAGNOSIS. Second antennal segment without swelling, third antennal segment as long or slightly longer than the second segment. Subgenital plate of male with apex truncate, of female pointed. Styles of subgenital plate of male long--four times longer than the basal width. Lateral margins of supra-anal plate concave. Titillators of male with arms short, half the length or less than the bases, turned inward, not appreciably parallel but abruptly turned inward from base (Fig. 18D). Ventral sclerite of titillators projecting only as slight blunt swelling, few tubercles present near apex. (Fig. 20E).

DESCRIPTION OF SPECIES. - Size moderate for genus, form robust. Pronotum well produced, cucullate. Head moderately well seated in the pronotum. Interspace between fastigia of vertex and face high when seen in profile, both sections of equal height. Vertex of head with but slight indications of depression or none at all. Eyes dorso-ventrally elongate. First antennal segment nearly as broad as eye, second segment half as long as first, without swelling. Third segment half as long or slightly longer than second. Antennae with white and brown annulations, the brown ones more than three times the width of the white ones.

Pronotum with greatest dorsal length less than half the length of the hind femur. Dorsal outline of pronotum with lateral margins parallel to convex, convergent on anterior 1/5. In lateral profile, pronotum with noticeable bulge in posterior. Broadest point of disk on posterior 1/2. Cephalic margin of disk of pronotum straight to slightly concave. Lateral lobes of pronotum normal for

genus, anterior ventral portion straight, truncate. Angle delineating anterior portion of lateral lobe from posterior portion decided, not gradual. Greatest depth of lateral lobe in cephalic 1/5. Surface of lateral lobes of pronotum and disk not rugulose, often slightly wrinkled. Median carina of pronotum well indicated throughout (females), obsolete on posterior 1/4 (males). Single transverse, shallow sulcus present in anterior 1/5 of pronotum. Tegmina well concealed by pronotum. Prosternum armed with a pair of widely separated, well developed spines.

Fore tibia armed dorsally with a single spine on foramina, a single apical spine on anterior and posterior margins. Ventral margins of middle tibia with 7 spines on anterior and posterior margins, including 2 apical spines. Hind tibia armed dorsally with many spines alternating in length. Ventral margins with 2 apical spurs, the inner spurs half again as long as outer spur.

Abdomen robust, median carina well indicated. Cerci of male slender, gradually tapering from base, covered with long hairs. Cercus as long or slightly longer than the supra-anal plate, half the length of the pseudocercus. Pseudocercus tapering to apex, acutely pointed. Supra-anal plate of male somewhat constricted at base, flared outward with lateral margins trapezoiform. Apex of supra-anal plate pointed in median portion, concave laterally. Latero-posterior angles of supra-anal plate acutely pointed. Supra-anal plate of female tongue-shaped. Apex rounded to slightly pointed. Subgenital plate of male scoop-shaped, truncate in apical portion, without median depression. Styles of sub-genital plate of male elongate, more than 4 times longer than basal width. Subgenital plate of female normal for subgenus, apex acutely, narrowly pointed. Ovipositor shorter than hind femur with spines in posterior 1/5, the last few often twinned. Ovipositor distinctly upcurved, broadest at base.

Titillators with arms half again the length or less than the base. Arms of titillators directed inward, not parallel, abruptly upcurved at base, slightly twisted apically, sharply pointed. Ventral sclerite projecting only as a slight, blunt swelling with very few tubercles near apex.

Coloration of female holotype light grey brown with light lateral markings on dorsum of abdomen (Fig. 18E). Lateral lobes of pronotum black, white in ventral posterior portion. Outer pagina of hind femur with black blotches dorsally, a longitudinal black stripe in median portion. Disk of pronotum brownish with a dark oblique line on each side in median portion. Other form described as *N. picturata* possesses dark longitudinal markings on the pronotum. Other gray, tan, yellow, brown and blackish forms also may be collected at a single locality with markings on the

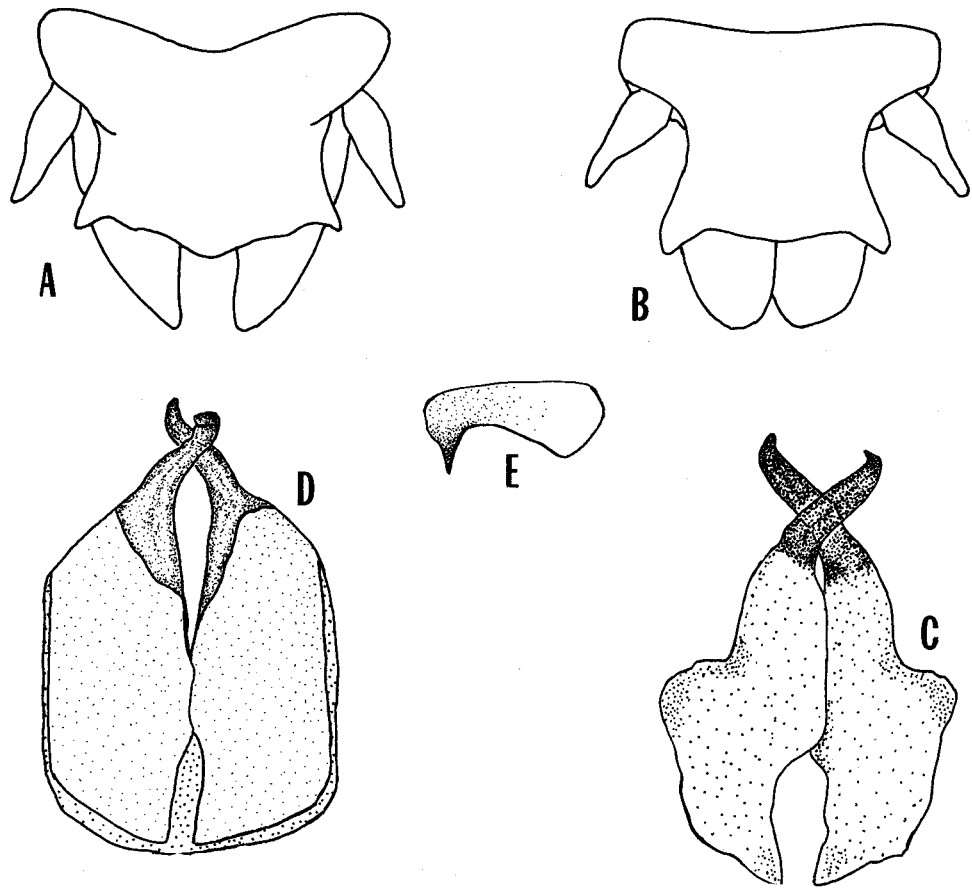

Fig. 18. A, terminalia of male *Neduba diabolica*. B, terminalia of male *N. convexa*. C, titillators of male *N. diabolica*. E, ventral sclerite of titillators of male *N. diabolica*.

abdomen varying from black spots to dark extensive patterns.

RECORDS. CALIFORNIA: CONTRA COSTA COUNTY: Mt. Diablo, VIII-1872 holotype female, MCZ); summit, 13-VIII-1965, 3,849 feet elevation (D.C. and K.A. Rentz, 1 male, DCR). Mt. Diablo Quicksilver Mines, 24-V-1958 (D.C. Rentz, 1 male, 1 female, DCR). Numerous localities from many central and northern California coastal counties.

DISCUSSION. This is the commonest decticid along the coast of California and may eventually be found to be a

complex of closely related species. The closest relative to this species is *N. carinata*, the name which has often been applied to this form. *N. diabolica* is one of the most abundant decticids in the summertime along coastal California. It inhabits wooded areas and can be collected during the day by walking through the leaves and rubble and carefully watching for hiding adults to jump and reveal themselves. Males stridulate actively at night and frequently will sing during overcast days. Nymphs can be found in February and March and can be collected in great numbers and taken to the laboratory to be reared to adulthood.

The toothed ovipositor of this and other species in the genus may indicate that the ovipositional site is wood or other plant tissue rather than the ground, which is thought to be the ovipositional site of most other decticids. The habitat of this species certainly would permit such activity. Caudell's (1907) and Scudder's (1899) reference to the low serrations on the ovipositor of the holotype of this species does not indicate a specific character. The most probable explanation of the low serrations is they were worn.

The stridulation of the species is of the "zwee-zwee-zwee" type different from the "chu-chu-chu" sound made by *N. carinata*. Mating is very similar to that described in this paper for *N. (Aglaothorax) ovata gigantea* Rentz and Birchim, new species.

Neduba (Neduba) convexa Caudell
(Figs. 18B, 18C, 20B, 20C, 34C, Table 2)

1907. *Neduba carinata* variety *convexa* Caudell, Proc. U. S. Nat. Mus., 32: 300, Fig. 9.
1909. *Neduba convexa*, Rehn and Hebard, Proc. Acad. Nat. Sci. Phila.: 475.
1912. *Neduba carinata convexa*, Caudell and Hebard, Proc. Acad. Nat. Sci. Phila., 64: 164.

Type locality: Mt. Shasta, Siskiyou County, California. Most likely the specimens came from Mt. Shasta City where the senior author has a series of specimens rather than from the mountain itself, which we have collected thoroughly and find unsuitable for *Neduba* species.

DIAGNOSIS. Measurements (Table 2), titillators (Fig. 18C). Similar to *N. carinata* and *diabolica*. Occurs in Sierra Nevada of California and the Cascade Mountain Chain of Oregon and California. Posterior portions of pronotum of most specimens with whitish markings. Ventral portion of abdomen and subgenital plate deep purple. Pronotum comparatively short, broad.

DISCUSSION. Caudell described *convexa* as a "variety" of *carinata*. He had specimens from both Mt. Shasta and

a female from Napa County, California. Later, Caudell and Hebard selected the former locality as the type locality which we feel was desirable because the female specimen from Napa County likely represents *N. diabolica*.

The call of the male of this species is of the "zwee-zwee-zwee" type. The titillators resemble those of its relatives *N. carinata* and *diabolica*. The illustration by Caudell of the terminalia of the male shows the pseudocerci a bit distorted as seen in the drying of some of the specimens here at hand.

RECORDS. ALL CALIFORNIA: ELDORADO COUNTY: Caldor on Dogtown Crk., 1-VIII-1964 (D. C. and K. A. Rentz, 1 male, DCR). Ice House Rd., 3 mi. N. Riverton, 22-X-1965 (D. C. Rentz, 1 male, DCR). GLENN COUNTY: Plaskett Mdws. Sta., 10-X-1964, 6,000 feet elevation (D. C. Rentz, J. D. Birchim, 5 males, DCR, JDB), 31-VII-1965 (J. T. Doyen, 1 male, DCR). PLUMAS COUNTY: Butt Valley, 3-VII-1961 (D. C. Rentz, 3 males, DCR). SISKIYOU COUNTY: Mt. Bardley, nr. Dunsmuir, 20-IX-1961, 5,000 feet elevation (P. Wygodzinsky, 1 female, DCR). Mt. Shasta City, 4 mi. E., McBride Camp, 26-VIII-1965 (D. C. and K. A. Rentz, 4 males, 2 females, DCR). TRINITY COUNTY: Big Flat, 15-VIII-1960 (P. H. Benson, 1 male, 1 female, DCR).

Subgenus *Aglaothorax*

DIAGNOSIS. Green forms commonly encountered. Of larger general size than subgenus *Neduba*, most species occupying desert areas. Pronotum of most forms more hood-like, covering a greater part of abdomen. Lateral lobes of pronotum of most forms with shoulders unmarked with black. Spination of legs variable within populations. Anterior tibia armed dorsally with 1-3 or no spines at all. Middle and posterior tibia variably spined. Supra-anal plate of male simple, not with lateral development. Pseudocerci with more development than found in *Neduba*. (Figs. 19A, 19C, 20A, 21A, 21C, 21E, 21G, 21I, 21K). Pseudocerci with apical or sub-apical spine. Subgenital plate of female with lateral finger-like extensions resting along base of ovipositor (Fig. 13A). Titillators of male genitalia with arms sinuous, apices divergent (Figs. 19B, 19D, 20B, 21B, 21D, 21F, 21H, 21J, 21L). No ventral sclerites.

Key to the Species and Subspecies of *Aglaothorax*

1. Size very small (15-18 mm). *Neduba*-like in general appearance. Abdomen of nearly uniform coloration, slightly mottled in dried specimens. Pronotum without black streakings or markings on dorsum, not glossy. Tegmina light pink, specimens never green.....2

Size much larger than 18 mm. Abdomen conspicuously marked dorsally with whitish quadrate spots, often with reddish brown longitudinal stripe. Pronotum usually streaked with black either throughout or on periphery, frequently with white, longitudinal stripes. Pronotum often appearing glossy, tegmina light straw yellow to dark brown. Specimens often green. Desert forms, fringes of Mojave and northern Sonoran Deserts.....3

2. Size very small (15-16 mm). Smallest known species in genus. Apex of supra-anal plate distinctly truncate (Fig. 19C). Known only from Mt. Diablo State Park, Contra Costa County, California.....
.....*N. (Aglaothorax) diminutiva* Rentz and Birchim, new species (p. 63)

Size larger than 18 mm. Apex of supra-anal plate gradually rounded (Fig. 19A). Known from Los Angeles, San Bernardino, and Riverside Counties, California.....
.....*N. (Aglaothorax) morsei* Caudell (p. 61)

3. Dark brown in coloration (Fig. 36E), 2 white quadrate spots frequently present on dorsum of abdominal segments 4, 5. Dorsum of abdomen without reddish dorsal longitudinal stripe. Pronotum light brown to dark brown, often streaked with black. Tegmina usually dark brown. Cercus nearly half as long as pseudocercus. San Bernardino and San Gabriel Mts. of San Bernardino and Los Angeles Counties, California.....
.....*N. (Aglaothorax) gurneyi* Rentz and Birchim, new species (p. 65)

Variable in coloration, not dark brown, white spots present on most abdominal segments. Dorsum of abdomen always with reddish brown longitudinal stripe. Pronotum with basal coloration pale yellow to tan, sometimes pale green, often heavily streaked with black, or at least rimmed with it. White longitudinal streaking frequently present on surface of pronotum.....4

4. Pseudocercus with tooth apical in position (Fig. 21K). Nye County, Nevada.....*N. (Aglaothorax) ovata segnis* (Rehn and Hebard) (p. 85)

Pseudocercus with tooth subapical in position. Distribution (Fig. 22).....*N. (Aglaothorax) ovata* subspecies.....5

(Since subspecies are involved below, the key is best worked with a series of specimens rather than single individuals).

5. Dorsum of pronotum with white longitudinal streaking, if without then pronotum tan or pale yellow.....6

Dorsum of pronotum without white markings, if with markings then pronotum heavily streaked with black.....7

6. Size larger (Table 4). Ovipositor of female much longer than hind femur (Fig. 35E), gracefully upcurved. Sides of abdomen with conspicuous spines on terga 2, 3 (Fig. 35F). Pronotum with streaks of "butterscotch" brown. Walker Pass, Inyo County, California (Fig. 22)..... .....*N. (Aglaothorax) longicauda* Rentz and Birchim, new subspecies (p. 71)

Size smaller (Table 4). Ovipositor of female longer than hind femur, nearly straight. Sides of abdomen with spines present, not developed as above. Pronotum frequently uniform tan with or without longitudinal white streaks (Fig. 35A), or lightly streaked with brown. Distribution (Fig. 22)..... .....*N. (Aglaothorax) ovata ovata* (Scudder) (p. 69)

7. Size smaller (Table 4). Ovipositor of female appearing short, distinctly upcurved (Fig. 35I). Dorsum of abdomen with conspicuous black or very dark brown dorsal markings (Fig. 35H). Pronotum with or without black streaking. Springs Mts., Clark County, Nevada north to White Mts., Inyo County, California..... .....*N. (Aglaothorax) ovata armiger* (Rehn and Hebard) (p. 83)

Size larger (Table 4). Without the above combinations of characters.....8

8. Surface of pronotum heavily streaked longitudinally with black (Fig. 35C), never without streaking at all. East side of Sierra Nevada and adjoining desert foothills of Inyo County, California)..... .....*N. (Aglaothorax) ovata gigantea* Rentz and Birchim, new subspecies (p. 77)

Surface of pronotum almost entirely uniform pale yellow or light green, almost entirely without internal markings in main portion of disk (Fig. 35G). Santa Rosa Mts. and Little San Bernardino Mts. of Riverside County, California (Fig. 22).....*N. (Aglaothorax) ovata tinkhamorum* Rentz and Birchim, new subspecies (p. 81)

Neduba (Aglaothorax) morsei Caudell
(Figs. 19A, 19B, Table 3)

1907. *Neduba morsei* Caudell, Proc. U. S. Nat. Mus., 32: 301, Fig. 11.

Type locality: Mt. Wilson, Los Angeles County, California.

DIAGNOSIS. Slightly larger than *N. diminutiva* Rentz and Birchim, new species, but small for genus. Titillators (Fig. 19B). Supra-anal plate of male with apex rounded, not truncate (Fig. 19A). Subgenital plate of female with finger-like projections but slightly produced.

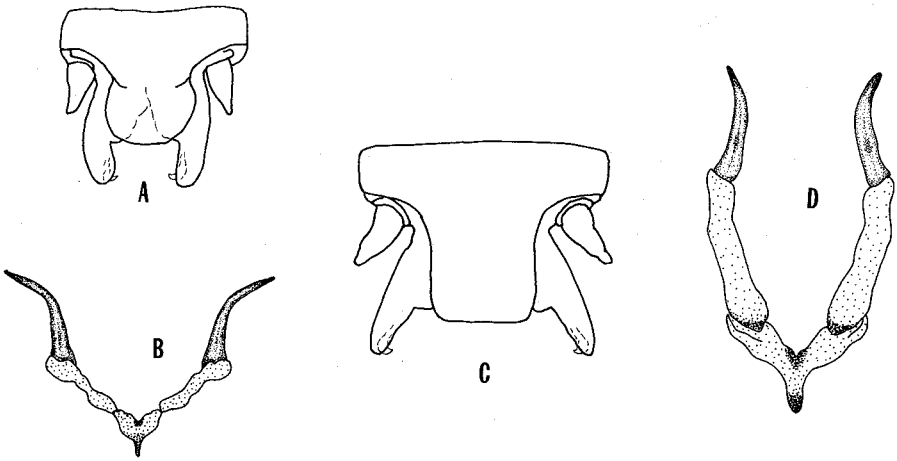

Fig. 19. *Neduba morsei*, A, terminalia of male. B, titillators of male. *N. diminutiva*. C, terminalia of male. D, titillators of male.

RECORDS. Arizona: Flagstaff, 20-IX-1952 (M. D. Anderson, 1 female, UCLA). CALIFORNIA: LOS ANGELES COUNTY: Brentwood, 19-VIII-1952 (1 male, UCLA). Arroyo Seco, 8-VIII-1938 (R. H. Beamer, 1 male, ANSP). Los Angeles, 12-IX-1948 (1 female, USNM); 1959 (1 female, UMMZ). Tanbark Flat, 13-VII-1950 (D. Blodgett, 1 male, UCLA). RIVERSIDE COUNTY: Santa Rosa Mts., Pinyon Flats, 1-VII-1941 (D. J. and J. N. Knull, 1 female, USNM). SAN BERNARDINO COUNTY: Lake Arrowhead, 5-IX-1958 (P. E. Paige, 1 male, UCD), 30-VIII-1959 (P. E. Paige, 1 male, UCD).

DISCUSSION. This species is now known from several localities in southern California. It most closely resembles *N. diminutiva* Rentz and Birchim, new species herein described, but can easily be distinguished from it by the larger body size and the differently shaped supra-anal plate. From other members of the subgenus, it can be distinguished by the characters used in the key. This species and

N. diminutiva bridge the gap between *Neduba* and *Aglaothorax*, possessing the general appearance of *Neduba* but the genitalia of *Aglaothorax*. A specimen from Flagstaff, Arizona is placed here with some doubt.

Neduba (Aglaothorax) diminutiva
Rentz and Birchim, new species
(Figs. 19C, 19D, 36A, Table 3)

DIAGNOSIS. Smallest known species in the genus. Known only from type locality. Titillators (Fig. 19D). Pseudocercus with sub-apical tooth. Cercus nearly as long as supra-anal plate, covered with long hairs. Supra-anal plate with lateral margins convex, apex greatly truncate (Fig. 19C).

Type Locality: Mt. Diablo, summit 3,849 feet elevation, Mt. Diablo State Park, Contra Costa County, California.

DEPOSITION OF HOLOTYPE. The holotype is to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. - Size small for genus, smallest species known, form slender. Pronotum moderately produced, cucullate. Head well seated in the pronotum. Interspace between fastigia of vertex and face high when seen in profile. Fastigium of vertex well produced with slight median depression. Eyes round, bulging. First antennal segment as long as eye. Second segment produced as a light swelling, third segment longer than second. Antennae with light whitish and brownish annulations.

Pronotum with greatest dorsal length more than half the length of hind femur. Dorsal outline of pronotum with lateral margins convex, convergent in anterior 1/5. In profile, posterior of pronotum slightly bulging, broadest point of disk posterior to median portion. Cephalic margin of pronotum straight. Lateral lobes normal for genus. Anterior ventral portion of lobe not rounded, subtruncate, greatest depth of lobes at cephalic 1/5. Surface of lateral lobes not rugulose. Median carina of pronotum but weakly indicated, obsolete in posterior quarter. No transverse sulci at all. Tegmina very well concealed by pronotum. Prosternum armed with a pair of widely separated, well produced spines.

Fore tibia armed dorsally with a single spine on foramina, single apical spine on posterior margin. Middle tibia armed dorsally with 2-3 spines, single apical spur present on posterior margin. Fore and middle tibia armed with 6 spines on anterior and posterior margins, hind tibia with inner margin with longer spines separated by 3-4 shorter spines, outer margins with longer spines separated by a single shorter spine. Ventral margins of posterior tibia

with several scattered, small spines. Ventral portion with a single apical spur on inner and outer margins, the inner spur being half again as long as outer one. All femora with but few scattered dorsal spines.

Abdomen slender, median carina indicated only by folding on posterior portions of abdominal tergites. Cerci broad in basal portion, abruptly narrowed in posterior quarter, covered with long hairs. Cerci half the length or less than the pseudocerci. Pseudocercus broad in basal half, abruptly narrowed in median portion to apex, acutely pointed. Subapical tooth of pseudocercus pointed ventrally, slightly subapical in position, short, sharply pointed. Subgenital plate scoop-shaped, without median depression at apex. Styli long, more than 4 times longer than basal width. Supra-anal plate with lateral margins concave in basal portion becoming convex apically with latero-posterior angles well rounded. Apex of supra-anal plate greatly truncate.

Titillators of normal *Aglaothorax* type in general configuration with the arms shorter than base, bowed inward.

Coloration of light grey-brown with following differences: eyes dark brown, mottled with black. Base of antennae and face speckled dark brown. Lateral lobes of pronotum dark brown, lighter in posterior ventral portion. Borders of pronotum brown; abdomen without white alternated areas, numerous brown speckles. Fore and middle tibia with two bands of black, the innermost one fully twice as broad as distal band. Fore and middle femora with subapical brownish area indicated on outer portion only. Outer pagina of posterior femur with light whitish irregular longitudinal stripe, pagina dark brown ventrad of longitudinal stripe. Tegmina uniform pinkish purple.

DERIVATION OF NAME. Named for the diminutive size and secretive habits of this species.

RECORDS. Known only from two specimens from the area of the type locality. CALIFORNIA: CONTRA COSTA COUNTY: Mt. Diablo, summit 3,849 feet elevation, Mt. Diablo State Park, 13-VIII-1965 (D. C. and K. A. Rentz, 1 male, holotype); Juniper Camp, 2,900 feet elevation, 14-VIII-1965 (D. C. and K. A. Rentz, 1 male, paratype, DCR).

DISCUSSION. This interesting species was found with *N. diabolica*. It was found in dense chaparral where it stridulated at night making a low, short buzz followed by a long pause. The two males were sluggish when collected, one found near the ground, the other high in a bush. It can readily be distinguished from its relative *N. morsei* by its smaller size and more truncate supra-anal plate.

Table 3. Size variation in species of the subgenus *Aglaothorax*. The size (N) of the sample is listed first, followed by the range (R). Means (M) are based on original values. All measurements in millimeters as measured with an ocular micrometer.

Species		*diminutiva*	*morsei*		*gurneyi*	
		Male	Male	Female	Male	Female
total length	N	2	2	5	12	3
	R	15-16	16-19	15-18	21-25	21-25
	M	15.5	17.33	16.4	11.5	23
length pronotum	N	2	5	5	14	3
	R	7-7.25	7.5-8.6	7.2-9	11.5-13.5	11.5-13
	M	7.12	8.05	8.2	12.48	12.16
width pronotum	N	2	5	5	13	3
	R	5-5.5	5.3-6	5.3-6.7	7.5-8.7	8-8.4
	M	5.25	5.74	5.76	8.27	8.23
length posterior femur	N	2	5	5	13	3
	R	12-14	14-18	15-19	17-20	22-23.5
	M	13	15.6	17.37	18.75	22.5
length ovipositor	N			5		4
	R			11-13		17-21
	M			11.8		18.8

Neduba (Aglaothorax) gurneyi Rentz and Birchim, new species
(Figs. 20A, 20B, 36B, Table 3)

1944. *Aglaothorax ovatus*, Tinkham (not of Scudder, 1899), Amer. Midl. Nat., 31: 289.

DIAGNOSIS. Nearest relative *N. (Aglaothorax) ovata* (Scudder). Slightly larger than the nominate form of that species but smaller than the form *N. o. gigantea* Rentz and Birchim, new species. Overall color brown, no green form known. Pseudocercus with subapical tooth. Titillators (Fig. 22B).

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY. Lake Arrowhead, San Bernardino County, California.

HOLOTYPE MALE. Size medium for genus, form robust, micropterous with pronotum rounded posteriorly, not truncate as in *N. ovata*. Head well inserted into pronotum, greatest width of head across genae, face convex in profile. Fastigia of vertex and face not in contact, narrowly separated by interspace. Fastigium of vertex prominent, projecting as blunt protuberance. Dorsal surface of fastigium with shallow median sulcus. Eyes prominent, ovoid in outline. Antennae moderately heavy, not as in *ovata*, surpassing the body in length. First antennal segment longer than broad, depressed.

Pronotum strongly hood-shaped, well inflated dorsally, greatest dorsal length more than 3/4 that of caudal femur. Dorsal outline of pronotum strongly convex in lateral profile, strongly convex, subsellate cephalad. Cephalic margin of disk of pronotum slightly concave, caudal margin broadly ovate. Lateral margins of pronotum divergent, becoming obsolete on prozona, lateral and caudal margins of disk slightly thickened. Disk of pronotum with broadest point approximately 4/5 entire pronotal length. Greatest length of pronotum almost twice as long as greatest width. Median carina of pronotum distinct on prozona, less distinct caudally. Surface of pronotum finely rugulose, more distinctly cephalad. Lateral carinae of pronotum bounded on each side by two shallow sini separated by a median transverse sulcus giving rise to the bulbous cucullate posterior portion of pronotum. Lateral lobes of pronotum deep, greatest depth at cephalic 1/5. Cephalic margin of lateral lobes sinuate-truncate, ventro-cephalic angle broadly rounded, ventral margin ascending caudad joining caudal margin of disk briefly caudad of point of greatest width of disk. Tegmina normal for genus, distinctly hidden beneath pronotum. Prosternum armed with a pair of short, blunt, broadly spaced spines.

Fore and middle femora short, irregularly sparsely spined above, ventral margins unspined. Fore tibia with foramina rimate. Dorsal margins of fore tibia unarmed, ventral margins with 6 spines. Middle tibia armed with 2-3 spines on dorsal margins, ventral margins with 6-7 spines. Posterior femur slightly longer than length of head and pronotum combined, moderately inflated proximad. Dorsal surface of inflated area with numerous adpressed spines. Hind tibia no longer than femur, ventral margins armed with 3-5 spines. A single pair of distal spurs present, the internal one longer than external spur.

Abdomen with weak median longitudinal carination of dorsal tergites. Supra-anal plate longer than broad, lateral margins convex, distal extremity truncate. Pseudocercus well developed, incurved with internal subapical

tooth. Dorso-internal surface of pseudocercus excavate, dorsal carina sharp. Cercus 1/3 length of pseudocercus, elongate, conical, basal width approximately 1/2 total length. Subgenital plate large, scoop-shaped, styles represented as small elongate rudiments 3-4 times as long as broad.

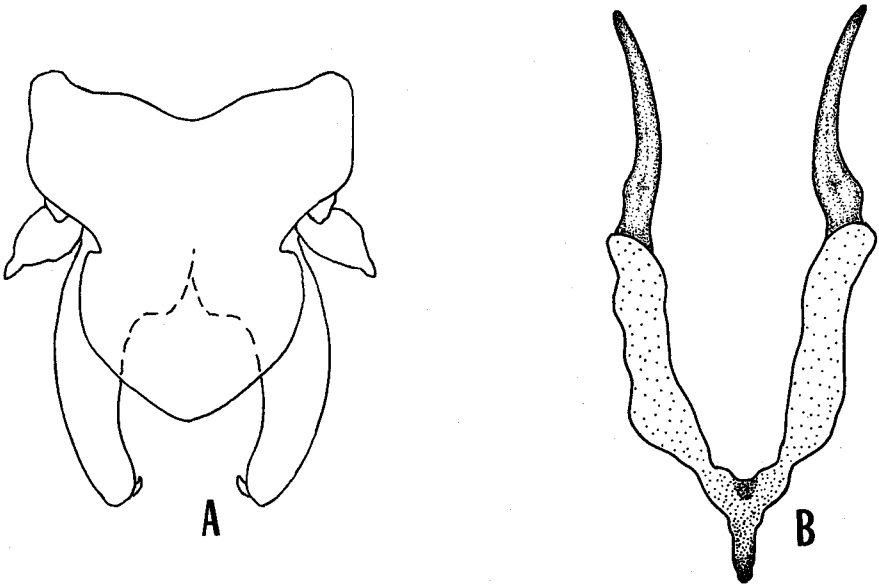

Fig. 20. *Neduba gurneyi*. A, terminalia of male. B, titillators of male.

Titillators (Fig. 20B) with base slightly longer than arm. Arm not greatly bowed inward.

General color brownish, black spot present on cephalic dorsal extremity of lateral pronotal lobe. Posterior extremity of pronotum and antennae alternately marked with black and light brown. Abdomen darker brown with blackish dorsal markings. Tegmina uniform dark brown. Antennae with proximal joints pale, segments distal to them dark, annuli pale. Fore and middle femora with dark preapical annulus of dark brown to black, irregularly defined. Fore tibiae with weak brown annulation; annuli weak on middle tibiae. Hind femur with irregular, incomplete dark annuli, preapical, disto-median in position, indicated only on dorsal and lateral surfaces. Hind tibia of uniform light brown, slightly lighter apically. Tarsus of hind tibia with dorsal surface light brown, ventral surfaces blackish.

In life the species is probably very similar to what

has been described above. There is no evidence to indicate that this species exists in a green phase and it is not at all likely that any of the specimens at hand had any green color while alive.

ALLOTYPE FEMALE. Differs from male in following features: pronotum more ovate, not as bulbously produced, more deplanate transversely than in male, longitudinal median carina more distinct. Fastigium of vertex not as deeply sulcate as in male. Lateral lobes of pronotum slightly deeper proportionately than those of male; lateral carinae of pronotal disk somewhat parallel, not divergent.

Pseudocercus shorter than that of male. Ovipositor heavy, upcurved, nearly same length as hind femur, dorsal margin with distinct erect teeth on distal half; ventral margin with short serrate teeth on distal quarter. Subgenital plate broad in subproximal section, narrowing distally with pair of slightly subparallel, elongate fingers as long as proximal section of plate, the fingers of the subgenital plate lying on each side of the ventral ridge. Interspace between fingers equal to basal width of one of them; ventral edge of interspace with a distinct tooth.

Coloration nearly same as male but pronotum more uniformly dark. Caudal femur lighter medially.

DERIVATION OF NAME. We take pleasure in naming this species in honor of our friend and colleague Dr. Ashley B. Gurney of the U. S. Department of Agriculture and the U. S. National Museum, Washington, D. C. Dr. Gurney has helped in many ways in the past and has particularly given much advice in the preparation of this study.

SPECIMENS STUDIED. 21; holotype, allotype, 17 paratypes.

RECORDS. ALL CALIFORNIA: LOS ANGELES COUNTY: San Gabriel Mts., 25-VIII-1938 (E. R. Tinkham, 2 males, paratypes, ERT). Westwood Hills (1 female, questionable placement, USNM). SAN BERNARDINO COUNTY: Barton Flats, 2-VIII-1936 (1 female, CAS). Lake Arrowhead, 15-IX-1935 (R. H. Smith, 1 male, paratype, USNM); 14-VI-1958 (P. Paige, holotype, allotype), 5-IX-1958 (P. Paige, 2 males, 1 female, paratypes, UCD), 9-VIII-1958 (E. R. Tinkham, 1 male, paratype, ERT), IX-1958 (P. Paige, 1 male, paratype, ERT), VIII-1958 (1 male, paratype, ERT). San Bernardino Mts., 4 mi. west Running Sprs., 12-X-1952, 7,200 feet elevation (E. R. Tinkham, 4 males, paratypes, ERT). No data (1 male, ERT).

DISCUSSION. This species is quite distinct from *N. ovata* and its many subspecies. The pronotum is more extensive and more rounded in *gurneyi* than in *ovata*. Specimens of *gurneyi* are more uniformly brown without extensive other coloration and no green phase is known. The lateral

lobes of the pronotum of this species are dark brown ventrad of the lateral keels as seen in most species of the nominate subgenus. Tinkham (1944) confused this species with *N. ovata* and his remarks for that species apply here. He described the song of this species as "a strong zip-zip broken by a pause of several seconds and quite distinct from the zic-zic-zic of *segnis*" (here considered *N. o. gigantea*). Tinkham also stated the call could be heard for a distance of about 100 feet. He collected this species from Western yellow pine (*Pinus ponderosa*) and oaks.

Neduba (Aglaothorax) ovata (Scudder)

The large series of specimens now before us shows that this species is composed of many races. This determination was made possible only after comparison of large series from many localities.

This species appears to occur on the fringes of the Mojave and Sonoran deserts. It does not inhabit the hottest parts of the desert but rather is found at higher elevations where the temperatures are not as extreme. We believe that this species probably was more extensively distributed in past times, perhaps during the Pleistocene when the area was luxuriant due to the moister climate which permitted formation of the extensive Lake Lahontan system. The increasing aridity since that time has driven the species up into more favorable habitats and we believe the remaining populations, which we show here to be subspecies, are gradually developing into distinct species.

Neduba (Aglaothorax) ovata ovata (Scudder)
(Figs. 21A, 21E, 22, 35A, Table 4)

1899. *Tropizaspis ovata* Scudder, Proc. Amer. Acad. Arts and Sci., 35: 84.
1907. *Aglaothorax ovatus*, Caudell, Proc. U. S. Nat. Mus., 32: 291.

Type locality: California (D. Saunders collector, likely northern Los Angeles County).

DIAGNOSIS. Smallest known subspecies. Measurements (Table 4), distribution (Fig. 22). Apex of pronotum extending only to base of hind legs or slightly beyond. Apex of pronotum broadly rounded to slightly truncate. Ovipositor longer than hind femur, nearly straight. Pronotum almost always with white streaking. Titillators with arms as long as base, distinctly upturned. (Fig. 21B).

DEPOSITION OF TYPE. The holotype is deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

DESCRIPTION OF SUBSPECIES. Size small for genus (slightly larger than *N. morsei* and *N. diminutiva*), form moderately robust. Pronotum moderately produced, more broadly truncate in posterior portion than in other subspecies. Head well seated in pronotum, short, deep. Interspace between fastigia of vertex and face high when seen in profile. Fastigium of vertex more produced than in other forms. Eyes nearly round. Pronotum with greatest dorsal length more than 3/4 the length of hind femur. Lateral outline of pronotum convex. Disk of pronotum with mesozona and metazona only slightly inflated when viewed in profile. Broadest point of disk of pronotum convex. Lateral lobes of pronotum with greatest depth in cephalic quarter. Cephalic margin of lateral lobes straight, ventro-cephalic angle broadly acute. Surface of lateral lobes of pronotum greatly rugulose. Median carina of pronotum moderately well indicated. Surface of pronotum finely rugulose. Transverse sulcus present on anterior quarter of pronotum. Humeral sini deep, prominent. Tegmina of males not well concealed by pronotum as in other forms; pronotum held upward exposing tegmina.

Fore and middle femora short, robust as in other subspecies, compressed, with 2-6 scattered dorsal spines. Hind femur with many scattered spines, not to as great an extent as in other subspecies. Ventral margins of fore and middle femora with no spines. Dorsal margins of anterior tibia with single distal spine on posterior margin, a single spine mesad on dorsal surface distad of foramina. Ventral margins of fore and middle tibiae with 7 posterior and 6 anterior spines. Dorsal anterior margin of middle tibiae with 5 spines and 3 spines on anterior margin. Hind femur as long as head and pronotum combined. Ventro-external margin of hind femur with 2-7 spines, ventro-internal margin with 3-4 spines in distal portion.

Abdomen similar to that as described for other subspecies. White markings on dorsum of abdomen faintly indicated. Dorsum of abdomen with little indication of median carina. Supra-anal plate of male less produced, more slender than in other subspecies. Pseudocerci much as in other forms, internal tooth pre-apical, its size smaller than in other subspecies. Apex of pseudocercus more tapering than seen in any of other subspecies. Cercus approximately 1/4 length of pseudocercus, short, broad, conical, more evident in this subspecies. Ovipositor of female slightly longer than hind femur, nearly straight. Posterior quarter of ovipositor toothed as described for *N. o. gigantea* Rentz and Birchim, new subspecies.

Titillators (Fig. 21B) with arms as long as basal portion, distinctly turned inward.

Coloration likely predominately brown as indicated by poorly preserved forms. However, a few faded green speci-

mens suggest abdominal coloration similar to that described for *N. o. gigantea* Rentz and Birchim, new subspecies. Pronotum with broken black on borders, often streaked with tan giving pronotum distinct overall tan appearance. Pronotum with 2 rather broad white parallel stripes running distad from pronotal sini to apex of pronotum. Cercus and pseudocercus yellow-brown to reddish brown. Supra-anal plate reddish brown. In all other features of coloration, this subspecies seems to resemble *N. o. gigantea*, but the authors have not seen this form alive and cannot present the true picture of its coloration.

RECORDS. CALIFORNIA: LOS ANGELES COUNTY: July (D. W. Coquillette, 2 males, one figured by Caudell, 1907, USNM). Llano 1-VI-1957, (W. E. Simonds, 4 males, 1 female, CDA). Pearblossom, 3-VII-1957 (W. E. Simonds, 6 males, CDA). SAN BERNARDINO COUNTY: Desert Sprs., Mojave Desert, 14 mi. NW. Cajon, 24-VII-1954, 4,000 feet elevation (G. H. Nelson, 1 male, on *Juniperus californicus*, UMMZ), 25-VI-1956 (E. R. Tinkham, 1 female, ERT). "California" (D. Saunders, taken with type, 1 male, ANSP).

DISCUSSION. This smallest known subspecies was described by Scudder with no more definite locality data than "California". It seems likely that the species was described from material taken in northern Los Angeles County since comparison of a paratype agrees with specimens from that area. A specimen from the region under consideration compared by Caudell also agrees with specimens we have from northern Los Angeles County and southwestern San Bernardino County. The presence of two white broad stripes on the pronotum is a good identifying characteristic but it is not always present as seen in a series from Desert Springs, San Bernardino County. However, in size this race is unrivaled being only about half as large as most specimens of the larger forms. The apex of the pronotum of *N. o. ovata* is more truncate than in other forms and is often held high with its apex at an oblique angle with the dorsum of the abdomen, exposing the tegmina.

Neduba (Aglaothorax) ovata longicauda
Rentz and Birchim, new subspecies
(Figs. 21C, 21D, 22, 35E, 35F, Table 4)

1944. *Aglaothorax segnis*, Tinkham (not of Rehn and Hebard, 1920), Amer. Midl. Nat., 31: 291.

DIAGNOSIS. Of moderate size (Table 4). Titillators (Fig. 21D), distribution (Fig. 22). Most distinctive characters are: very long, gracefully upcurved ovipositor (longer than in any other form) short, dense spines on lateral segment of abdominal terga 1-3 (Fig. 35F). Basic coloration of pronotum of darker brown than *N. o. gigantea*, with black spot present in median anterior portion of

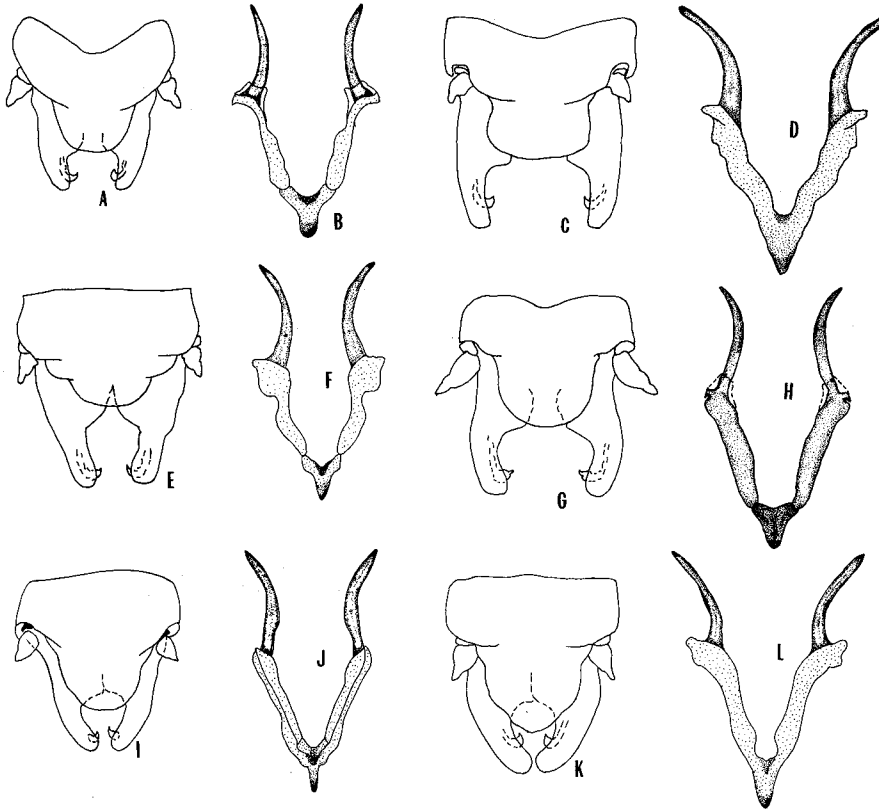

Fig. 21. Terminalia and titillators of males of subspecies of *Neduba ovata*. A, B, *N. o. ovata*. C, D, *N. o. longicauda*. E, F, *N. o. gigantea*. G, H, *N. o. tinkhamorum*. I, J, *N. o. armiger*. K, L, *N. o. segnis*.

pronotum. Pronotum rimmed with broken black.

TYPE LOCALITY. East side of Sierra Nevada below Walker Pass, Kern County, California. Elevation 4,500 feet.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. Size moderate, form slender, less robust. Pronotum moderately cucullate, apex well produced in dorsal view beyond base of hind legs. Head well seated in pronotum, short, deep. Interspace between fastigia of vertex and face very well produced with well defined dorsal sinus. Eyes ovoid, slightly longer dorso-ventrally, slightly to moderately bulging.

Pronotum with greatest dorsal length more than 3/4 the length of the hind femur. Outline of pronotum with lateral carinae parallel to slightly convex. Disk of pronotum with metazona distinctly elevated relative to prozona. Broadest point of disk slightly distad of median portion. Cephalic margin of disk of pronotum slightly convex. Lateral lobes of pronotum as described for other subspecies, with posterior ventral margin continuous to anterior margin in nearly straight, oblique line. Cephalic margin of lateral lobes concave, ventro-cephalic angle broadly rounded. Surface of lateral lobes only slightly rugulose. Median carina of pronotum faintly, to well indicated. Surface of pronotal disk rugulose only in anterior 1/4. Transverse sulci of pronotum indistinct. Tegmina well concealed by pronotum. Spination of prosternum varying from no spines at all to 2 widely spaced, short spines.

Fore and middle femora long, slender for species. Dorsal surface of all femora spined. Posterior femora densely spined. Dorsum of apex of anterior femora with single spine on anterior margin. Fore tibia armed with 0-2 spines. Ventral surfaces of fore and middle tibiae with 1-7 spines on anterior and posterior margins. Dorsal margin of fore and middle tibiae with a single dorsal spine on anterior and posterior margin. Hind femur spined on external ventral margin with 6-7 spines irregularly placed. Hind femur as long or slightly longer than head and pronotum combined.

Abdomen similar to that found in other subspecies but more slender, less robust. Supra-anal plate extending for a distance of half or slightly less than half to apex of pseudocercus. Pseudocercus with subapical tooth, its length fully twice the distance from its base to apex. Cercus short, stout, 3-4 times broader basally than distally, 1/4 length of pseudocercus. Apex of pseudocercus well-rounded to slightly acute. Lateral portions of abdominal segments 1, 2, 3, with prominent stout spines in both sexes.

Titillators (Fig. 21D) with arms greatly bowed inward; arms slightly longer than base.

Coloration predominantly brownish with median stripe of darker brown on dorsum of abdomen, as described for *N. o. gigantea*, frequently present. Pronotum rimmed with black, faint black streaking infrequently seen in median portion. Anterior margin of pronotum with median black spot in some specimens. Femoral apices all with light brown subapical band preceded by light brown area twice the length of black band, the whitish area in turn preceded by an irregular black area.

ALLOTYPE FEMALE. Differs from male in following characters: median carina of pronotum very distinct. Ovipositor much longer than hind femur, slightly upturned. Teeth of ovipositor beginning on posterior 1/5, the teeth on

posterior half twinned, the internal tooth being slightly shorter than external one. Ovipositor of unicolorous shining yellow-brown except on apex which is darker brown.

DERIVATION OF NAME. This species is named with reference to the long ovipositor.

SPECIMENS STUDIED. 19; holotype, allotype, 14 paratypes.

RECORDS. CALIFORNIA: KERN COUNTY: east side of Sierra Nevada below Walker Pass, 28-V-1954, 4,500 feet elevation (J. A. Rehn, holotype, allotype, 4 females, paratypes, ANSP). Walker Pass, 23-VIII-1938 (E. R. Tinkham, 13 males, paratypes ERT).

DISCUSSION. The presence of the very long ovipositor and dense spines on the dorsal surface of the lateral portions of the first three abdominal terga serve to readily identify this subspecies. Collection of the holotype and allotype in May indicates that this form has an early occurrence in the adult stage. This is likely dependent on the weather conditions at the time.

Intermediates between *N. ovata ovata* and *N. ovata longicauda*
(Fig. 35D, Table 4)

A series of five males and a single female taken some 14-19 miles north northeast of Mohave, Kern County show an intermediate condition between *N. o. ovata* and *N. o. longicauda*. They are larger in size than *ovata* but not as large as most specimens of *longicauda* (Table 4). The pronotum is approximately the same length as in *ovata* but the coloration suggests *longicauda*. The dorsum of the abdomen shows spination only on the first tergum and this is not as dense as seen in *longicauda*. The ovipositor of the single female is distinctly upturned but not as long as is usually seen in either subspecies. Coloration of all specimens is similar to that described for *N. o. gigantea* Rentz and Birchim, new subspecies.

RECORDS. CALIFORNIA: KERN COUNTY: Mojave, 14 mi. NNE., 13-IV-1962, matured VII-1962 (D. C. Rentz, C. D. MacNeill, 2 males, DCR); 19 mi. NNE., 14-IV-1962 (D. C. Rentz, C. D. MacNeill, R. M. Brown, 2 males,DCR).

Table 4. Size variation in subspecies of *Neduba ovata*. The size (N) of the sample is listed first, followed by the range (R). Means (M) are based on original values. All measurements are in millimeters as measured with an ocular micrometer.

Species		*armiger*		*gigantea*		*longicauda*	
		Male	Female	Male	Female	Male	Female
Total length	N	10	7	102	17	9	5
	R	20-24		22-30	21-31	24-27	23-27
	M	21.81	24	25	26.11	25.49	25.6
length pronotum	N	12	7	113	17	9	5
	R	11.5-13.5	12-14	11-17	11-16	13-15.5	13-14
	M	12.47	11.5	13.44	13.38	14.33	13.7
width pronotum	N	13	7	113	17	9	5
	R	7.5-8.5	7.3-8.3	8-10	7.8-10.5	8.7-9.8	8.2-9.5
	M	7.73	7.97	9.19	9.72	9.25	9.1
length posterior femur	N	13	7	113	16	9	5
	R	17-20	19-20.5	15-23	18-25	18-22	21-22
	M	17.9	19.64	19.6	20.64	21.05	21.6
length ovipositor	N		7		17		5
	R		17-18		17-24		25-30
	M		17.57		20.79		27.6

Species		Intermediate Between *ovata* and *longicauda*		*ovata*	
		Male	Female	Male	Female
Total length	N	7	1	14	2
	R	22-27	26	17-24	25-26
	M	25.4		20.64	25.5
length pronotum	N	7	1	17	2
	R	12.5-13.5	13	10-13.5	13-14
	M	13.16		12.17	13.5

Species		Intermediate Between *ovata* and *longicauda*		*ovata*	
		Male	Female	Male	Female
width pronotum	N	7	1	17	2
	R	8.9-9.5	11	6.3-8.8	8.9-9.9
	M	9.1		8.01	9.4
length posterior femur	N	7	1	17	2
	R	18-19	15	16-20	21-22
	M	18.25		17.91	21.5
length ovipositor	N		1		2
	R		23		23-25
	M				24

Species		*segnis*	*tinkhamorum*		Intermediate Between *segnis, armiger*
		Male	Male	Female	Male
Total length	N	2	10	1	3
	R	22-28	22-26	30	17-22
	M	25	24		19.67
length pronotum	N	3	11	1	3
	R	13-13.5	13-15	30	9-13
	M	13.12	13.95		11
width pronotum	N	3	11	1	3
	R	8-8.1	7.9-9.5	10	7.2-8
	M	8.02	8.8		7.24
length posterior femur	N	3	9	1	3
	R	17-19	18-21	23	15-19
	M	18.25	19.61		16.34
length ovipositor	N			1	
	R			22	

Neduba (Aglaothorax) ovata gigantea
Rentz and Birchim, new subspecies
(Figs. 21E, 21F, 35B, 35C, Table 4)

1944. *Aglaothorax segnis*, Tinkham (not of Rehn and Hebard, 1920), Amer. Midl. Nat., 31: 291.

DIAGNOSIS. Largest known subspecies (Table 4). Pronotum extending well beyond the base of the hind femora. Apex of pronotum well rounded. Pseudocerci with subapical tooth. Known only in green phase. Pronotum streaked with black; no white at all present on pronotum. Occupies range as shown Fig. 22.

TYPE LOCALITY; 9 miles west of Lone Pine, Inyo County, California.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. Size large for genus, form robust. Pronotum well produced, cucullate to greater degree than in other forms. Head well seated in the pronotum, short, deep. Interspace between fastigia of vertex and face high when seen in profile. Fastigium of vertex well produced. Eyes more vertically elongate than those of *armiger*.

Pronotum with greatest dorsal length about 3/4 the length of hind femora; outline of pronotum nearly straight, slightly converging in posterior, not greatly inflated. Disk of pronotum with mesozona and metazona bulging when viewed in lateral profile. Broadest point of disk posterior of median portion of disk. Greatest width of pronotum approximately 1.67 the length of pronotum. Cephalic margin of disk of pronotum subtruncate. Lateral lobes of pronotum normal for genus, greatest depth of lobes at cephalic 1/5. Cephalic margin of lateral lobes subtruncate, ventrocephalic angle obtuse. Surface of lateral lobes of pronotum greatly rugulose. Median carina of pronotum only weakly indicated. Surface of pronotal disk very rugulose. Transverse sulci as described for *N. o. segnis* but more pronounced. Tegmina well concealed by pronotum. Prosternal spines either present or absent.

Fore and middle femora short, robust, compressed, dorsal surface with scattered spines, usually more densely spined in proximal portion. Ventral margins of fore and middle femora sparsely spined. Dorsal margins of fore tibia with a single distal spine mesad on dorsal surface of foramina. Ventral margins of fore tibia and middle tibia with 5-6 spines, middle tibia with 3-4 spines on dorsal margins, ventral margins with 6-7 spines. Hind femora nearly as long as head and pronotum combined, inflated section dorsad with scattered spines. Ventro-external margin with 7-8

spines, ventro-internal margin with 3-5 spines distad.

Abdomen similar to that as described for *N. o. armiger* and *N. o. segnis* but with following exceptions: supra-anal plate simple, more closely resembling that of *armiger* but differing in the more rounded and tapering margins of plate. Pseudocercus much as in other subspecies, internal tooth present, preapical. Apex of pseudocercus not as blunt as in *armiger*. Cercus about 1/5 as long as pseudocercus, short, conical, similar to those of *segnis*, approximately twice as long as broad. Titillators (Fig. 21F).

Coloration somewhat similar to that originally described for *segnis* and *armiger*, very distinctive in comparison. Greater amount of black present on borders of pronotum. Pronotum greatly streaked with black throughout. Areas of pronotal sini always without black, of light yellow-brown coloration. No white at all present on pronotum. Abdomen conspicuously void of any black margins as is found in *segnis* and *armiger*. Dorsal surface of abdomen with broad, reddish brown band running from apex of pronotum to apex of supra-anal plate, the band irregularly flecked with whitish markings. Band on abdomen bordered with conspicuous white quadrate to ovoid markings on nearly every abdominal segment, the largest markings being located in the middle of abdominal segments 5 and 6. Sides of abdomen green, frequently faded in dried museum specimens. Ventral surface of abdomen light green flecked with whitish and light brown spots. Subgenital plate green ventrally and internally within the scoop. Cercus and pseudocercus light straw brown. Head and sternum unicolorous light brown, the sternum light green. Eyes dark brown. Fore and middle femora with preapical band of brown present in proximal quarter. Fore and middle tibiae with very light preapical annulus and proximal infuscation. Median portion of middle tibiae light green, proximal half brown, distal quarter of much darker brown. Hind femur with apical band brown, preapical black spot bordering apical brown band. Dorsal area of light brown to black present in posterior dorsal portion of hind femur. Anterior 1/3 of hind femur of either light brown, light green or reddish brown.

ALLOTYPE FEMALE. Differs from male in following characters: pronotum heavier, more broadened, apex more truncate. Median carina of pronotum more distinct than found in male. Lateral lobes of pronotum slightly deeper than those of male. Tegmina extremely minute. Abdomen with dorsal ridge more prominent posteriorly, better defined than in male, rounded distad. Ovipositor heavy, elongate, slightly shorter than hind femur, narrowing in distal third, acute in apical proximity. Ovipositor abruptly turned upward, dorsal margin with distinct erect teeth becoming bifurcate in posterior portion, the inner teeth shorter than the external ones. Ventral teeth of ovipositor not bifurcate, not extending to as great a degree as dorsal ones.

Coloration of female very similar to that of male sex. Ovipositor light brown anteriorly gradually darkening to darker brown apex. Teeth of ovipositor reddish brown basally becoming black at apex.

DERIVATION OF NAME. This subspecies is named with reference to its large size.

SPECIMENS STUDIED. 134; holotype, allotype, 132 paratypes.

RECORDS. CALIFORNIA: INYO COUNTY: Big Pine Canyon, 4-VII-1931, 16-VIII-1938, 25-VIII-1957 (E. R. Tinkham, 31 males, 2 females, paratypes, ERT). Big Pine, 7 mi. SW. Glacier Lodge Rd., 25-VIII-1957, 7,000 feet elevation (T. J. Cohn, 2 males, UMMZ). Independence, 6 mi. W. 12-VII-1965, 23-VII-1965 (J. D. Birchim, 10 males, paratypes, JDB). Lone Pine, 28-VII-1940 (R. H. Beamer, E. E. Kenaga, L. C. Kuitert, 4 males, paratypes, ANSP), 20-VIII-1938 (E. R. Tinkham, 4 males, ANSP); 9 mi. W. 4-VIII-1931 (E. R. Tinkham, 5 males, 1 female, paratypes, ERT), 6-VII-1961 (D. C. Rentz, 34 males, 13 females, holotype, allotype, paratypes), 8-VIII-1961 (G. I. Stage, 6 males, 1 female, paratypes, DCR), 8-VIII-1961 (J. S. Buckett, J. Powell, 11 males, 1 female, paratypes, CIS, UCD), 16-VII-1962 (C. W. O'Brien, 2 males, paratypes, DCR), 3-VII-1965 (J. D. Birchim, 6 males, 1 female, paratypes, JDB); 11 mi. W. 22-VII-1964 (J. D. Birchim, 1 male, paratype, DCR).

DISCUSSION. This is the largest known subspecies of *N. ovata*. It is known only from the eastern slopes of the southern Sierra Nevada of California in the pinyon-juniper zone. It was to this subspecies that Tinkham referred in his 1944 work using the name *Aglaothorax segnis*. This name was originally given to the easternmost population by Rehn and Hebard (1920) which is characterized by having the tooth of the pseudocercus apical in position. Tinkham apparently confused the names, thinking that *armiger* has the tooth in the apical position.

The contrasting colors of this subspecies present a spectacular appearance when seen alone, but when it is found in its habitat it is often difficult to locate. The sluggish nature of the individuals of this race permit easy collection.

Neduba ovata gigantea apparently occurs in greater numbers in some years, but few or no specimens can be found in other years. This is undoubtedly due to climatological conditions, since this is a desert form which is dependent upon vegetation for food. The year 1961 was one of great abundance for this subspecies. Specimens could be heard at night in July on nearly every bush at the type locality, and the great numbers of specimens could readily be seen. The katydids were even found on Mexican tea *(Ephedra)*, a

spindly desert bush adapted to xeric conditions with very small leaves. When on this plant, individuals could be seen at great distance. No predation of any kind was noted even with the great numbers of specimens present. A trip to the type locality a year later on the same dates produced only a few specimens. The authors do not believe that the population was in the immature state at the time of the second visit since the vegetation was intensively searched. A trip a month or so later was made with similar results.

Males stridulate with a loud zwick (Fig. 37A). This race has the loudest call of any of the subspecies heard by the authors. The call can easily be heard from a moving automobile. Stridulation usually ceased by midnight as the coolness of night approached.

This subspecies occupies a habitat somewhat different from that described for *N. (Aglaothorax) o. armiger* by Rehn and Hebard in 1920. No "Joshua trees" *(Clistoyucca brevifolia)* occur in the range of *gigantea*. Rehn and Hebard pointed out "This species *(armiger)* is almost entirely restricted to the tree yucca of Joshua tree *Clistoyucca brevifolia* belt on the northeastern slope of the Spring or Charleston Mountains in Clark County, southern Nevada." Specimens of the large *gigantea* collected at the type locality were found in *Chrysothamnus*, Sagebrush *(Artemisia tridentata)* Apache plume *(Cowiana stansburiana)*. As the pinyon-juniper zone was approached, specimens could be heard high in the trees, but they were not restricted to the pines and others could be found in the lower bushes. In 1962 when specimens were scarce, they were found only in the pinyon pines.

Mating of *Neduba ovata gigantea*,
based on specimens from the type locality.

Several instances of mating have been observed, all in the laboratory. All were very similar and the following description was considered typical of those studied.

The male approaches the female on a horizontal substrate. When receptive after a number of advances, she raises herself slightly to permit the male to enter under her body. As the male makes his way under the female, the latter constantly palpates the body of the male, especially the dorsal portions. No visible excretions were noted. Throughout the entire course of mating, the male stridulates with short, constant "zwicks" unlike that of the calling song. When the male assumes a position directly under the female, he continuously probes her abdominal extremity with the tip of his abdomen. Eventually the male grasps the female's abdomen with the pseudocerci which hold the abdomen of the female in place during the short time in which the spermatophore is passed. These appendages seemingly perform the same function as do the cerci of other decticine katydids. The male uses the pseudocerci to grasp

the female at a point at the base of the subgenital plate which is deeply forked (Fig. 14A). The female uses the forks of the subgenital plate to scoop the spermatophore out of the abdomen of the male. At this point the male utters very loud rapid "zwicks" which can be detected in the field from a great distance and when investigated always reveal a pair of katydids just completing the nuptial act. After removal of the spermatophore, the female moves away. The entire process from the advance stage to the removal of the spermatophore took some ten minutes in each case observed. In all instances the female ate the external portions of the spermatophore at a later time. It is assumed that mating occurs several times during life.

Neduba (Aglaothorax) ovata tinkhamorum
Rentz and Birchim, new subspecies
(Figs. 21G, 21H, 22, 25G, Table 4)

DIAGNOSIS. Distribution (Fig. 22), measurements (Table 4). Nearest in size to *gigantea*. Pronotum with black markings on lateral carinae and anterior and posterior margins only. Median portion of pronotum unmarked with black for the most part although a minority of specimens show some darkness in the central portion and a black spot in the median anterior quarter of the pronotal disk. No white at all on the pronotum (Fig. 35G). Lateral carinae nearly parallel in median portion. This race occurs in green or brown forms. Dorsum of abdomen with white markings laterad of the dorsal longitudinal reddish brown stripe. Ovipositor of female distinctly upturned.

TYPE LOCALITY; Pinyon Flats, on California state highway 74, Santa Rosa Mountains, California. 4,000 feet elevation.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. Size large for genus, form robust. Pronotum moderately produced, cucullate. Head moderately seated in the pronotum, short, deep. Interspace between fastigia of vertex and face moderately high when seen in profile. Fastigium of vertex well produced, slight dorsal sinus. Eyes ovoid, slightly bulging. Pronotum with greatest dorsal length more than 3/4 the length of the hind femur. Outline of pronotum with lateral carinae nearly parallel. Disk of pronotum with mesozona and metazona slightly bulging when viewed in lateral profile. Broadest point of disk in median portion, cephalic margin straight. Lateral lobes of pronotum as described for other subspecies, with posterior portion more decidedly declivent. Cephalic margin of lateral lobes straight, ventro-cephalic angle broadly

rounded. Surface of lateral lobes of pronotum rugulose. Median carina of pronotum well indicated throughout. Surface of pronotal disk with only scattered rugulosities. Transverse sulci moderately distinct, especially posterior sulcus. Tegmina well concealed by pronotum. Prosternal spines absent to well produced.

Fore and middle femora long, slender, slightly laterally compressed. Dorsal surface of all femora well spined on internal and external ventral margins, the external margin frequently unspined. Dorsum of fore tibia armed with 0-3 spines. Ventral margins of fore and middle tibia armed with 6-7 spines. Dorsal margin of fore and middle tibia with a single distal spine on posterior margin. Hind femur nearly as long as head and pronotum combined, proximal 3/4 with dense dorsal spines, ventro-external margin of hind femur armed with from 8-10 spines.

Abdomen similar to that found in other subspecies. Supra-anal plate extending to a distance slightly more than half the length of pseudocercus. Pseudocercus with subapical tooth the length of which is approximately equal to distance from its base to apex of pseudocercus. Cercus short, broad basally, abruptly narrowing in distal quarter. Cercus slightly less than half length of pseudocercus. Apex of pseudocercus well rounded.

Titillators (Fig. 35H). Arms of titillators not greatly bowed inward, length of arms shorter than length of base.

Coloration faded due to drying in holotype. Series of individuals shows it to be similar to that described for *gigantea*. An exception is the pronotum which is merely rimmed with black. Center of pronotum without black, of unicolorous yellow-brown or light green.

ALLOTYPE FEMALE. Differs from male in the following characters: pronotum covering less of abdomen, proportionately smaller. Median carina of pronotum very distinct. Lateral lobes of pronotum with ventroanterior margin distinctly upturned in median portion. Ovipositor shorter than hind femur, abruptly upturned in median portion. Teeth of ovipositor beginning just posterior of median portion. In other features and coloration similar to that described for *gigantea*.

DERIVATION OF NAME. The authors name this species in honor of our friends Dr. and Mrs. Ernest R. Tinkham of Indio, California who have spent the greater part of their lives becoming familiar with the flora and fauna of the desert and contributing valuable scientific articles of their investigations. Most of the specimens used in the study of this subgenus were collected by Dr. Tinkham.

SPECIMENS STUDIED. 16; holotype,allotype, 11 paratypes.

RECORDS. CALIFORNIA: RIVERSIDE COUNTY: Pinyon Flats, on California state highway 74, 27-VI-1952, 4,000 feet elevation (H. L. Mathis, holotype), 17-IV-1962, matured VII-1962 (C. D. MacNeill, D. C. Rentz, R. M. Brown, allotype), 1-IX-1957 (J. T. Goodman, 1 male, paratype, ERT), 13-IX-1957 (E. R. Tinkham, 3 males, paratypes, ERT), 2-VII-1958 (C. Cushner, 1 male, paratype, DCR); nymphs all females, 18-IV-1934 (B. Brookman, CIS), 27-V-1939, 1-VI-1940 (C. D. Michener, CIS). SAN BERNARDINO COUNTY: Little San Bernardino Mts., 1 mi. W. Yucca Valley, 30-VI-1953 (E. R. Tinkham, 4 males on *Yucca brevifolia*, ERT).

DISCUSSION. Most specimens of this subspecies rival those of *N. o. gigantea* in size. Little variation was found in the pronotal character with but two specimens possessing slight green markings on the pronotum. Specimens have been collected in *Pinus parryana* and *Yucca brevifolia*. The senior author collected second instar nymphs in April at the type locality on the latter host plant at night. The nymphs appeared rather sluggish and were of similar coloration as found in the adults.

Neduba (Aglaothorax) ovata armiger (Rehn and Hebard)
(Figs. 21F, 21J, 22H, 25H, Table 4)

1920. *Aglaothorax armiger* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 229, Pl. 8, Figs. 2, 4; Pl. 9, Figs. 2, 3.

Type Locality: Lee Canyon, Spring Mt., Charleston Mts., Clark County, Nevada. 6,000 feet elevation.

DIAGNOSIS. A small subspecies. Titillators (Fig. 21J, distribution (Fig. 22), measurements (Table 4). Pseudocercus with subapical tooth. Ovipositor as long as posterior femur, upcurved. Pronotum either light yellow with little or no black streaking or moderately streaked with black. No whitish present on pronotum. Dorsum of abdomen with dark brown or blackish markings.

DESCRIPTION OF MALE SEX. Size small for subgenus, form robust. Pronotum moderately produced, cucullate. Head well seated in pronotum, short deep. Interspace between fastigia of vertex and face broader and shallower than in *segnis*, in profile. Fastigium of face low, blunt.

Pronotum with greatest dorsal length 3/4 length of posterior femur. Outline of pronotum in profile nearly straight in anterior portion, moderately arcuate in posterior. Disk of pronotum with mesozona and metazona ovoelliptical in outline, broadest point of disk posterior to

middle. Greatest width 1.67 greatest length of pronotum. Cephalic margin of disk normal for genus, greatest depth at cephalic 1/5. Cephalic margin of lobes truncate, ventro-cephalic angle obtuse, ventral margin descending on cephalic 1/5, there rounded obtusely, concave in distal 1/4. Surface of lobes weakly rugulose, the transverse sulci weakly indicated. Prosternum spined or unspined.

Fore and middle femora short, robust, compressed. Dorsal surfaces spined, ventro-cephalic margins with a single spine, ventro-caudal margins unspined. Dorsal margin of fore tibia with single spine over foramina, and a single distal spur. Ventral margins with 5-6 spines. Middle tibiae with 3-4 spines on dorsal margins, ventral margins with 6-7 spines. Posterior femora with scattered dorsal spines, ventro-external margin with 7-10 spines, ventro-internal margin with 3-4 spines distad. Posterior tibiae shorter than the femora. Ventral margins with few scattered spines, a single pair of distal spurs, the internal one longer than the external spur.

Abdomen similar to that of other subspecies. Supra-anal plate broader than in *segnis*, lateral and posterior margins convex. Pseudocercus with tooth subapical, apex blunt. Cercus 1/4 as long as pseudocercus, short, conical, basal width 3/4 length of cercus. Subgenital plate scoop-shaped, V-shaped median depression. Styles of subgenital plate extremely minute. Titillators with arms (Fig. 21J) much longer than base, greatly bowed inward. Arms of titillators slender, tapering from base, apices sharply pointed.

DESCRIPTION OF FEMALE SEX. Differs from male in following characters: greatest width of pronotum 1.5 times greatest length, median carina more evident. Lateral lobes of pronotum slightly deeper than in male, ventral margin of lobes more broadly arcuate cephalad.

Coloration of head, thorax and sides of abdomen pale yellow. Pale color of dorsum of abdomen ranging from buff to light reddish, median dorsal stripe of abdomen reddish brown. Eyes dark brown. Pronotum ranging from light yellow with blackish flecks along posterior portion to greatly streaked with black. No white at all present on pronotum. Infrequently, specimens have light green present on the pronotum. Dorsum of abdomen with conspicuous white ovoid to quadrate markings on nearly every segment, the largest markings being located in the middle of the abdomen on segments 5 and 6. The whitish markings are attingent to the dark brown and blackish blotches. All femora with subapical bands, those on fore and middle femora dark brown, the one on posterior femur black. Posterior femora with narrow, broken longitudinal stripe on outer pagina. Dorsum of posterior femora with broken brown markings anterior to broad, light yellow annulus which is present in posterior quarter.

RECORDS. CALIFORNIA: INYO COUNTY: Westgard Pass, 26-VII-1962, 7,200 feet elevation (D. C. Rentz, 1 male, DCR); 5 mi. W. , 26-VIII-1965 (J. D. Birchim, 3 males, 1 female, DCR); 1 mi. W. summit Westgard Pass, 23-VII-1965 (D. C. Rentz, 3 males, DCR). NEVADA: CLARK COUNTY: Charleston Mts., Spring Mt., Lee Canyon, 18-21-VIII-1919 (Rehn and Hebard, 5 males, 4 females, ANSP), 3-VIII-1951, 6,800 feet elevation (J. A. G. Rehn, 1 male, 2 females, ANSP, Charleston Park, 2 mi. E., 8-IX-1957 (T. J. Cohn, 2 males, UMMZ). Charleston Peak, 15-VIII-1931 (E. R. Tinkham, 1 male,ERT). NYE COUNTY: West base of Belted Peak, 25-VIII-1924, 6,700 feet elevation (Rehn and Hebard, 1 male, ANSP).

Intermediates between *N. o. armiger* and *N. o. segnis*

A series of three male specimens from central Nevada show characters intermediate between *N. o. armiger* and *N. o. segnis*. The size is very small for the species. The coloration is as described for *N. o. armiger* with pronotal markings slightly more streaked. The pseudocerci show intermediate characters as well. The tooth is only slightly subapical. Hebard determined the specimens in 1938 as "atypical *A. armiger*" indicating he had difficulty ascribing a name to them.

RECORDS. ALL NEVADA: NYE COUNTY: Ox Spring, Quinn Canyon Range, 27-VIII-1924, 6,650 feet elevation (Rehn and Hebard, 1 male, ANSP). Pine Creek, Quinn Canyon Range, 26, 27-VIII-1924, 6,500-6,900 feet elevation (Rehn and Hebard, 1 male, ANSP). WHITE PINE COUNTY: Horse Range, 1 mi. N. Currant, 29-VIII-1924, 7,350 feet elevation (Rehn and Hebard, 1 male, ANSP).

Neduba (Aglaothorax) ovata segnis (Rehn and Hebard)
(Figs. 21K, 21L, 22, 35, Table 4)

1920. *Aglaothorax segnis* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 225, Pl. 8, Figs. 1, 3; Pl. 9, Fig. 1.
1944. *Aglaothorax armiger*, Tinkham (not of Rehn and Hebard, 1920) Amer. Midl. Nat., 31: 292.

Type locality: Crestline, Lincoln County, Nevada.

DIAGNOSIS. Distribution (Fig. 22), measurements (Table 4), titillators (Fig. 21L). Only known form with tooth of pseudocercus apical in position.

DESCRIPTION OF MALE SEX. Size medium to small, form robust. Pronotum well produced, cucullate. Head well seated in the pronotum, short, deep. Greatest width of the head across genae greater than across eyes. Fastigium of vertex and face not in contact, separated by an interspace

which is triangular when seen in profile. Fastigium of vertex with disto-lateral margins distinct, convergent, when viewed dorsally apex bluntly produced. Dorsal surface of fastigium with a narrow, sinuate median sulcus, facial costa, blunt, tuberculate. Eyes moderately prominent, in basal outline short, ovoid. Antennae seemingly somewhat heavier than seen in other forms of this species, first segment broader than long, depressed.

Pronotum appreciably inflated, especially in posterior portion. Greatest dorsal length 3/4 that of posterior femur. Disk of pronotum with mesozona and metazona together ovoid in outline, broadest point of disk at 3/5 entire pronotal length. Greatest width 1.5 times greatest length. Anterior margin of disk subtruncate. Posterior margin and posterior portions of lateral margins ovate. Median carina obsolete on prozona, weakly indicated on mesozona, very distinct on metazona. Surface of mesozona of disk rugulose, metazona of fine transverse rugulae. Lateral lobes of pronotum deep, characteristic for species. Cephalic margin of lateral lobes truncate, ventro-anterior angle broadly rounded, ventral margin sinuate ascending in posterior portion. Surface of lobes rugulose. Tegmina well concealed by pronotum.

Cephalic and median femora relatively short, moderately robust, slightly compressed. Dorsal surface with few scattered spines in basal portion, ventral margins unspined. Cephalic tibiae with foramina rimate. Dorsal margins of fore femora unarmed except for single distal spines on anterior margin, ventral margins with 5-6 spines. Median tibiae with 3-4 spines on dorsal margins, ventral margins with 5-7 spines. Posterior femur somewhat longer than head and pronotum combined. Dorsum with numerous spines, ventro-external margin with 3-4 spines. Posterior tibiae no longer than femora, ventral margins spined with only a few spines distad. Single pair of distal spurs, internal spur much longer than external one.

Abdomen with weak dorsal carina. Supra-anal plate with lateral margins weakly converging, nearly straight, posterior margin broadly arcuate. Pseudocercus strongly developed, weakly arcuate in most of its length, tooth apical in position. Dorso-internal surface concave. Cercus equal to about 1/3 length of pseudocercus, elongate, conical, basal width equal to 1/2 length. Subgenital plate large, scoop-shaped, subparallel laterad, distal extremity reaching apex of pseudocercus, portion of distal margin between styles biarcuate. Styles represented by small rudiments.

Coloration very similar to that described under *armiger* but with less contrast in some individuals. This may be due to drying.

FEMALE UNKNOWN.

RECORD. NEVADA: LINCOLN COUNTY: Crestline, 4-IX-1909, 6,000 feet elevation (1 male, paratype, ANSP).

DISCUSSION. This subspecies has not been collected by the authors and not much is known of its habits. It apparently occurs at fairly high elevations and specimens have been taken in juniper. Rehn and Hebard state its stridulation "is much like that of *Scudderia*." This indicates that the song might be quite different from that of the other races of this species. *N. o. segnis* is the most readily distinguished member of this species and occupies the most extreme easterly limit known for the species.

Genus *Cyrtophyllicus* Hebard

1908. *Cyrtophyllicus* Hebard, Ent. News, April: 156, Figs. 1-3.
1927. *Cyrtophylleicus* Hebard, Trans.Amer. Ent. Soc., 53: 2.
1963. *Cyrtophyllicus*, Helfer, How to Know the Grasshoppers, Cockroaches and their Allies, W. C. Brown.

Type of the genus: *Cyrtophyllicus chlorum* Hebard, by original designation.

New records of this genus broaden our knowledge of its range and the habits of the single species. Collection of a female from the type locality permits description of that hitherto unknown sex.

Cyrtophyllicus chlorum Hebard
(Figs. 23A, 23B, 36G, 36H, 36I, Table 5)

1908. *Cyrtophyllicus chlorum* Hebard, Ent. News, April: 158. Figs. 1-3.

Type Locality: El Portal, Mariposa County, California

DESCRIPTION OF FEMALE SEX. Size slightly larger than male. Head more slender than in male. Vertex short, slender, sulcate. Eyes moderately large, round. Tegmen extending nearly to abdominal apex (Figs. 36G, 36H). Wing much reduced.

Abdomen moderately robust. Cerci slender, styliform, clothed with long hairs. Subgenital plate with notch relatively broad, rounded, latero-posterior angles sharply pointed. Ovipositor straight, half again as long as posterior femur.

Coloration uniform "phaneropterine" green with exceptions: eyes, antennae, dorsum of pronotum light straw brown.

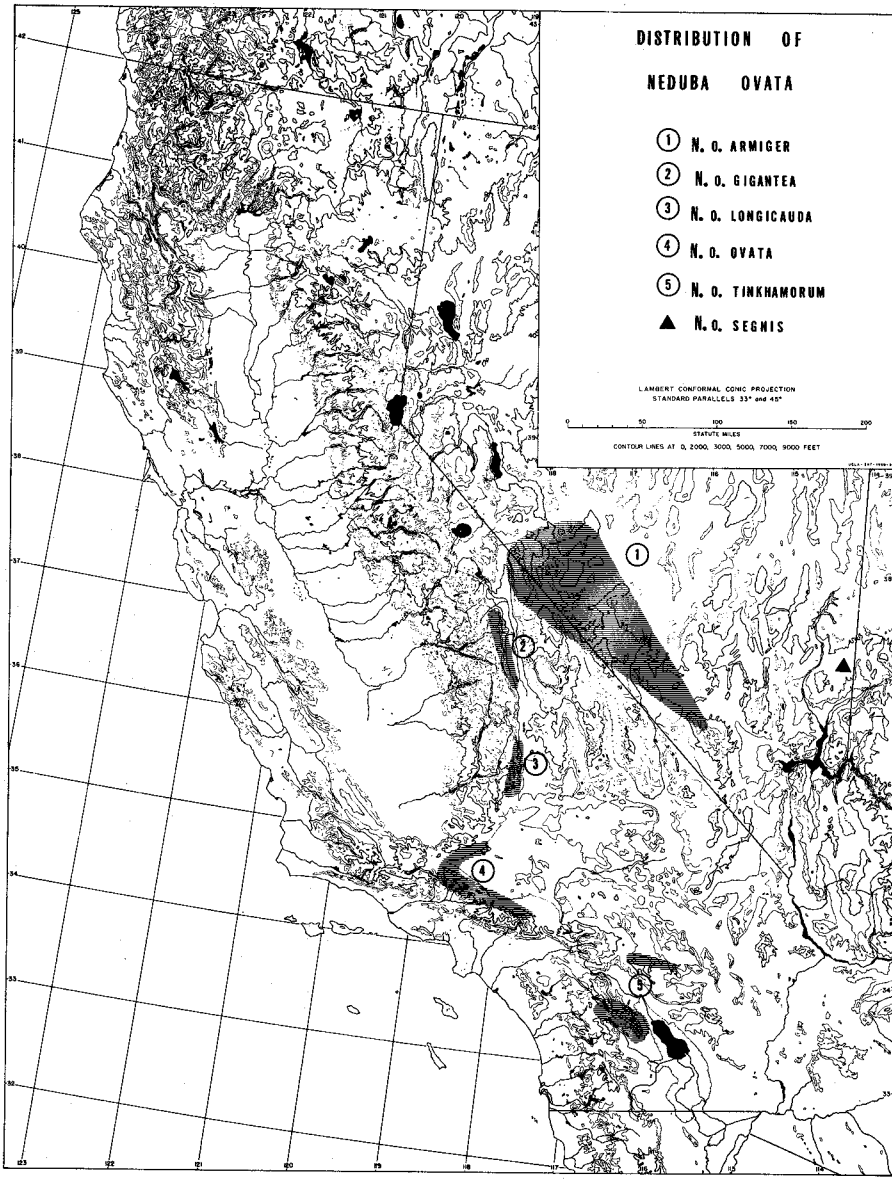

Fig. 22. Known distribution of *Neduba ovata*.

RECORDS. CALIFORNIA: COLUSA COUNTY: Highway 20 from Clear Lake, 18-VIII-1959 (J. R. Helfer, 1 male, JRH). CONTRA COSTA COUNTY: Antioch, 23-VI-1961 (D. C. Rentz,

2 males, DCR). Mt. Diablo State Park, summit 3,849 feet elevation, 13-VIII-1965 (D. C. and K. A. Rentz, 1 male, DCR). GLENN COUNTY: Rumsey Creek, 28-VI-1963(J. R. Helfer, 2 males, JRH). LAKE COUNTY: Clear Lake, 27-VI-1961 (J. R. Helfer, 1 male, JRH). Highway 20, east of Clear Lake, 29-VII-1960 (J. R. Helfer, 1 male, JRH), 25-VII-1960 (J. R. Helfer, 1 female, JRH). West of Lakeport, 19-VII-1962 (J. G. Snell, 1 male, DCR). Near Oasis, 4-VIII-1959 (D. C. Rentz, 1 male, DCR); 8 mi. N. Oasis, 26-VI-1961 (D. C. Rentz, 3 males, DCR); 1 mi. E. 27-VI-1961 (D. C. Rentz, 1 male on *Eriodictyon*). MARIPOSA COUNTY: El Portal, 5 mi. W., 20-VII-1957, 2,000 feet elevation (T. J. Cohn #30, 1 male, 1 female plesiotype, UMMZ); 2.5 mi. E. Arch Rock Ranger Sta., Yosemite, 24-VIII-1957, 3,000 feet elevation (T. J. Cohn #64, 1 male, UMMZ). Mariposa, 11-12 mi. SW., 10-VIII-1957, 1,250-1,350 feet elevation (T. J. Cohn #47, 1 male, UMMZ).

DISCUSSION. The specimens from Mariposa County are smaller than those from most other localities. The female from Lake County is fully twice the size of the one here described. Coloration is also variable to some degree. A single male from Lake County is uniform light brown.

Variation in the form of the cercus and titillators is seen within a series of males from a single locality (Figs. 23A, 23B). The cercus of some males may have a minute subapical tooth as figured by Hebard (1908), or may lack it entirely. On the average, the specimens from the Sierra Range appear smaller than those from the Coast Ranges and the possibility of subspeciation exists; but until many more specimens are collected, this cannot be determined.

Quite possibly *Cyrtophyllicus* is the loudest sounding decticine in the Nearctic Region. Its call can be heard from nearly 1/4 mile distance. Specimens are usually widely spaced, as seen from observations of the calling males, and this likely accounts for the scarcity of specimens, especially females, in collections. There seems to be no definite preferred host plant. Specimens have been taken on Yerba santa *(Eriodictyon)* Oaks *(Quercus spp.)*, California buckeye *(Aesculus californica)*, Poison oak *(Rhus diversiloba)* and California laurel *(Umbellularia californica)*. Since specimens tend to seek high spots from which to stridulate, series can often be collected from areas recently burned by forest fires and invaded by low chaparral brush. When colonies of stridulating males are encountered, the call is amplified because the males tend to stridulate in unison.

Table 5. Size variation in *Cyrtophyllicus*. The size (N) of the sample is listed first, followed by the range (R). Means (M) are based on original values. All measurements are in millimeters as measured with an ocular micrometer.

Species		*Cyrtophyllicus chlorum*	
		Male	Female
Total length	N	18	2
	R	20-27	20-31
	M	23	25.5
length pronotum	N	18	2
	R	6-8	6-7
	M	7	6.5
width pronotum	N	18	2
	R	4.6-5.5	4-5.2
	M	5.04	4.6
length posterior femur	N	18	2
	R	18-22	20-22
	M	20.86	21
length ovipositor	N		2
	R		29-34
	M		31.5

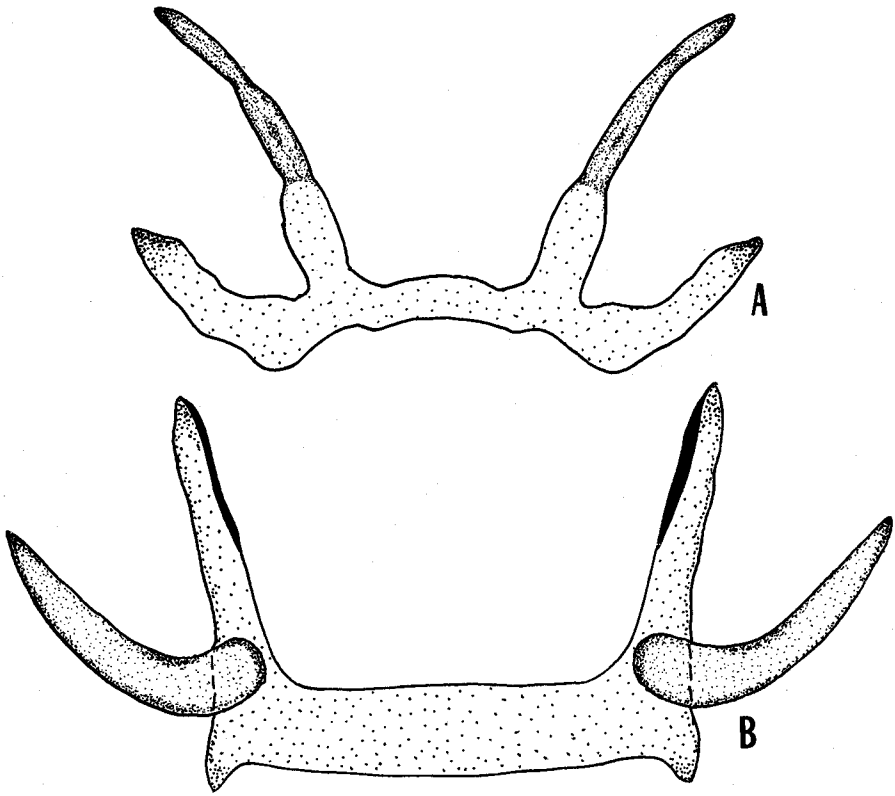

Fig. 23. Variation in the titillators of *Cyrtophyllicus chlorum*.

Genus *Zacycloptera* Caudell

1907. *Zacycloptera* Caudell, Proc. U. S. Nat. Mus., 32: 308.

Type of the genus: *Zacycloptera atripennis* Caudell, by original designation.

This genus consists of but a single species which has an extremely restricted range. Intensive collecting has found it to occur only at a few localities near Walker Lake, Nevada. La Rivers (1951) reported extensively on the habits of *Z. atripennis* Caudell.

Zacycloptera atripennis Caudell
(Fig. 26I)

1907. *Zacycloptera atripennis* Caudell, Proc. U. S. Nat. Mus., 32: 309, Figs. 18-19.

Type Locality: Hawthorne, Mineral County, Nevada.

This is an extremely arenophilic species found far from water. Plants found where it occurs include Greasewood *(Sarcobatus baileyi)*, Indian tea *(Ephedra nevadensis)*, Sand bunchgrass *(Oryzopsis hymenoides)*. *Z. atripennis* is nocturnal in habits. It is aggressive and omnivorous in food habits. The black hind wings of the species are actively displayed when disturbed.

RECORDS. La Rivers (1951) listed the following localities and data. NEVADA: LYON COUNTY: Smith Valley, 3 mi. east central, 18, 21, 23-VII-1949, 4,850 feet elevation (I. La Rivers). MINERAL COUNTY: Thorne Dunes, 23-VII-1949, 4,600 feet elevation (I. La Rivers). Yerington-Schurz highway, 1 mi. E. Mineral-Lyon County line, 23-VII-1949, 5,000 feet elevation (I. La Rivers).

Genus *Plagiostira* Scudder

1876. *Plagiostira* Scudder, U. S. Geog. Surveys West of 100th Merid., Ann. Rept. Chief Eng., Append. #9: 501.

Type of the Genus: *Plagiostira albonotata* Scudder by monotypy.

This genus is rather widespread across the Great Basin and southward. According to La Rivers (1951), *P. gillettei* can be found in large numbers during favorable years. *Plagiostira* was reviewed recently by Tinkham (1960, 1962). New records for *P. gillettei* are given below.

Key to species and subspecies of *Plagiostira*
(Adapted from Tinkham, 1962)

1. Size large to medium for genus, pronotum almost square. No nacreous markings on metazona. Subgenital plate of male rather broad from above, projecting only slightly beyond apices of cercus.....2

   Size medium to small for genus, pronotum narrowly rectangular. Nacreous markings present on both prozona and metazona of pronotum. Subgenital plate narrow, projecting well beyond apices of cercus.....3

2. Size large, crenulated lateral margins of pronotum broadest near middle. San Raphael and Lahontan Deserts). .....*Plagiostira gillettei gillettei* Caudell (p. 93)

Size medium, crenulated lateral margins of pronotum nearly parallel. Coral Pink Dunes, Utah.....
.....*Plagiostira gillettei utahensis* Tinkham (p. 94)

3. Size medium large, pronotum in profile distinctly subsellate. Nacreous markings on prozona consisting of two short, parallel streaks, with two long parallel streaks on metazona, the cephalic apices of which flare outwardly. Eastern New Mexico; Mescalero Sands.....
.....*Plagiostira mescaleroensis* Tinkham (p. 94)

Size small, pronotum in profile almost flat. Pronotal length more than twice pronotal width. Prozona with two pairs of nacreous spots, metazona with an inverted, white, straight-bottomed "U"-shaped design. Northern Arizona, southern Utah east to Rio Grande, New Mexico..
.....*Plagiostira albonotata* Scudder (p. 94)

Plagiostira gillettei Caudell
(Fig. 26H, 37D)

1907. *Plagiostira gillettei* Caudell, Proc. U. S. Nat. Mus., 32: 392, Fig. 77.

Type locality: Grand Junction, Colorado

There seems to be a possibility that the specimens recorded as *P. gillettei* from Nevada, and now California, represent an undescribed species. The type locality for *gillettei* is in Colorado many miles distant, but because the type specimen is the only record known from that area, occurrence of *gillettei* there has not been confirmed. The fact that the type specimen is an immature male adds to the uncertainty.

The California specimens were all found in Tumbleweed or Russian thistle *(Salsola kali* variety *tenuifolia)* growing along the roadsides. The area from which they were collected by the authors was an arid alluvial fan near the locality described for *Inyodectes pallida* and *Oreopedes cryptoptera,* but somewhat lower in elevation.

Males buzz (Fig. 37D) with an interestingly loud whirring sound which ceases immediately following the slightest disturbance. All specimens were found along the roadside where plants are denser and greener. None were found out on the desert.

RECORDS. CALIFORNIA: INYO COUNTY: Big Pine, 3 mi. E., 21-VII-1964 (D. C. Rentz, J. D. Birchim, 3 males, 2 females, DCR). MONO COUNTY: Benton Station, 7 mi. S., 9-VIII-1962 (G. M. Buxton, T. Kono, many males, females, DCA, DCR).

Plagiostira gillettei utahensis Tinkham

1962. *Plagiostira gillettei utahensis* Tinkham, Great Basin Nat., 22(4): 105.

Type locality: Coral Pink Dunes, 13 miles south of Mt. Carmel Junction, Kane County, Utah.

Known only from the type locality, the type series was collected with *P. albonotata* in a red sand habitat occupied by Sagebrush *(Artemisia tridentata)*, Silver sage *(A. filifolia)* and Rabbitbrush *(Chrysothamnus* sp.). Nothing is known of the habits of this species.

Plagiostira albonotata Scudder

1876. *Plagiostira albonotata* Scudder, U. S. Geog. Surveys west of 100th Merid., Ann. Rept. Chief Engr., Appen., #9: 501.

1907. *Plagiostira albonotata* variety *brevipes* Caudell, Proc. U. S. Nat. Mus., 32:392. Type locality: Williams, Coconino County, Arizona.

Type locality: Northern New Mexico.

This species is found principally on the Painted Desert region of Arizona. It extends into New Mexico and north to Colorado. *P. albonotata* has been found on Rabbitbrush *(Chrysothamnus* sp.) and Sagebrush *(Artemisia tridentata)*.

Plagiostira mescaleroensis Tinkham

1960. *Plagiostira mescaleroensis* Tinkham, Great Basin Nat., 20(1, 2): 40, Figs. 3, 6, 8.

Type Locality: Mescalero Sands, 45 miles east of Roswell on highway 380, New Mexico.

P. mescaleroensis is known only from Mescalero Sands. It is found in a Scrub oak environment where it is active at night. This katydid is omnivorous feeding on plant material and insects which it actively catches.

Genus *Apote* Scudder

1894. *Drymadusa* Scudder (not Stein), Canad. Ent., 26: 178.
1897. *Apote* Scudder, Canad. Ent., 29: 73.

Type of the genus: *Apote notabilis* Scudder, by monotypy.

This genus is composed of large, diurnal grey species. It was formerly thought to contain but one species. Caudell (1907) placed *robusta* as a variety of *notabilis*, a larger form, and Gurney (1939) considered *robusta* as a subspecies of *notabilis*. It now seems better to raise *robusta* to specific status, since little is known of the distribution of the two forms and no intermediates have been seen. Detailed studies of large series may show that several species exist. The specimens from Idaho show a tendency towards gigantism, being fully twice as large as other specimens seen in the course of this study. The two species are readily separable by the features in the key below.

Key to the Species of *Apote*

1. Size smaller (Table 6). Inner tooth of cercus of male placed at about half the distance from the base of the cercus to its apex. Dorsal arm of titillators of male genitalia with apex decurved, unspined (Fig. 24A). Latero-posterior lobes of pronotum light in color. Ovipositor of female as long or slightly longer than the hind femur. Washington, British Columbia.....*Apote robusta* Caudell

   Size larger (Table 6). Inner tooth of cercus of male placed near apex of shaft of cercus. Dorsal arms of titillators of male genitalia with apex blunt, spined (Fig. 24B). Latero-posterior lobes of pronotum without conspicuous light areas.

   Ovipositor of female much longer than hind femur. Oregon, western Idaho.....*Apote notabilis* Scudder

Apote notabilis Scudder
(Fig. 24B, Table 6)

1897. *Apote notabilis* Scudder, Canad. Ent., 29: 73.

Type locality: Oregon

RECORDS. IDAHO: WASHINGTON COUNTY: Mann Creek, 15 mi. S. Midvale on highway 95, 30-VIII-1965 (D. C. and K. A. Rentz, 2 males, DCR). Midvale, 7.5-8.5, 0.7 W., 1.25, 0.2 E., 7-VII-1961 (Cross, 1 female, DCR).

The first listed collection was made in a relatively undisturbed habitat surrounded by rolling hills and scattered short brush. The immediate vicinity was heavily overgrazed and somewhat cultivated but specimens were heard stridulating only in a native area untouched by cattle because of terrain.

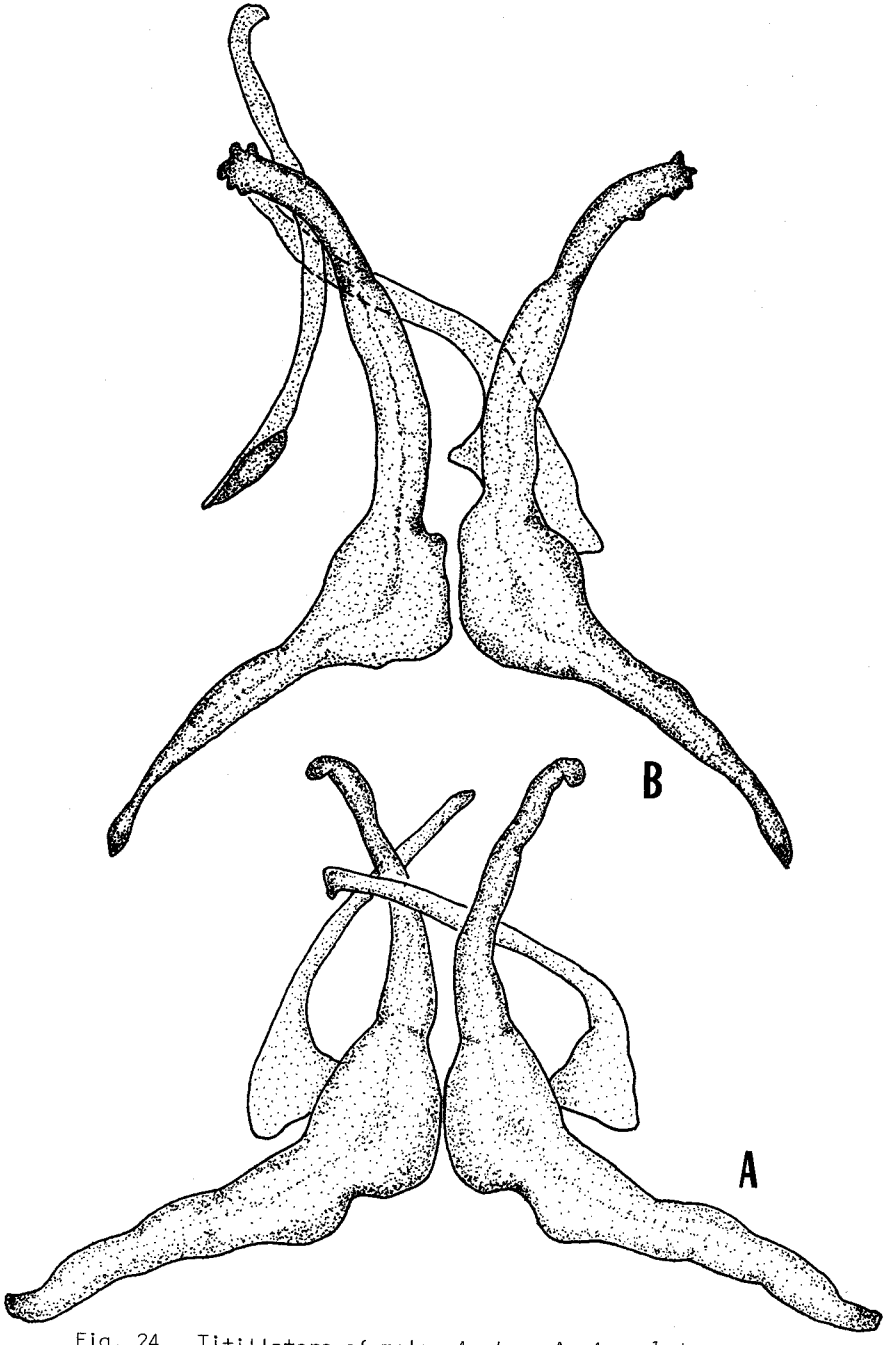

Fig. 24. Titillators of males *Apote*. A, *A. robutsa*. B. *A. notabilis*.

Males sit high (3-4 feet from the ground) in bushes, which they resemble in coloration, and stridulate loudly with a continuous buzz audible from 1/8 to 1/4 mile distant. tance. The visual or auditory acuity of the males is most remarkable. At 50-100 yards they are able to spot the intruder and they immediately drop to the ground and bury themselves in the leaf litter at the base of the bush. They remain motionless in the litter. When handled they bite readily and painfully. It seems likely that the members of the genus are predators or at least omnivorous.

It is now evident that the scarcity of specimens in collections is not due to their rarity in nature but rather due to the wary habits of the adults. In over 3 hours of searching at the first listed locality, many specimens were heard, but only 2 were collected.

Table 6. Size variation in the genus *Apote*. The size (N) of the sample is listed first, followed by the range (R). Means (M) are based on original values. All measurements in millimeters as measured with an ocular micrometer.

Species		*notabilis*		*robusta*	
		Male	Female	Male	Female
Total length	N	2	1	2	1 *
	R	42-44	37	30-34	27
	M	43		32	
length pronotum	N	2	1	2	1
	R	13-15	14	9.5-11	11
	M	14		10.25	
width pronotum	N	2	1	2	1
	R	6.5-7.5	7.2	5-6	6
	M	7		5.5	
length posterior femur	N	2	1	2	1
	R	22.5-25	25	18-21.5	23
	M	23.75		19.75	
length ovipositor	N		1		1
	R		32		25

* Females somewhat shriveled.

Apote robusta Caudell

1897. *Apote notabilis* variety *robusta* Caudell, Proc. U.S. Nat. Mus., 32: 330, Fig. 34.

Type locality: Rockland, Washington.

Gurney (1939) reported on this species. It is seldom abundant enough to cause damage.

Genus *Atlanticus* Scudder

1838. *Decticus* Burmeister, Handb. der Entomol., 2, abth. 2, Pt. 1: 709 (In part).
1859. *Orchesticus* Saussure (Not of Cubanis, 1851), Rev. et. Mag. de Zool.-Bot. 2nd ser, 11:201.
1862. *Thyreonotus*, Scudder (not of Serville, 1839), Bost. Jour. Nat. Hist., 7:453.
1893. *Engoniaspis* Brunner, Ann. Mus. Civ. Stor. Nat. Genova, 13: 185 (No species included).
1894. *Engoniaspis* Scudder, Canad. Ent. 26: 177, 179. (No species included).
1894. *Atlanticus* Scudder, Canad. Ent., 26: 179.
1900. *Engoniaspis*, Scudder, Proc. Davenp. Acad. Nat. Sci. 8: 96.
1900. *Stipator* Rehn, Trans. Amer. Ent. Soc., 26: 90. (Replaced the preoccupied genus *Orchesticus* Saussure).

Type of the genus: *Atlanticus pachymerus* (Burmeister), selected by Kirby 1906.

Rehn and Hebard (1916) gave an extremely detailed treatment of the genus and presented much taxonomic and biological information. A key for the separation of species and a list of species with synonymies and type localities is given here. The reader is urged to refer to the earlier work for details. This genus contains several species in eastern Asia.

Key to the Nearctic Species of *Atlanticus*
(Adapted from Rehn and Hebard, 1916)

1. Medio-internal spur of hind tibia more than twice as long as ventro-internal spine. Prosternum unspined. Low coastal region of southeastern Georgia to northeastern Florida.....*Atlanticus calcaratus* Rehn and Hebard

Medio-internal spur of hind tibia distinctly less than twice or not more than twice as long as ventro-internal spur.....2

2. Pronotal disk in both sexes narrow, subequal, greatest width nearly one and one-half times the greatest length of disk, lateral angles subparallel. Central and southern Florida, Ft. Reed and Tampa south to extreme point of eastern Pine Belt.....*Atlanticus glaber* Rehn and Hebard

   Pronotal disk of both sexes more or less distinctly expanding posteriorly, greatest width never twice greatest length of disk, lateral angles distinctly diverging posteriorly.....3

3. Lateral angles of pronotal disk distinct, rounded in section, never sharp or carinate. Tegmina of male almost completely covered by pronotum.....4

   Lateral angles of pronotal disk distinct, strongly angulate in section, sharp, frequently carinate. Tegmina of male never completely covered by pronotum.....5

4. Size medium. Width of disk of pronotum at cephalic fourth not less than at cephalic margin; posterior margin of disk arcuato-truncate. Posterior femur not greatly inflated basally. Cercus of male short, robust, with short tooth. South Carolina south to northeastern Florida, west to southwestern Georgia.....*Atlanticus dorsalis* (Burmeister)

   Size very large (largest of genus). Width of disk of pronotum at cephalic fourth appreciably less than that at cephalic margin; posterior margin of disk strongly arcuate. Posterior femur greatly inflated basally. Cercus of male elongate, coniform, with elongate equally coniform tooth. Coastal Plain and adjacent portions of Piedmont Region from North Carolina south to north and central Florida west to western Florida and inland as far as Currahee Mountain and Warm Springs, Georgia; from sea level to 1,700 feet elevation.....*Atlanticus gibbosus* Scudder

5. Cercus of male relatively elongate. Subgenital plate of male narrowly and deeply fissate. Subgenital plate of female deeply divided, lateral portions sublanceolate.....6

   Cercus of male relatively short, robust. Subgenital plate of male angularly emarginate, never fissate. Subgenital plate of female V or U-emarginate, lateral portions never sublanceolate.....7

6. Size averaging smaller, limbs shorter. Male subgenital

plate with medio-longitudinal cleft between the cerci, cleft longer than one of the styles, usually narrow, cleft always preceeded by a fine but decided medio-longitudinal carina for some distance. Female subgenital plate narrowly divided medio-longitudinally, the cleft extending decidedly more than half the distance to the base of the plate, lateral projections thus formed each longer than its basal width. Carolinian Life Zone and portions of Alleghanian and Austroriparian zones from central New England south..... .....*Atlanticus americanus americanus* (Saussure)

Size averaging larger, limbs longer. Male subgenital plate with median emargination between the cerci angulate emarginate, individually U-shaped or narrowly V-emarginate, this usually not as long as one of the styles, with medio-longitudinal carina before it normally obsolete, rarely faintly indicated. Female subgenital plate V-emarginate mesodistad, this cleft extending less than half the distance to the base of the plate lateral projections thus formed each slightly shorter than or no longer than its basal width. Western race; occurs east to Lookout Mountain; Bainbridge Georgia south to Liberty County, Florida, west to Meridian and Natchez, Mississippi and Alto Pass and Thebes, Illinois.....*Atlanticus americanus hesperus* Rehn and Hebard

7. Tegmina of male projecting posterior of pronotal disk a distance greater than half the pronotal length. Pronotum of male proportionately large. Subgenital plate of female narrowly V-emarginate with lateral portions of plate broadly rounded distally. Eastern Massachussetts, southern Ontario, northwestern Michigan and Minnesota, south to northern Virginia east of the Appalachians, to central Kentucky, southern Indiana and central Illinois west of the Appalachians. Not known west of the Mississippi..*Atlanticus testaceus* (Scudder)

Tegmina of male projecting posterior of pronotal disk a distance less than half the pronotal length. Pronotum of male relatively shorter, narrower. Subgenital plate of female when narrowly V-emarginate always having the lateral portions of plate at least subangulate distally.....8

8. Posterior femur more elongate, disk relatively more slender, lateral angles less divergent posteriorly. Tegmina of male slightly produced posteriorly. Coastal Plain region and adjacent portions of Piedmont area of North and South Carolina and Ozark Mountain Region of Arkansas.....*Atlanticus pachymerus* (Burmesiter)

Posterior femur less elongate, more robust. Pronotum more abbreviate, more robust, the disk relatively broader, lateral angles strongly divergent posteriorly. 9

9. Subgenital plate of female U-emarginate. Ovipositor distinctly arcuate. Lateral angles of pronotal disk strongly sigmoid. Eyes prominent. Elevated areas of southern Appalachian region from 3,000 feet to 6,000 feet elevation.....*Atlanticus monticola* Davis

Subgenital plate of female V-emarginate. Ovipositor straight, faintly arcuate or faintly decurved. Lateral angles of pronotal disk less sigmoid, more regularly diverging posteriorly. Eyes normal. Northern New York south to south-central Virginia, west to southern Iowa. .....*Atlanticus davisi* Rehn and Hebard

Atlanticus americanus (Saussure)

1859. *Orchesticus americanus* Saussure, Rev. et Mag. de Zool.-Bot., 2nd ser., 11: 201.
1862. *Thyreonotus dorsalis* Scudder (not *Decticus dorsalis* Burmeister 1838), Bost. Journ. Nat. Hist., 7: 454.
1869. *Decticus derogatus* Walker, Cat. Derm. Salt. Brit. Mus., 2: 260.
1894. *Atlanticus dorsalis* Scudder, (not *Decticus dorsalis* Burmeister 1838), Canad. Ent., 26: 179, 180, 183.
1900. *Stipator americanus*, Rehn, Trans. Amer. Ent. Soc., 27: 901.
1907. *Atlanticus dorsalis*, Caudell, Proc. U. S. Nat. Mus., 32: 321.
1916. *Atlanticus americanus*, Rehn and Hebard, Trans. Amer. Ent. Soc., 42: 72.

Type locality: Tennessee.

Atlanticus americanus hesperus Hebard

1916. *Atlanticus americanus* (Saussure), Rehn and Hebard, Trans. Amer. Ent. Soc., 42: 72. (In part)
1934. *Atlanticus americanus hesperus* Hebard, Trans. Amer. Ent. Soc., 60: 31, Figs. 3, 4.

Type locality: River Junction, Gadsdan County, Florida.

Atlanticus calcaratus Rehn and Hebard

1916. *Atlanticus calcaratus* Rehn and Hebard, Trans. Amer.

Ent. Soc., 42: 93, Pl. 6, Figs. 1, 19, 25; Pl. 7, Figs. 9, 18, 27.

Type locality: Billy's Island, Okeefenokee Swamp, Georgia.

Atlanticus davisi Rehn and Hebard

1903. *Atlanticus dorsalis*, Blatchley, (not *Decticus dorsalis* Burmeister 1838) Orth. Indiana: 395.
1907. *Atlanticus pachymerus*, Caudell, Proc. U. S. Nat. Mus., 32: 323. (In part)
1911. *Atlanticus pachymerus*, Sherman and Brimley, Ent. News, 22: 390. (In part)
1916. *Atlanticus davisi* Rehn and Hebard, Trans. Amer. Ent. Soc., 42: 58, Pl. 6, Figs. 7, 8, 9; Pl. 7, Figs. 3, 12, 21; Pl. 8, Figs. 3, 4, 5, 13.

Type locality: Orange, Orange County, Virginia.

Atlanticus dorsalis (Burmeister)

1838. *Decticus dorsalis* Burmeister, Hand. der Entom., 2, abth. 2, Pt. 1: 713.
1905. *Atlanticus gibbosus* Rehn and Hebard, (not of Scudder 1894), Proc. Acad. Nat. Sci. Phila.: 797.
1907. *Atlanticus dorsalis*, Caudell, Proc. U. S. Nat. Mus., 32: 323. (In part)

Type locality: South Carolina, possibly Georgetown. See Rehn and Hebard 1916: 87.

Atlanticus gibbosus Scudder

1877. *Thyreonotus dorsalis*, Scudder, Proc. Bost. Soc. Nat. Hist. 19: 83.
1894. *Atlanticus gibbosus* Scudder, Canad. Ent., 26: 180.

Type locality: Fort Reed, Seminole County, Florida.

Atlanticus glaber Rehn and Hebard

1877. *Thyreonotus dorsalis*, Scudder, Proc. Bost. Soc. Nat. Hist., 19: 83.
1905. *Atlanticus* sp., Rehn and Hebard, Proc. Acad. Nat. Sci. Phila.: 48.
1912. *Atlanticus glaber* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila.: 269, Figs. 20-22.

Type locality: Miami, Dade County, Florida.

Atlanticus monticola Davis

1911. *Atlanticus pachymerus*, Rehn and Hebard, (not *Decticus pachymerus* Burmeister 1838), Proc. Acad. Nat. Sci. Phila.: 644.
1915. *Atlanticus monticola* Davis, Bull. Brookl. Ent. Soc., 9: 104.

Type locality: Lake Toxaway, Transylvania County, North Carolina.

Atlanticus pachymerus (Burmeister)

1838. *Decticus pachymerus* Burmeister, Handb. der Entom., 2, abth. 2, Pt. 1: 712.
1842. *Locusta pachymera*, De Haan, Verhandl. Natuurl. Gesschied., Bdjr. Kenn. Orth.: 178.
1907. *Atlanticus pachymerus*, Caudell, Proc. U. S. Nat. Mus. 32: 323. (In part: North Carolina)
1911. *Atlanticus pachymerus*, Sherman and Brimley, Ent. News, 22: 390. (In part)

Type locality: South Carolina. (There is the possibility that this species was actually taken at Georgetown, South Carolina. See Rehn and Hebard, 1916).

Atlanticus testaceus (Scudder)

1862. *Thyreonotus pachymerus* Scudder, Bost. Journ. Nat. Hist., 7: 453.
1900. *Engoniaspis testacea* Scudder, Proc. Davenp. Acad. Nat. Sci., 8: 97.
1916. *Atlanticus testaceus*, Rehn and Hebard, Trans. Amer. Ent. Soc., 42: 48.

Type locality: Missouri (?)

Genus *Pediodectes* Rehn and Hebard

1897. Orchesticus Scudder (not of Saussure, 1859), Guide North Amer. Orthop.: 55.
1916. *Stipator*, of authors prior to 1916.
1916. *Pediodectes* Rehn and Hebard, Trans. Amer. Ent. Soc., 42: 45.

Type of the genus: *Pediodectes grandis* (Rehn) by original designation.

The true identity of the species of this genus remains uncertain. Several have not been collected since the original collections were made and others show intergradation. The similarity of this genus with *Eremopedes* may

someday result in their coalition. Work is being done presently by authorities at the University of Michigan and elsewhere on the problem. Material from type localities is needed in large series in order to correctly associate the species. It is not possible to present a key to species at this time. Species' synonymies and type localities are listed below.

Pediodectes ateloploides (Caudell)

1907. *Stipator ateloploides* Caudell, Proc. U. S. Nat. Mus., 32: 350.

Type locality: San Jose del Cabo, Baja California Sur, Mexico.

Pediodectes bruneri (Caudell)

1907. *Stipator bruneri* Caudell, Proc. U. S. Nat. Mus., 32: 343.
1944. *Pediodectes bruneri*, Tinkham, Amer. Midl. Nat., 31 (2): 309.

Type locality: Texas.

Pediodectes daedalus Rehn and Hebard

1920. *Pediodectes daedalus* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 245, Pl. 9, Figs. 8-11.

Type locality: Uvalde, Uvalde County, Texas.

Pediodectes grandis (Rehn)

1904. *Stipator grandis* Rehn, Proc. Acad. Nat. Sci. Phila: 544.

Type locality: Alta Mira, Tamaulipas, Mexico.

Pediodectes haldemani (Girard)

1853. *Anabrus haldemani* Girard, Marcy's Expl. Red Riv.: 259; Pl. 15, Figs. 5-8.
1885. *Thyreonotus cragini* Bruner, Bull. Washb. Coll. 1: 129. Type locality: Barbour County, Kansas.
1916. *Pediodectes haldemani*, Rehn and Hebard, Trans. Amer. Ent. Soc., 42: 45.

Type locality: Red River of Louisiana, main south fork.

Pediodectes mitchelli (Caudell)

1911. *Stipator mitchelli* Caudell, Canad. Ent. 43: 137, Fig. 7.
1920. *Pediodectes mitchelli*, Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 245.

Type locality: Hondo, Medina County, Texas.

Pediodectes nigromarginatus (Caudell)

1902. *Orchesticus nigromarginata* Caudell, Trans. Amer. Ent. Soc., 28:89.
1907. *Stipator grandis* variety *insignis* Caudell, Proc. U.S. Nat. Mus., 32: 348, Fig. 45. Type locality: Dallas, Texas.
1916. *Pediodectes nigromarginatus*, Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 5:65.

Type locality: Texas.

Pediodectes pratti (Caudell)

1911. *Stipator pratti* Caudell, Proc. Ent. Soc. Wash., 13: 79.
1920. *Pediodectes pratti*, Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 245.

Type locality: Alice, Jim Wells County, Texas.

Pediodectes stevensonii (Thomas)

1870. *Anabrus stevensonii* Thomas, Proc. Acad. Nat. Sci. Phila.: 75.
1870. *Thyreonotus minutus* Thomas, Proc. Acad. Nat. Sci. Phila.: 75.
1885. *Thyreonotus scudderi* Bruner, Bull. Washb. Coll., 1: 90. Type locality: Barbour County, Kansas.
1907. *Stipator stevensonii*, Caudell, Proc. U. S. Nat. Mus., 32: 344.
1916. *Pediodectes stevensonii*, Rehn and Hebard, Trans. Amer. Ent. Soc., 42: 45.

Type locality: Southern Colorado. ("On the elevated grassy terraces near the mountains").

Pediodectes tinkhami Hebard

1933. *Pediodectes tinkhami* Hebard, Trans. Amer. Ent. Soc., 60: 35, Pl. 2, Fig. 1; Pl. 3, Figs. 1, 2.

Type locality: Chinati Mountains, Presidio County, Texas.

Genus *Anabrus* Haldeman

1852. *Anabrus* Haldeman, Stansbury Exped. to Valley of the Great Salt Lake of Utah: 372, Pl. 10, Figs. 4-56.

Type of the genus: *Anabrus simplex* Haldeman by monotypy.

Members of the genus *Anabrus* have long been known throughout the west for the damage they cause to crops during outbreak years. Before modern control methods were in widespread use, huge numbers could be seen in affected areas and insects piled in heaps along roadsides were not an uncommon sight.

Anabrus is a member of the Great Basin community and is closely associated with Sagebrush *(Artemisia tridentata)*. All of the species are diurnal. Cowan (1929) and Wakeland (1959) discussed life histories and outbreak phenomena of *A. simplex*, the Mormon Cricket, the most notorious member of the genus. Gurney (1939) gave a key to the species and compiled distributional data on the genus and other genera with which it could possibly be confused.

Provisional Key to the Species of *Anabrus* (Adapted from Gurney, 1939)

1. Male cercus with inner tooth greatly developed, at right angle to main body of cercus. Specimens large for genus, frequently 2 inches in body length. Washington, Oregon.....*Anabrus cerciata* Caudell (p.108)

   Male cercus with inner tooth only moderately developed, not at right angle to main body of cercus.....2

2. Hind femur less than twice as long as pronotum, occasionally twice as long. Male cercus with inner tooth stout, tip of inner tooth extending to half or more than half, the length of cercus from base of main body of cercus. Lateral carinae of pronotum feebly indicated, lateral lobes smoothly merging with upper surface. Washington to Manitoba, south to northern New Mexico, east to eastern California.....*Anabrus simplex* Haldeman (p. 107)

   Hind femur a little more than twice as long as pronotum.....3

3. Lateral and median carinae of pronotum feebly indicated. Cercus with long sweeping curve at apex, inner tooth small placed near base. Oregon to British Columbia.....*Anabrus longipes* Caudell (p.108)

Lateral and median carinae of pronotum well indicated. Cercus not as above. Western Montana, northern Idaho.. .....*Anabrus spokan* Rehn and Hebard (p. 108)

Anabrus simplex Haldeman
(Fig. 26B)

1872. *Anabrus simplex* Haldeman, Stansbury Exped. to Valley of the Great Salt Lake of Utah: 372, Pl. 10, Figs. 4-56.
1864. *Anabrus purpurescens* Uhler, Proc. Ent. Soc. Phila., 2: 550.
1866. *Acheta nigra* Lord, Nat. in Vanc. 1: 264. Type locality: Eddy Route County, Colorado.
1872. *Anabrus coloradus* Thomas, Ann. Rept. U. S. Geol. Surv. Terr., 5: 440.
1872. *Anabrus similis* Scudder, Rept. U. S. Geol. Surv. Terr., Nebr.: 249.
1907. *Anabrus maculatus* Caudell, Proc. U. S. Nat. Mus., 32: 356. Type locality: Ft. Walsh, British Columbia.
1907. *Anabrus simplex* variety *nigra* Caudell, Proc. U. S. Nat. Mus., 32: 355.
1912. *Anabrus simplex nigra*, Caudell and Hebard, Proc. Acad. Nat. Sci. Phila.: 166.
1912. *Anabrus simplex maculatus*, Caudell and Hebard, Proc. Acad. Nat. Sci.,Phila.: 166.

Type locality: Valley of the Great Salt Lake, Utah.

Records of the Mormon Cricket from California are not very numerous. It has been recorded from the northern part of the state (Lassen, Modoc, Siskiyou Counties) and data below extend its range considerably.

RECORDS. CALIFORNIA: INYO COUNTY: Near Mono Pass, 7-VIII-1959, 6-IX-1960, 28-VIII-1965 (D. C. Rentz, C. D. MacNeill, J. D. Birchim, many males, females, DCR, CAS). MONO COUNTY: White Mts. Research Station, 21-VII-1961, 10,150 feet elevation (D. C. Rentz, R. Friedricks, many males, females, DCR).

DISCUSSION. All of the specimens listed above were found near sagebrush *(Artemisia tridentata)*. Males stridulate loudly only during the late morning and are extremely wary and stop at the slightest disturbance. When eviscerated, the gut contents almost always smell highly of wild onion. Females were frequently taken with large, cotton-

like spermatophores attached to the genital opening. Wakeland (1959) reported extensively on the economic history of this species.

Anabrus spokan Rehn and Hebard

1920. *Anabrus spokan* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 248, Pl. 9, Figs. 12-15.

Type locality: Sand Point, Lake Pend d'Oreille, Kootenai County, Idaho. 2,100 feet elevation.

Anabrus cerciata Caudell

1907. *Anabrus cerciata* Caudell, Proc. U. S. Nat. Mus., 32: 361, Fig. 48.

Type locality: Washington.

Anabrus longipes Caudell

1907. *Anabrus longipes* Caudell, Proc. U. S. Nat. Mus., 32: 361, Fig. 49.

Type locality: Pullman, Whitman County, Washington.

Genus *Peranabrus* Scudder

1894. *Peranabrus* Scudder, Canad. Ent., 26: 181.

Type of the genus: *Peranabrus scabricollis* (Thomas) by monotypy.

This genus is monotypic and its species, *Peranabrus scabricollis* (Thomas) the Coulee Cricket, is diurnal. The rough appearance of the pronotum renders it shining when seen alive. The genus is quite distinctive and not really closely related to any known Nearctic genera with the possible exception of *Anabrus*.

Peranabrus scabricollis (Thomas)

1872. *Thamnotrizon scabricollis* Thomas, Ann. Rept. U. S. Geol. Surv. Terr., Pt. 5: 441.
1894. *Peranabrus scabricollis*, Scudder, Canad. Ent., 26: 181.

Type locality: Montana ("Found in southern Montana on the dividing range of the Rocky Mountains at an elevation of 6,000 to 8.000 feet above the level of the sea.")

Snodgrass (1905) and Melander and Yothers (1917) reported extensively on the habits of the species in the Pacific Northwest. The former work is discussed here in the introduction. *P. scabricollis* ranges from eastern Montana west to northeast Oregon and eastern Washington.

Inyodectes Rentz and Birchim, new genus

DIAGNOSIS. Size moderate to small. Wings extending beyond posterior margin of pronotum for a distance less than half the length of pronotum. Pronotum without lateral carinae. Body surface shining. Hind femur with dark apical annulus. Ovipositor shorter than hind femur, nearly straight, apex dark. Titillators relatively simple.

Type of the Genus. *Inyodectes pallidus* Rentz and Birchim, new genus and species, by monotypy.

DESCRIPTION OF GENUS. Size moderate for subfamily, form slightly robust. Body surface shining. Head with vertex well produced, round, without furrow. First antennal segment as broad as vertex; second segment 1/4 the length of first. Flagellum of antenna relatively thin, thread-like. Eye dorso-ventrally elongate.

Pronotum elongate, dorsally narrowed in posterior quarter. Disk of pronotum rounded dorsally, apex truncate. Pronotum without distinct lateral carinae, slightly indicated on posterior 1/4. Lateral lobes of pronotum well developed, anterior ventral margin broadly rounded, declivent in posterior 1/2. Surface of pronotum and lateral lobes smooth. Tegmina projecting for a distance less than half the length of pronotum (male) to nearly wholly concealed by pronotum (female). Prosternum unarmed.

All femora spined on anterior ventral margin with several scattered spines. Middle femur with scattered spines on both posterior and anterior ventral margins. All tibiae well spined dorsally and ventrally. Plantula of hind tarsus moderately well developed. Posterior tibia with 4 apical spurs, inner pair half the length of the outer spurs.

Dorsum of abdomen smooth, without median longitudinal carina. Last abdominal segment of male greatly produced in median portion with pair of spiniform projections. Subgenital plate of male with moderate excavation, styli short; subgenital plate of female with deep excavation. Ovipositor of female heavy, nearly straight, shorter than hind femur, unserrated, apex solid black.

Coloration of nearly uniform pallid brownish yellow. Bluish overcast on dorsum of abdomen and legs in life. Posterior 1/5 of ovipositor black.

Titillators of male genitalia simple, consisting of undeveloped paired flat structure.

Inyodectes pallidus Rentz and Birchim,
new genus and species
(Figs. 25A, 25B, 25C, 25D, 36D, 36E, Table 7)

DIAGNOSIS. Size medium, form robust, uniform pallid yellow coloration. Hind femur with apical annulus. All femora spined on ventral margin. Last abdominal segment of male with dorsal projections. Cercus of male relatively short. Titillators of male broad, flange-shaped basally, arm well spined.

TYPE LOCALITY. 4 miles west of summit of Westgard Pass, White Mountains, Inyo County, California.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. In addition to the characters stated in the generic description, the following may be regarded as specific. Size similar to that of *Idiostatus inyo*. Spination of femora sparse. Fore and middle tibiae with 6 spines on inner and outer ventral margins. Dorsum of fore tibia with 3 widely spaced spines on inner margins; outer dorsal margin unspined. Dorsum of middle tibia with 4 evenly spaced spines on inner margin, outer dorsal margin with 2 spines. Ventral margin of hind tibia with several scattered spines on inner and outer margin, dorsum well spined with length of spines alternating. Cercus and last abdominal segment (Figs. 25A, 25B).

ALLOTYPE FEMALE. Differs from male in following characters. Slightly larger, tegmina ovate, extending but slightly beyond apex of pronotum. Ovipositor heavy, straight, to slightly upcurved (Fig. 36E), shorter than hind femur. Cerci attenuate, more than 5 times longer than basal width.

DERIVATION OF NAME. The generic name is derived from Inyo County, an area rich in decticine species. The specific name is derived from the pallid appearance of the living specimens of the species.

SPECIMENS STUDIED. 9; holotype, allotype, 7 paratypes.

RECORDS. CALIFORNIA: INYO COUNTY: Westgard Pass 4 mi. W. summit, 24-VII-1965 (D. C. Rentz, J. D. Birchim, holotype, allotype), 9-IX-1966 (D. C. and K. A. Rentz, 1 female, paratype, DCR); 5 mi. west Westgard Pass summit, 19-VIII-1965, 21-VIII-1965, 25-VIII-1965, 26-VIII-1965 (J. D. Birchim, 1 male, 4 females, paratypes); 5 mi. E.

Westgard Pass summit, 9-IX-1966 (D. C. Rentz and K. A. Rentz, 1 female, paratype, DCR).

DISCUSSION. It was extremely interesting to find this secretive katydid occurring along with the equally rare *Oreopedes cryptoptera*. As noted by Rehn and Hebard (1920), *Oreopedes* seems to combine several characteristics of other decticine genera such as *Eremopedes, Idiostatus* and *Ateloplus*. *Inyodectes* also shows some superficial similarities to several genera.

The shape of the pronotum suggests relationships with *Eremopedes* and *Pediodectes*. The ovipositor of the female is slightly similar to that found in *Eremopedes scudderi*. The tegmina are reminiscent of those found in *Ateloplus* and *Oreopedes*. The presence of the dorsal pair of distal spurs on the hind tibia is different from the condition found in *Oreopedes* in which the dorsal pair of spurs is absent.

All specimens were collected at night along the Westgard Pass road and adjacent alluvial slopes. Wandering females were easily seen on the black asphalt road. Examination of foliage along the road and on the talus slope revealed specimens resting on low-growing Gooseberry (*Ribes* sp.)

The type locality is a rather arid part of an extensive alluvial fan facing northwest in the rain shadow of the Sierra Nevada. Saltbrush (*Atriplex* sp.), Sagebrush (*Artemisia tridentata*),Pinyon Pine (*Pinus monophylla*), Gooseberry (*Ribes* sp.), and Tumbleweed or Russian thistle (*Salsola kali* variety *tenuifolia*) are the predominant plants. Other decticines in the region include *Neduba (Aglaothorax) ovata armiger, Capnobotes occidentalis, C. fuliginosus, Ateloplus hesperus, Oreopedes cryptoptera, Plagiostira gillettei*.

I. pallidus and *Oreopedes cryptoptera* appear to be genuinely rare in nature. Intensive searching both by road and by examination of plants revealed only very few specimens.

Table 7. Size variation in *Inyodectes* and *Oreopedes*. The size (N) of the samples is listed first, followed by the range (R). Means (M) are based on original values. All measurements are in millimeters as measured with an ocular micrometer.

Species		*Inyodectes pallidus*		*Oreopedes cryptoptera*	
		Male	Female	Male	Female
Total length	N	2	4	3	2
	R	18-22	20-22	14-15	14-15
	M	20	20.75	14.5	14.5

Table 7 - continued.

Species		*Inyodectes pallidus*		*Oreopedes cryptoptera*	
		Male	Female	Male	Female
length pronotum	N	2	4	3	2
	R	6-6.1	6.1-6.8	4.9-5	4.5-4.7
	M	6.05	6.7	4.96	4.6
width pronotum	N	2	4	3	2
	R	3.3	3.3-4	2.5-2.8	3
	M	3.3	3.65	2.66	3
length posterior femur	N	2	4	3	2
	R	17	17-19.5	12-13	14
	M	17	18.62	13.33	14
length ovipositor	N		4		2
	R		14-16		12-13
	M		15		12.5

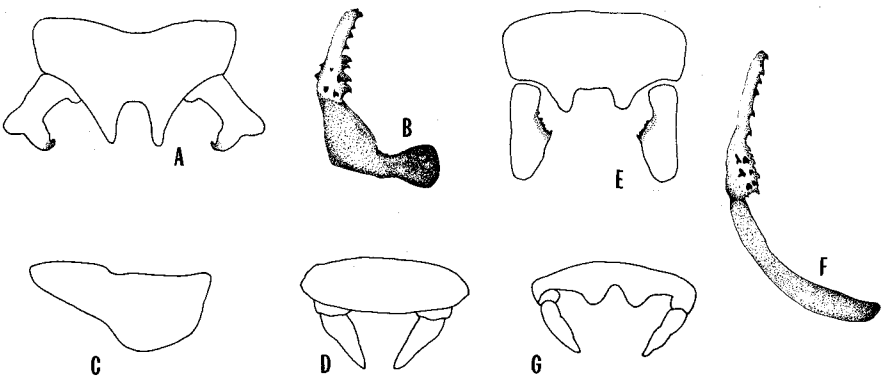

Fig. 25. A, terminalia, holotype male *Inyodectes pallida*. B, right portion of titillator, holotype male *Inyodectes pallida*.. C, pronotal outline, holotype male *Inyodectes pallida*. D, terminalia male allotype female *Inyodectes pallida*. E, terminalia *Oreopedes cryptoptera*. F, right portion of titillator of male *Oreopedes cryptoptera*. G, terminalia female *Oreopedes cryptoptera*.

Genus *Oreopedes* Rehn and Hebard

1920. *Oreopedes* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 251.

Type of the genus: *Oreopedes cryptoptera* Rehn and Hebard by monotypy.

This diminutive and nocturnal monotypic genus formerly was known only from the holotype male. It now has been collected from several different localities, and the possibility of an undescribed species exists. Collection of females from near the type locality permits description of that sex which heretofore was unknown.

Oreopedes cryptoptera Rehn and Hebard
(Figs. 25E, 35F, 25G, 36F, Table 7)

1920. *Oreopedes cryptoptera* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 252, Pl. 10, Figs. 1-5.

Type locality: Silver Canyon Trail, White Mts., Inyo County, California.

DESCRIPTION OF FEMALE SEX. (Based on specimen from near Westgard Pass.) Size larger than male. Tegmen broad, extending slightly from beneath apex of pronotum. Ovipositor shorter than hind femur, gently upcurved, darkened at apex. Subgenital plate with moderate, broad notch. Spination of legs as described for male.

RECORDS. CALIFORNIA: ALPINE COUNTY: Woodfords, 18-X-1962 (W. E. Simonds, 1 female on *Chrysothamnus*, CDA #62J29-43). INYO COUNTY: Westgard Pass summit, 5 mi. W., 26-VIII-1965 (J. D. Birchim, 3 males, 2 females, DCR), 9-IX-1966 (D. C. and K. A. Rentz, 2 females, DCR). MONO COUNTY: Tioga Pass, near Mono Lake, 1-VIII-1931 (E. R. Tinkham, 1 female, ANSP).

DISCUSSION. The titillators of the male genitalia are quite different from those of *Inyodectes* Rentz and Birchim, new genus, a close relative. They are much more attenuate and lack the development seen in the base of the titillator of *Inyodectes*.

Coloration of all specimens but one is quite remarkably uniform. The color pattern is similar to that of the darker specimens of *Ateloplus hesperus*. The tegmina are black with the veins white.

The single female from Alpine County is darker in coloration, somewhat suggestive of *Eremopedes* species, and has the notch of the subgenital plate slightly broader than seen in other specimens. Perhaps this represents another species.

It occurs in a habitat similar to that found at the other localities. The Alpine and Mono County records extend the known range of the genus to a considerable extent. *Oreopedes* is apparently closely associated with sagebrush.

Genus *Eremopedes* Cockerell

1898. *Eremopedes* Cockerell, Ann. Mag. Nat. Hist., 7(2): 323.

Type of the genus: *Eremopedes scudderi* Cockerell, selected by Kirby in 1906.

This genus is closely related to *Ateloplus* and *Pediodectes* and may even be found to be congeneric with one or both of these genera. All are desert or thorn forest species. The genus is under revision and a key is presented below with the little biological information known for each species.

Key to the Species of *Eremopedes*

(Excluding *E. spinosa* Hebard, known only from several islands in the Gulf of California and *E. subcarinatus* known from northern Chihuahua, Mexico)

(Adapted from Tinkham, 1944)

1. Cercus long, slender, outcurved in apical half, bearing a median or subapical inner tooth. Outer pagina of hind femur not striped with black. Humeral angle of pronotum not shining black.....2

   Cercus short, broad, inner apex toothed. Outer pagina of hind femur with two basal black stripes. Humeral angles of pronotum marked with shining black.....5

2. Color green, form slender with pair of white dorso-lateral stripes. Cercus long, internal tooth basad of center. Lower Sonoran Faunal Region; widely distributed on the Sonoran Desert.....
   .....*Eremopedes bilineatus* (Thomas)
   (p.116)
   Cercus with internal tooth median or caudad of center. Form not as slender, without distinct dorso-lateral stripes.....3

3. Male ultimate tergite with deep, narrow cleft reaching to base of tergite. Tegmina black with veins white; posterior margin of pronotum buff. Lower Sonoran Faunal Region of the Chihuahuan Desert.....
   .....*Eremopedes covilleae* Hebard
   (p. 117)

Male ultimate tergite with "U"-shaped emargination of varying depth, produced by length of triangular processes of tergite. Tegmina reddish brown to blackish brown, never black, veins straw-colored.....4

4. "U"-shaped emargination of ultimate tergite deep, with triangulate processes narrow, long. Portion of cercus beyond internal tooth longer. Size large. Lower Sonoran Faunal Region of the Chihuahuan Desert..... .....*Eremopedes scudderi* Cockerell (p.118)

"U"-shaped emargination of ultimate tergite broad, shallow with triangular lobes short, broad. Portions of cercus beyond internal tooth short. Size very small. Salado Desert, southern Chihuahua Desert..... .....*Eremopedes shrevei* Tinkham (P. 118)

5. Tegmina and veins black, outer margin of tegmina edged with buff.....6

Tegmina black with veins and outer margin buffish....7

6. Size smaller than 20 mm in body length. Sonoran Live Oak Zone of southeastern Arizona..... .....*Eremopedes ephippiatus ephippiatus* (Scudder) (p. 117)

Size much larger, 27-29 mm in body length. Ironwood and Resin Plant Zone of Sonoran Desert in Mexico as far south as Navajoa.....*Eremopedes ephippiatus sonorensis* Tinkham (p. 117)

7. Size small, coloration dark brown. Outer pagina of hind femur with two black stripes. Pine Zone, high elevations of mountains of southern Arizona; Mogollon Plateau of northern Arizona east of central New Mexico. .....*Eremopedes balli balli* Caudell (p. 115)

Size slightly larger, light pale brown coloration. Outer pagina of hind femur without two stripes. Petrified Forest of Painted Desert of northeastern Arizona..... .....*Eremopedes balli pallidus* Tinkham (p. 116)

Eremopedes balli Caudell

1901. *Eremopedes balli* Caudell, Canad. Ent., 33: 100.

Type locality: Arizona, probably Williams.

Tinkham (1944) reported that this species is mountain dwelling and lives in clumps of brachen fern on the tops

of high mountains. It is nocturnal in habits and hides among plants and grasses during the day. The call is a low continuous "zee-zee-zee".

Eremopedes balli pallidus Tinkham

1944. *Eremopedes balli pallidus* Tinkham, Amer. Midl. Nat., 31(2): 319.

Type locality: Petrified Forest, Arizona.

Nothing is known concerning the habits of this species.

Eremopedes bilineatus (Thomas)

1875. *Steiroxys bilineatus* Thomas, Rept. U. S. Geol. Surv. W. 100th Merid., 5: 905.
1899. *Cacopteris sinuata* Scudder, Proc. Amer. Acad. Arts and Sci., 25: 88. Type locality: Ft. Whipple, Arizona.
1902. *Plagiostira albofasciata* Scudder and Cockerell, Proc. Davenp. Acad. Nat. Sci., 9:55, Pl. 3, Fig. 2. Type locality: Mesilla Park, Mesilla, New Mexico.
1905. *Plagiostira gracila* Rehn, Publ. Kans. Acad. Sci.: 227. Type locality: Bill Williams Fork, Arizona.
1907. *Eremopedes albofasciata*, Caudell, Proc. U. S. Nat. Mus., 32: 337.
1907. *Idiostatus sinuata*, Caudell, Proc. U. S. Nat. Mus., 32: 378.
1907. *Idiostatus bilineatus*, Caudell, Proc. U. S. Nat. Mus., 32: 379.
1909. *Eremopedes gracilis*, Rehn and Hebard, Proc. Acad. Nat. Sci. Phila.: 480.
1935. *Eremopedes bilineatus*, Hebard, Trans. Amer. Ent. Soc., 61: 311.

Type locality: San Carlos, Gila County, Arizona.

Tinkham (1944) reported that this species is thamnophilus and strictly phyllophagous in its habits. The chief host plant is likely *Larrea tridentata* but we have taken it in its range on nearly every desert bush including spiny species of *Opuntia*. It is often the most common decticine katydid where it occurs.

The general coloration of this slender species is green with dorso-lateral stripes of white. Specimens from the northern part of its range, Mojave Desert, are much smaller than specimens from farther south.

RECORDS. The following records extend the known range

of *E. bilineatus*. ARIZONA: MARICOPA COUNTY: Gila Bend, 28 mi. SE., 26-VIII-1960 (D. C. Rentz, 1 male, DCR). PIMA COUNTY: Organ Pipe National Monument, 1-IX-1961 (D. C. Rentz, 11 males, DCR). MEXICO: SONORA: El Puerto, 18 mi. E., 7-VIII-1960 (D. C. Rentz, 1 male, DCR). Hermosillo, 18 mi. S., 11-VIII-1960 (D. C. Rentz, 1 male, DCR); 45 mi. S., 10-VIII-1960 (D. C. Rentz, 2 males, DCR).

Eremopedes covilleae Hebard

1934. *Eremopedes covilleae* Hebard, Trans. Amer. Ent. Soc., 60: 39, Pl. 2, Fig. 2, Pl. 3, Fig. 3.

Type locality: Big Bend of the Rio Grande, 20 miles north of Chisos Mountains, Brewster County, Texas. (Modified type locality based on notes by Tinkham (1944: 315-16; 1948: 683) and maps of Big Bend National Park: near Marathon-Boquillas Road about 9 miles south of Park entrance.

This species known only from the type series taken on Creosote bush *(Larrea tridentata)*.

Eremopedes ephippiatus (Scudder)

1899. *Cacopteris ephippiatus* Scudder, Proc. Amer. Acad. Arts and Sci., 35: 88.
1900. *Eremopedes unicolor* Scudder, Cat. Orth. U. S. Append.: 97. Type locality: Arizona.
1907. *Eremopedes ephippiata*, Caudell, Proc. U. S. Nat. Mus., 32: 332.

Type locality: Sonora, Mexico.

This species is found under oaks where it wanders over the forest floor. It is nocturnal in activity.

Eremopedes ephippiatus sonorensis Tinkham

1944. *Eremopedes ephippiatus sonorensis* Tinkham, Amer. Midl. Nat., 31: 320.

Type locality: 40 miles north of Hermosillo, Sonora, Mexico.

This large subspecies inhabits the southern Sonoran Desert and adjacent thorn forest. The senior author took a large series of individuals gathered together in an extremely thorny bush not far from the water's edge at San Carlos Bay, Sonora, Mexico. Dr. W. E. Ferguson of San Jose State College collected several additional specimens at the same locality near vespid wasp nests. It is thought that they may prey on the larvae at night when the wasps are inactive. At Alamos, Sonora, specimens were found seeking refuge by day in an ancient rock wall densely covered by

vegetation. At night they would move out on the wall and sing.

RECORDS. The following records extend the known range of the subspecies. MEXICO: SONORA: Alamos, 12-VIII-1960 (D. C. Rentz, 2 males, 3 females, DCR). San Carlos Bay, 9 miles north Guaymas, 10-VIII-1960 (D. C. Rentz, many males, females, DCR).

Eremopedes scudderi Cockerell

1898. *Eremopedes scudderi* Cockerell, Ann. Mag. Nat. Hist., 2(7): 323. Type locality: Mesilla, New Mexico.
1898. *Eremopedes scudderi* variety *viridis* Cockerell, Ann. Mag. Nat. Hist., 2(7): 324. Type locality: Mesilla, New Mexico.
1902. *Eremopedes scudderi* variety *bicolor* Cockerell, Proc. Davenp. Acad. Sci., 9: 54.
1902. *Eremopedes popeana* Scudder and Cockerell, Proc. Davenp. Acad. Sci., 9: 54. Type locality: El Paso, Texas.
1909. *Ateloplus macroscelus* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., Feb.: 169. Type locality: El Paso, Texas.
1929. *Eremopedes scudderi*, Hebard, Proc. Acad. Nat. Sci. Phila.: 403.

Type locality: Mesilla, Dona Ana County, New Mexico.

This species is nocturnal and omnivorous. It has been collected on Creosote bush *(Larrea tridentata)* and *Acacia constricta* and Ground Yucca *(Yucca elata)*. The host plant varies with the locality.

Eremopedes shrevei Tinkham

1944. *Eremopedes shrevei* Tinkham, Amer. Midl. Nat., 31(2): 316.

Type locality: 16 miles south of Doctor Arroyo, southern Nuevo Leon, Mexico.

E. shrevei is known only from the type series and is thamnophilus and nocturnal. The calling song is a low continuous "zee-zee-zee-zee".

Eremopedes spinosa Hebard

1923. *Eremopedes spinosa* Hebard, Proc. Calif. Acad. Sci., 12(15): 337, Figs. 10-13.

Type locality: Mejia Island, Gulf of California, Mexico.

This species has been taken on several islands in the Gulf of California but its habits are unknown.

Eremopedes subcarinatus (Caudell) new combination

1907. *Idionatus subcarinatus* Caudell, Proc. U. S. Nat. Mus., 32: 397.

Type locality: Colonia Garcia, Chihuahua, Mexico.

The authors have examined the type female of this species, kindly sent by Dr. A. B. Gurney, U. S. Department of Agriculture, and we feel that it either belongs here or in *Pediodectes*. No additional material from near the type locality has been taken so positive placement is not possible at this time. It definitely is not a species of *Idionotus*.

Genus *Ateloplus* Scudder

1900. *Ateloplus* Scudder, Cat. Orth. U. S.: 79.

Type of the genus: *Ateloplus notatus* Scudder by original designation.

This genus of rather similar-looking species is found throughout the Sonoran Desert. Nearly all species are primarily ground dwellers taking refuge in bushes or thickets during the day and wandering across the desert floor at night. All are nocturnal in habits.

Key to males of *Ateloplus* (Adapted from Tinkham, 1944)

1. Size very large for genus, pronotum exceeding 8 mm in length. Mojave Desert, California..... .....*Ateloplus splendidus* Hebard (p. 123)

   Size smaller, pronotum less than 7 mm in length.....2

2. Size medium to small, cercus almost as long as broad, with short-tooth inner prominence.....3

   Size small, cercus long, narrow with apical or subapical tooth directed inward.....4

3. Color uniformly brown, outer and apical margins of cercus actue-angled. Sonora Desert east of the Colorado River.....*Ateloplus schwarzi* Caudell (p.123)

Color mottled grey, outer and apical margins of cercus obtuse-angled. Lower elevations of Sonoran Live Oak Zone of Arizona.....*Ateloplus minor* Caudell (p.121)

4. Cercus with inner tooth subapical in position. Sonoran Desert region--Mojave Desert to just east of the Colorado River.....*Ateloplus coconino* Hebard (p. 120)

Cercus with inner tooth apical in position.....5

5. Pronotum averaging 6.00 mm in dorsal length. Body of both sexes 22.0 mm or more in length. Colorado Desert of southern California....*Ateloplus notatus* Scudder (p.123)

Pronotum averaging less in dorsal length. Size of body much smaller than above.....7

6. Predominantly grey in coloration, dorsal longitudinal stripe of abdomen and pronotum absent. Smallest known species of genus. Owens Valley, Inyo County, California.....*Ateloplus hesperus* Hebard (p.121)

Coloration predominantly light tan. Dorsal longitudinal stripe of abdomen and pronotum present. Size larger than above.....*Ateloplus luteus* Caudell (p. 121)

Ateloplus coconino Hebard

1905. *Ateloplus notatus* Rehn (not of Scudder, 1900), Trans. Kans. Acad. Sci. 19:227 (male, Bill Williams Fork, Arizona).
1907. *Ateloplus notatus* Snow (in part not of Scudder, 1900), Trans. Kans. Acad. Sci., 20: 39 (same specimen as above).
1907. *Ateloplus notatus* Caudell (in part not of Scudder, 1900), Proc. U. S. Nat. Mus. 32: 369, fig. 55 (Same specimen as above).
1935. *Ateloplus coconino* Hebard, Trans. Amer. Ent. Soc., 61: 140, Pl. 7, Figs. 1, 2.

Type locality: Bill Williams Fork, Coconino County, Arizona.

Nothing is known of the habits of this species. It likely is associated with the Yuccas which are common at the type locality.

Ateloplus hesperus Hebard
(Figs. 26E, 36E)

1934. *Ateloplus hesperus* Hebard, Trans. Amer. Ent. Soc., 60: 40.

Type locality: 9 miles west Lone Pine, Inyo County, California.

This diminutive decticine is relatively common on the Sierran side of the Owens Valley and the specimens here recorded from east of Big Pine and Mazourka Canyon are somewhat larger and a few are very pallid yellow and may actually represent another species.

Specimens are commonly found at night feeding on the blossoms of *Eriogonum fasciculatum*. Wandering females were taken on little-traveled roads at night.

RECORDS. CALIFORNIA: INYO COUNTY: Big Pine, 3 mi. E. 21-VII-1964 (D. C. Rentz, J. D. Birchim, 1 male, DCR); 4 mi. W., 2-VII-1961 (D. C. Rentz, 1 female, DCR). Independence, 6 mi. W., 25-VII-1965 (D. C. Rentz, J. D. Birchim, 4 males, 9 females, DCR). Lone Pine, 9 mi. W., 19-VII-1961 (D. C. Rentz, 1 male, 1 female, DCR); 8-IX-1966 (D. C. & K. A. Rentz, 2 females, DCR). Mazourka Canyon Road, 13-VII-1965 (J. D. Birchim, 1 male, 3 females, DCR). Westgard Pass, 4 mi. W., 22-VII-1965 (D. C. Rentz, 1 male, DCR); 5 mi. W., 9-IX-1966 (D. C. & K. A. Rentz, 1 male, DCR).

Ateloplus luteus Caudell

1907. *Ateloplus luteus* Caudell, Proc. U. S. Nat. Mus., 32: 373, Fig. 59.

Type locality: Mohave, Mohave County, Arizona.

This species has been found hiding in various desert bushes including Saltbush *(Atriplex confertifolia)*. Nothing is known of the biology of *A. luteus*.

Ateloplus minor Caudell

1907. *Ateloplus minor* Caudell, Proc. U. S. Nat. Mus., 32: 371, Fig. 56.

Type locality: Oracle, Pinal County, Arizona.

A. minor has been taken by Tinkham (1944) hiding by day in pendant leaves of Yucca. The calling song of the male described by Tinkham is a continuous "zeee-zeee-zeee" audible for a distance of from ten to fifteen feet.

Fig. 26. Right portion of titillators of some species of Decticinae. A, *Pediodectes nigromarginata*. B, *Eremopedes scudderi*. C, *Idiostatus hermanii*. D, *Ateloplus notatus*. E, *Ateloplus hesperus*. F, *Peranabrus scabricollis*. G, *Anabrus simplex*. H, *Plagiostira gillettei*. I, *Zacycloptera atripennis*. J, *Steiroxys strepens* (?). K, *Atlanticus testacea*.

Ateloplus notatus Scudder

1900. *Ateloplus notatus* Scudder, Cat. Orth. U. S.: 98, Pl. 2, Fig. 3.

Type locality: San Diego County, California.

Members of this species have been found on the desert floor at night where they search food which consists of bits of organic matter. It is found in the Pinyon-Juniper Zone of the Colorado Desert of southern California.

Ateloplus schwarzi Caudell

1907. *Ateloplus schwarzi* Caudell, Proc. U. S. Nat. Mus., 32: 372, Figs. 57, 58.

Type locality: Tinajas Altas, Yuma County, Arizona.

This species has been found on bushes or even on top of pack rat dens, Tinkham (1944). It is believed to be omnivorous. Tinkham noted the western limit of the range as being defined by the Colorado River.

Ateloplus splendidus Hebard

1934. *Ateloplus splendidus* Hebard, Trans. Amer. Ent. Soc., 60: 43, Pl. 2, Fig. 3; Pl. 3, Fig. 4.

Type locality: Barstow, Mojave Desert, San Bernardino County, California.

A. splendidus is the largest known species in the genus. It is thamnophilus having been found on Creosote bush *(Larrea tridentata)*. The song described by Tinkham is a loud, rapid "zee-zee" at approximately 180 per minute. The female sex was described from Coyote Wells, Imperial Valley, California and may actually represent another species.

Genus *Idiostatus* Pictet

1888. *Idiostatus* Pictet, Mem. Soc. Phys. Genev., 30: 63.
1894. *Cacopteris* Scudder, Canad. Ent., 26: 178.

Type of the genus: *Idiostatus californicus* Pictet (= *Idiostatus hermanii* (Thomas).

This genus is currently being revised by the senior author. There are many undescribed species. It is felt best not to include a key here but merely to list the species, synonymies and type localities for reference by the reader. Tinkham (1944) gave a key to some species but it is inadequate.

Idiostatus aequalis (Scudder)

1899. *Cacopteris aequalis* Scudder, Proc. Amer. Acad. Arts and Sci., 35(5): 92.
1907. *Idiostatus aequalis*, Caudell, Proc. U. S. Nat. Mus., 32: 376.

Type locality: Cajon Pass, Los Angeles County, California.

Idiostatus callimera Rehn and Hebard

1920. *Idiostatus callimera* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 255, Pl. 10, Figs. 9-12.

Type locality: Lone Pine Canyon, in eastern slope of the Sierra Nevada, Inyo County, California.

Idiostatus elegans Caudell

1907. *Idiostatus elegans* Caudell, Proc. U. S. Nat. Mus., 32: 384, Fig. 72.

Type locality: Nevada.

Idiostatus fuscopunctatus (Scudder)

1899. *Cacopteris fuscopunctata* Scudder, Proc. Amer. Acad. Arts and Sci., 35(5): 89.
1907. *Idiostatus fuscopunctatus*, Caudell, Proc. U. S. Nat. Mus., 32: 382.

Type locality: Tehachapi, Kern County, California.

Idiostatus fuscus Caudell

1934. *Idiostatus fuscus* Caudell, Pan. Pac. Ent., 10: 154, Fig. 8.

Type locality: Ralston Peak, El Dorado County, California.

Idiostatus hendersoni Hebard

1939. *Idiostatus hendersoni* Hebard, Trans. Amer. Ent. Soc., 65: 173, Pl. 8, Figs. 5, 7.

Type locality: Leamington, Millard County, Utah.

Idiostatus hermanii (Thomas)

1875. *Steiroxys hermanii* Thomas, Rept. U. S. Geol. Surv. west 100th merid., Pt. 5: 904.
1888. *Idiostatus californicus* Pictet, Mem. Soc. Phys. Hist. Nat. Genev., 30(6): 64, Pl. 3, Figs. 35, 35a, 35b.
1907. *Idiostatus hermanii*, Caudell, Proc. U. S. Nat. Mus., 32: 381.

Type locality: Most likely California, possibly the Mount Shasta area, Siskiyou County.

Idiostatus inermis (Scudder)

1899. *Cacopteris inermis* Scudder, Proc. Amer. Acad. Arts and Sci., 35(5): 89.
1899. *Cacopteris nevadensis* Scudder, Proc. Amer. Acad. Arts and Sci., 35(4): 91. (Female only)
1907. *Idiostatus inermis*, Caudell, Proc. U. S. Nat. Mus., 32: 386.

Type locality: Near Lake Tahoe, Nevada.

Idiostatus inyo Rehn and Hebard

1920. *Idiostatus inyo* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 254, Pl. 10, Figs. 6-8.

Type locality: Near Owens Lake, Inyo County, California.

Idiostatus magnificus Hebard

1934. *Idiostatus magnificus* Hebard, Trans. Amer. Ent. Soc., 60:46, Pl. 2, Fig. 4; Pl. 3, Fig.6.

Type locality: Cedar Peak, Warner Mountains, Modoc County, California. 8,200 feet elevation.

Idiostatus nevadensis (Scudder)

1899. *Cacopteris nevadensis* Scudder, Proc. Amer. Acad. Arts and Sci., 35(5): 91. (Male only)
1907. *Idiostatus nevadensis*, Caudell, Proc. U. S. Nat. Mus., 32: 378.

Type locality: Ruby Valley, Elko County, Nevada. (Lt. Wheeler's Explorations of 1876).

Idiostatus rehni Caudell

1907. *Idiostatus rehni* Caudell, Proc. U. S. Nat. Mus, 32: 382, Fig. 70.

Type locality: Siskiyou County, California.

Idiostatus variegata Caudell

1907. *Idiostatus variegata* Caudell, Proc. U. S. Nat. Mus., 32: 387.

Type locality: Pocatello, Bannock County, Idaho.

Idiostatus wymorei Caudell

1934. *Idiostatus wymorei* Caudell, Pan-Pac. Ent., 10: 156, Fig. 7.

Type locality: Strawberry, El Dorado County, California.

Genus *Acrodectes* Rehn and Hebard

1920. *Acrodectes* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 258.

Type of the genus: *Acrodectes philopagus* Rehn and Hebard by original designation.

This is one of the most interesting genera of the subfamily both systematically and biologically. Only one species is known and it occurs at the highest elevations of the Sierra Nevada of California. It is diurnal.

Acrodectes philopagus Rehn and Hebard
(Figs. 3, 36J)

1920. *Acrodectes philopagus* Rehn and Hebard, Trans. Amer. Ent. Soc., 46: 259, Pl. 10, Figs. 1-7.

Type locality: Mt. Whitney, Sierra Nevada, Fresno County, California, 13,800-14,200 feet elevation.

Rehn and Hebard (1920) and Tinkham (1944) commented extensively on the habits of this katydid. We can add little beyond suggesting that Tinkham's idea that *A. philopagus* feeds on lichens may be only partly true. At the Mono Pass locality specimens were found on open slopes and at the bases of composite plants and bunch grasses. It is more likely that the species subsists on a wide variety of foods

that it scavenges from its habitat. Its somewhat aggressive behavior suggests that it may be a predator and feed in part on the numerous insects of its habitat.

Specimens brought back from the high mountains seem to suffer no ill effects in the laboratory and live for many months. Mating was frequently observed and lasts, in some instances, for over an hour. The male assumes a horizontal position (Fig. 36J) and grasps the ovipositor of the female. Females wander during mating and the males often continue stridulating, at a low level, during copulation.

This species' period of activity is short when compared to that of other decticines. Eggs likely hatch after snow melts (mid-July) and development proceeds at a rapid rate until late October when temperatures are extremely cold and individuals die. Even daily activity is relatively restricted. At the Mono Pass locality, summer cloud covers are frequent and specimens were found to be active only when the sun was out. As clouds covered the sun, specimens would seek temporary refuge in talus material where they would remain inactive until the sun again appeared. Specimens were found only between 11 o'clock and 3 o'clock. At other times conditions were found to be too cold for their activity.

Acrodectes philopagus is the only species of Nearctic Decticinae seen in the course of this study which does not possess titillators in the male genital complex. The extensive fleshy membranes seen in other species are not present. It is thought that the titillators aid in transfer of sperm from male to female. Perhaps the relatively long length of time that the pairs remain "in copulo" compensates for the absence of the titillators although some other species with titillators *(Decticita* sp.*)* remain in copulation for a long while. However, the length of time during which they are paired is somewhat shorter than for *A. philopagus*.

RECORDS. CALIFORNIA: FRESNO COUNTY: Humphreys Basin, 14 mi. SW. Bishop, 24-IX-1965, 11,000 feet elevation (G. M. Buxton, F. L. Blanc, 1 male, CDA). INYO COUNTY: Mono Pass, 7-VIII-1959, 6-IX-1960, 8-VIII-1961, 14-VIII-1964 (D. C. Rentz, C. D. MacNeill, J. D. Birchim, 26 males, 11 females, DCR, CAS).

Genus *Idionotus* Scudder

1894. *Idionotus* Scudder, Canad. Ent., 26: 172. (Invalid, no species included.)
1897. *Idionotus* Scudder, Guide to N. A. Orth.: 56. (Invalid, no species included.)
1900 *Idionotus* Scudder, Cat. Orth. U. S.: 79.

Type of the genus: *Idionotus brunneus* Scudder by monotypy.

In superficial appearance the various species of *Idionatus* look rather similar and do not show any real specific distinctiveness; they are medium-sized dull brown, short-winged species producing a low buzzing stridulation which the average entomologist may not detect. However, when critically examined under the microscope, members of this genus show the most distinctive characters of any other in the subfamily in North America. Both the external male genitalia and the concealed genitalia show great diversity among the species. Female specimens as well possess obvious distinctive characters.

In California early instar nymphs of *Idionatus* may be collected in large numbers in early spring and then brought back to the laboratory and reared to maturity. Sometimes this is more desirable than collecting for the adults, because dry conditions of summer often seem to kill the majority of specimens in a given population.

All species known to us are active at night; however, specimens of *I. siskiyou* Hebard are taken in stridulation during an overcast day. Specimens can often be readily collected by driving little-traveled roads at night and carefully watching for specimens. This method is of great use when males are not stridulating and localities appear devoid of specimens.

Idionotus is made up of some 7 known species confined to southern Oregon and California west of the Sierra Nevada. *I. siskiyou* represents the northernmost known species occurring as far north as Josephine County, Oregon and *I. tehachapi* Hebard the southernmost species, known from the Tehachapi Mountains of Kern County, California. *Idionotus* shows strong affinities with certain European genera *(Antaxius, Rhacocleis)*. Detailed comparison of the concealed genitalia of those genera might suggest the degree of relationship.

In the following treatment of this genus, the more obviously closely related species are grouped together, otherwise alphabetical placement is followed.

Key to the Species of *Idionotus*

1. Cerci of both sexes very thin, spine like (Figs. 28D, 28F, 28G, 28I), not at all greatly swollen, more than 10 times as long as basal width. Titillators of male genitalia with arms elongate, tapered, often protruding from end of abdomen (Figs. 28E, 28H).....2

   Cerci of both sexes proportionately broader (Figs. 27A, 27C, 27D, 27F, 27H, 27I, 27M, 28A, 28C), often only 2-3 times longer than broad. Titillators of male genitalia not as above, often bifurcate (Figs. 27B, 27E, 27J, 27L, 28B).....3

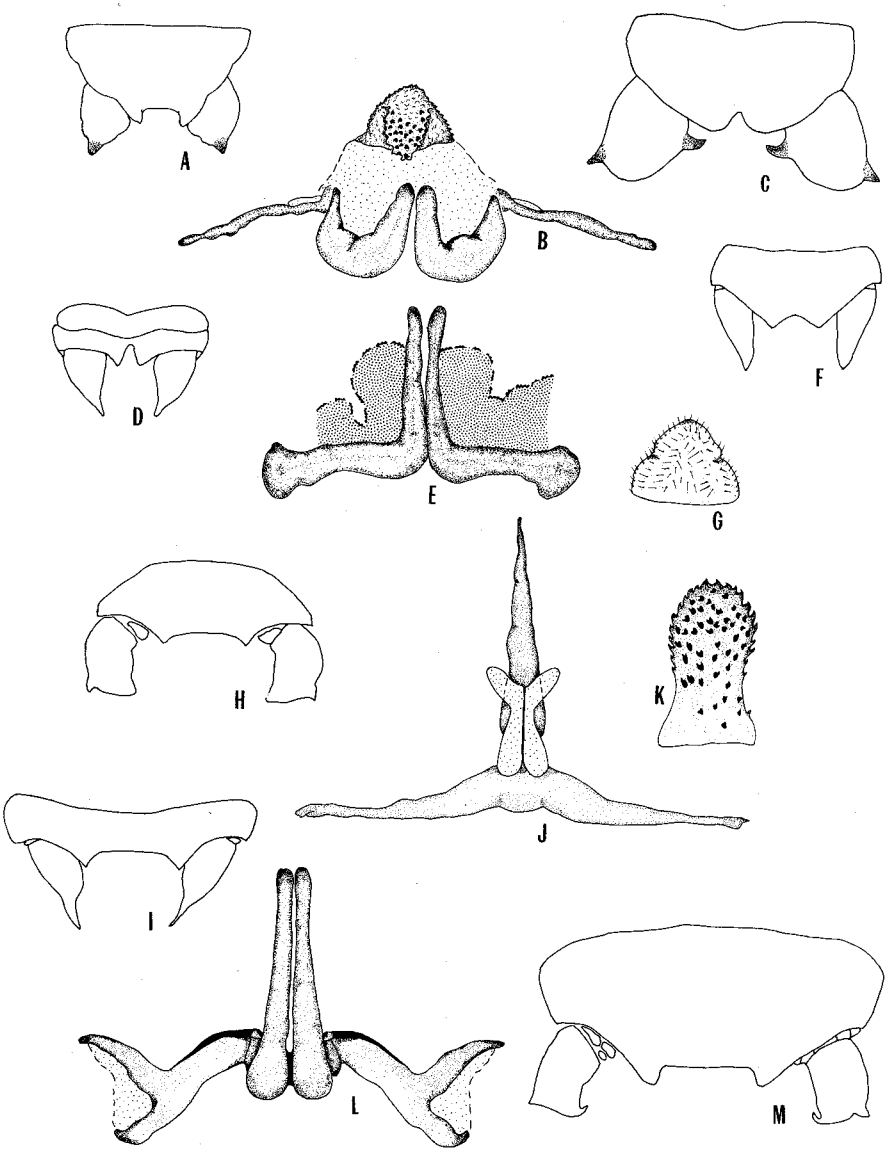

Fig. 27. Terminalia and titillators of *Idionotus*. A, B, terminalia and titillators of immature male *I. lundgreni*. D, terminalia, holotype female *I. lundgreni*. C, E, terminalia and titillators of male *I. siskiyou*. F, terminalia female *I. siskiyou*. G, tongue of titillator of male *I. siskiyou*. H, J, K, terminalia, titillators and tongue of titillators of male *I. brunneus*. I, terminalia of female *I. brunneus*. L, M, titillators and terminalia of male *I. similis*.

2. Cerci curving inward only slightly, often with internal tooth (male) in median portion (Figs. 27G, 27I). Tenth tergum of male with moderately broad excavation (Fig. 28G). Titillators of male genitalia with arms extremely long, over 2 mm., tapered, fused in entire length and extending greatly beyond tip of abdomen (Fig. 28H). Distribution (Fig. 29)....*Idionotus tuolumne* Hebard (p.140)

Cerci of both sexes greatly curving inward, without internal tooth (Figs. 28D, 28F, 28G, 28I). Titillators of male genitalia with arms not as long as above, bifurcate, diverging in apical half (Fig. 28E). Distribution (Fig. 29).....*Idionotus incurvus* Rentz and Birchim, new species (p. 141)

3. Titillators of male genitalia without dorsal tongue (Fig. 28B). Cerci of male cylindrical, more than 4 times longer than broad, with sharp internal tooth at apex (Fig. 28A). Largest species in size. Distribution (Fig. 29).....*Idionotus tehachapi* Hebard (p. 140)

Without above combination of characters.....4

4. Cerci of male extremely broad, flattened (Figs. 27A, 27C), of female somewhat broad (Figs. 27D, 27F). Last abdominal segment of male with excavation narrow (Figs. 27A, 27C), of female somewhat broad (Figs. 27D, 27F)... 5

Cerci of male cylindrical in shape, apex decurved, less than 3 times longer than broad (Figs. 27H, 27M). Last abdominal segment of male with excavation somewhat broad (Figs. 27H, 27M), of female rather narrow (Figs. 27I).....6

5. Cerci of male with internal tooth on inner distal margin (Fig. 27C). Last abdominal segment of male and female with excavation relatively narrow (Figs. 27C, 27F). Titillators of male genitalia with arms bifurcate, membrane of titillators sclerotized (Fig. 27E). Tongue of titillators very broad, densely spined (Figs. 27G). Distribution (Fig. 29)....*Idionotus siskiyou* Hebard (p. 132)

Cerci of male without internal tooth on inner distal margin (Fig. 27A). Last abdominal segment of male and female with excavation relatively broad (Fig. 27D). Titillators of adult male unknown (Fig. 27B). Distribution (Fig. 29).....*Idionotus lundgreni* Rentz and Birchim, new species (p. 133)

6. Cercus of male with outer "finger" well produced (Fig. 27M). Last abdominal segment of male with excavation

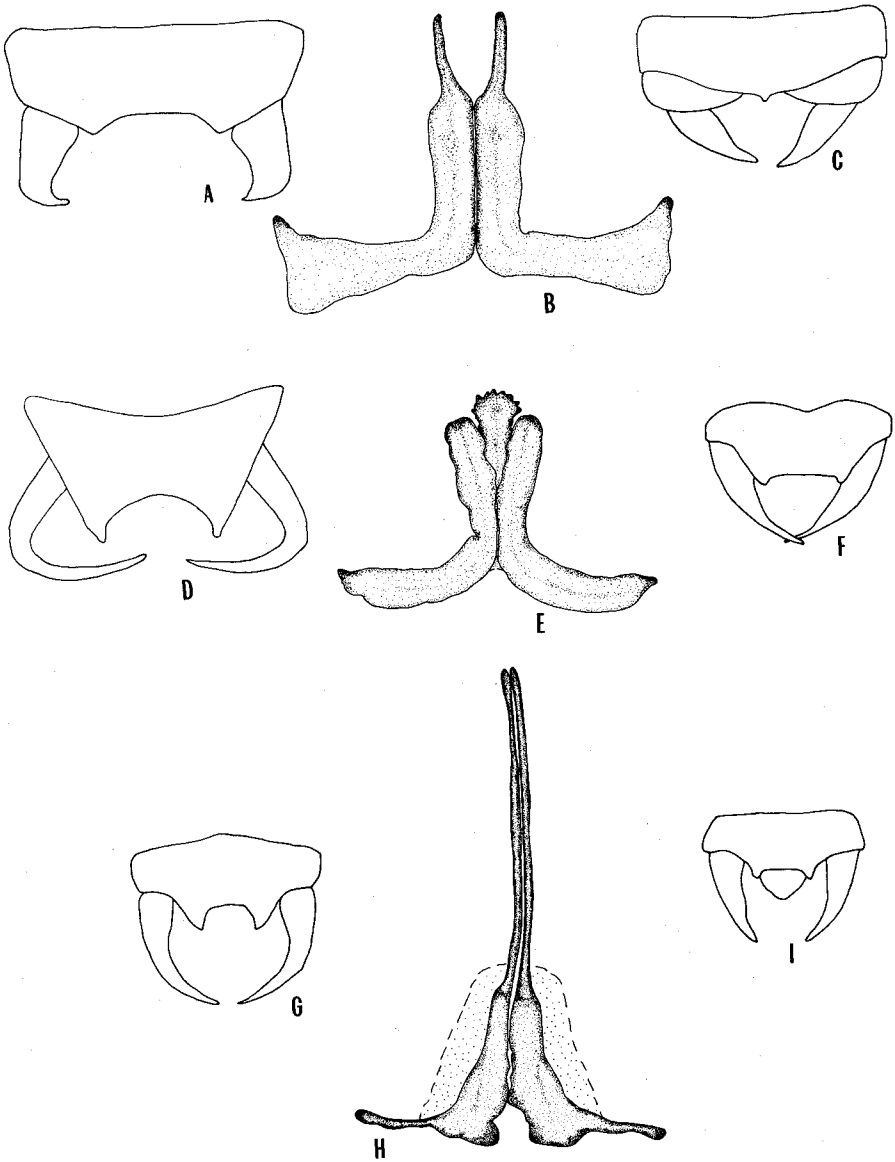

Fig. 28. Terminalia and titillators of *Idionotus*. A, B, terminalia and titillators of male *I. tehachapi*. C, terminalia of female *I. tehachapi*. D, E, terminalia and titillators of male *I. incurvus*. F, terminalia of female *I. incurvus*. G, H, terminalia and titillators of male *I. tuolumne*. I, terminalia female *I. tuolumne*.

broad (Fig. 37M). Titillators of male genitalia with arms at right angles to base which is undulant. Distal portion of arms of titillators parallel, fused (Fig. 27L). Tongue of titillators with base broad, of uniform width throughout, surface with dense, blunt spines. Distribution (Fig. 29).....*Idionotus similis* Caudell (p. 139)

Cercus of male with "finger" not very well produced (Fig. 27H). Last abdominal segment of male with excavation narrower than above (Fig. 27H). Titillators of male genitalia with arms arising directly from base, apices divergent (Fig. 27J). Tongue of titillators tapering from apex, very sharply pointed (Fig. 27K). Distribution (Fig. 29)....*Idionotus brunneus* Scudder (p. 137)

Idionotus siskiyou Hebard
(Figs. 27E, 27F, 27G, 29, Table 8)

1907. *Idionotus brunneus* Scudder, Caudell (males only, not of Scudder 1900), Proc. U. S. Nat. Mus., 32: 395.
1934. *Idionotus brunneus* Hebard (female only, not of Scudder 1900), Trans. Amer. Ent. Soc., 60: 48, Pl. 3, Fig. 11.
1934. *Idionotus siskiyou* Hebard, Trans. Amer. Ent. Soc., 60: 48, Pl. 3, Fig. 7.

Type locality: Thrall, Siskiyou County, California.

DIAGNOSIS. Size medium for genus. Closest relative, *I. lundgreni*. Cercus of male broad, quadrate to slightly elongate, with inner tooth at apex, external apex tapered (Fig. 31H). Tenth tergum of male narrowly concave, lateral portion well produced (Fig. 27H). Subgenital plate of male broadly incised, styles elongate. Titillators of male genitalia showing some variation, the illustration (Figs. 27E, 27G) showing a typical specimen. Variation is seen in shape of callosities which are portions of thinly sclerotized membrane ventrad of arms of titillators. Callosities covered with minute, dense tubercles. Ventral tongue of titillators with base as broad as width of both callosities combined but individually of varying width depending upon the size of callosities. Entire surface of callosity covered with rather long spines. Arms of titillators arising almost vertically from base, fused in basal portion, always separated at apex which is acute. Arms of titillators vary in length and somewhat in width, with some specimens possessing arms as long as the horizontal portion of base and other specimens with arms but half that length.

RECORDS. OREGON: JOSEPHINE COUNTY: Grants Pass, 18-VII-1923 (F. H. Wymore, 1 male, CIS). Hayes Hill, Road summit, 15-VIII-1941 (Rehn, Pate, Rehn, 1 male, 3 females,

ANSP). CALIFORNIA: GLENN COUNTY: east of Plaskett Mdws., 26-VI-1961, matured VII-1961, 4,000 feet elevation (D. C. Rentz, 3 males, 1 female, DCR). LAKE COUNTY: Oasis, 5 mi. W. on Hwy 20, 27-VI-1961, matured VII-1961 (D. C. Rentz, 1 male, 1 female, DCR). MENDOCINO COUNTY: Covelo, 16 mi. E., 28-VI-1961, matured VII-1961 (D. C. Rentz, 1 male, 2 females, DCR). NAPA COUNTY: Anguin, 9-VI-1965, matured 20-VI-1965 (D. C. Rentz, 2 males, DCR). Conn Dam (Lake Hennessey) 9-VI-1965, matured VII-1965 (D. C. Rentz, 3 males, 3 females, DCR). Pope Valley, 9 mi. SE. on Chiles and Pope Valley Rd., 20-VII-1965 (D. C. Rentz, 2 males, DCR). SHASTA COUNTY: O'Brien, on Lake Shasta, 25-VIII-1965, 1,100 feet elevation (D. C. & K. A. Rentz, 1 male, 1 female, DCR). Redding, 11-VII-1954 (R. O. Schuster, 1 male, CIS). SONOMA COUNTY: Santa Rosa, 11-IX-1965 (J. D. Birchim, 5 males, JDB & DCR). TEHAMA COUNTY: Red Bluff, 27-VI-1935 (J. Beamer, 1 male, ANSP).

DISCUSSION. As seen from the distributional map (Fig. 29), this is the most widespread species. It has been collected early in the season (June) and reared in the laboratory. Specimens from Lake County, California were collected at night, feeding on Toyon *(Photina arbutifolia)* blossoms. The male specimen from O'Brien, California, was found stridulating in the late afternoon and early evening in a dense blackberry thicket. The female from the same locality was taken late at night feedong on Common Mullein *(Verbascum thapsus)*. Although considered primarily nocturnal, the series of specimens from Santa Rosa, California was collected in stridulation during the daytime on an overcast day.

Idionotus lundgreni Rentz and Birchim, new species
(Figs. 27A, 27B, 27D, 29, Table 8)

DIAGNOSIS. Distribution (Fig. 33). Size moderate for genus. Nearest relative *I. siskiyou* Hebard. Incision of last abdominal segment of male broader than in that species (Fig. 27A). Cerci broad as in *I. siskiyou*, without inner tooth. Incision of subgenital plate of male broader and more rounded than in *I. siskiyou*. Cerci of female straight, broad in basal half, then abruptly tapered to apex (Fig. 27D). Last abdominal segment of female broadly excavate (Fig. 27D), similar to that found in *I. incurvus* Rentz and Birchim, new species. Titillators of male genitalia (last instar nymph in alcohol) with arms arising directly from and swollen at base (Fig. 27B). Apices of arms of titillators parallel, attingent throughout. Membrane of fleshy portion of genitalia without sclerotization.

Type locality: Twain Harte, Tuolumne County, California. 3,600 feet elevation.

DEPOSITION OF TYPE. The holotype is to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. Size medium for genus, form moderately robust. Head moderately deep; fastigium of vertex broad, not sulcate, slightly less than twice width of the first antennal segment. Frontal costa with transverse sulcus as described under *I. incurvus*. Face slightly punctate.

Pronotum of normal length for genus, slightly wrinkled dorsally. Lateral carinae prominent, especially in posterior half. Disk of pronotum cut by single, weak, transverse sulcus in anterior 1/5, obsolete in median of pronotum. Median carina of pronotum prominent in posterior 1/4, but weakly indicated anterior of this point. Tegmina extending for distance of less than half length of pronotum, veins moderately pronounced. Prosternum unspined.

Fore and middle femora unspined. Posterior femur armed on outer margin with 3-5 short spines. Fore and middle tibiae armed on ventral anterior and posterior margins with 6 spines of moderate length. Dorsal margins of fore femur armed with 3-4 spines on posterior margin. Middle tibia with 2 anterior, 4 posterior spines. Ventral portion of posterior tibia with 4 apical spurs, an inner pair of equal length and only half as long as external spurs, the innermost spur slightly longer than external one.

Abdomen similar in shape and size to that of other species. Last abdominal segment rather broadly excavate, similar to that of *I. incurvus*, corners moderately produced. Cerci broad in basal half, abruptly tapered to apex. Subgenital plate with slight to moderate excavation. Ovipositor nearly straight, slightly longer than half length of the posterior femur.

Coloration of uniform light brown on dorsum, ventral parts lighter. Dorsum of abdomen with sparse, black speckling. Surfaces of all femora with darker blotches. Outer pagina of posterior femur with but faint indication of a broad, dark stripe.

DESCRIPTION OF MALE SEX. (last instar nymph in alcohol). Similar to female but with following exceptions: cercus very broad (Fig. 27A) without internal tooth; posterior corner of cercus sharply pointed. Subgenital plate broadly excavate, styles greatly elongate. Titillators of male genitalia with arms arising directly perpendicular from base, greatly swollen in basal half. Arms attingent, parallel throughout, apices not divergent (Fig. 27B). Tongue of titillators broad at base, upturned at apex which is densely spined. Membrane of fleshy portion of genitalia without sclerotization.

DERIVATION OF NAME. We take pleasure in naming this species in honor of Mr. Milford R. Lundgren of Twain Harte, California who has contributed many specimens of several species included in this report.

SPECIMENS STUDIED. 3; 1 holotype, 2 paratypes.

RECORDS. ALL CALIFORNIA: TUOLUMNE COUNTY; Twain Harte, 10-VIII-1958 (D. C. Rentz, 1 female, holotype), VII-1962 (D. C. Rentz, 1 male, last instar nymph, DCR), 30-X-1962 (M. R. Lundgren, 1 female, DCR).

DISCUSSION. This species has been collected in meadow situations of forested areas at the type locality. Vigorous sweeping of grasses late at night yielded the holotype. We have a small nymph collected 18-VII-1964 at 2 mi. E. Dardanelle, Tuolumne County, California, 5,800 feet elevation, which may represent this species. It was found sunning itself on a small conifer at midday.

Table 8. Size variation in species of *Idionotus*. The size (N) of the sample is listed first followed by the range (R). Means (M) are based on original values. All measurements are in millimeters as measured with an ocular micrometer.

Species		*Idionotus brunneus*		*Idionotus incurvus*	
		Male	Female	Male	Female
Total length	N	5	5	4	5
	R	16-18	17-21	17-26	17-21
	M	17.60	19.0	16.75	18.66
length pronotum	N	5	5	4	5
	R	5-5.3	5-5.5	5-5.40	4.8-5.5
	M	5.06	5.30	4.92	5.18
width pronotum	N	2	5	4	5
	R	3.2-3.6	3.2-3.6	3-3.6	3-3.5
	M	3.32	3.46	3.32	3.25
length posterior femur	N	2	5	4	5
	R	17.5-21.00	20.5-22.0	18-19	18-22
	M	19.00	21.00	18.25	18.00
length ovipositor	N		5		5
	R		14-15		11-17
	M		14.40		13.66

Table 8 (Continued)

Species		*lundgreni* Female	*similis* Male	*siskiyou* Male	*siskiyou* Female
Total length	N	1	1	5	5
	R	20	21	15-18	19-24
	M			16.20	21
length pronotum	N	1	1	5	5
	R	5.4	5.7	5-5.9	4.7-6
	M			5.38	4.6
width pronotum	N	1	1	5	5
	R	3.5	3.6	3.4-3.8	3.3-3.8
	M			3.50	3.58
length posterior femur	N	1	1	5	5
	R	22	20.5	18.5-20.5	19-22.5
	M			19.5	21.40
length ovipositor	N	1			5
	R	16.5			16-19.5
	M				17.10

Species		*tehachapi* Male	*tehachapi* Female	*tuolumne* Male	*tuolumne* Female
Total length	N	2	1	4	5
	R	20	22	16-18	16-20
	M	20		17	16.75
length pronotum	N	2	1	4	5
	R	5.5-5.7	6.1	4.2-4.7	4.5-4.8
	M	5.6		4.02	4.62
width pronotum	N	2	1	4	5
	R	3.4-3.6	3.7	2.6-3.0	2.7-3
	M	3.5		2.62	3.06

Table 8 (Continued)

Species		*tehachapi*		*tuolumne*	
		Male	Female	Male	Female
	N	2	1	4	5
	R	22-22.5	26	16-19	17.5-20
	M	22.25		16.5	17.30
length ovipositor	N		1		5
	R		20		12-13
	M				12.60

Idionotus brunneus Scudder
(Figs. 27H, 27I, 27J, 27K, 29, Table 8)

1900. *Idionotus brunneus* Scudder, Cat. Orth. U. S.: 98.

Type locality: Folsom, Sacramento County, California.

DIAGNOSIS. Distribution (Fig. 33). Nearest relative *I. similis* Caudell. Incision of last abdominal segment moderately broad as in that species. Cerci robust, stout, three times as long as basal width, outer "finger" broadly pointed, not narrow as in *I. similis* (Fig. 27H). Titillators with arms fused, straight, parallel to apical 1/4, there abruptly divergent forming an acute angle (Figs. 27J, 27K).

DESCRIPTION OF SPECIES. (Based on specimens from Loomis, Placer County, California.) Size medium for genus, form moderately robust. Head moderately deep, fastigium of vertex broad, not sulcate, less than twice width of first antennal segment. Frontal costa with minute transverse sulcus extending across the face from base of antennae. Face punctate.

Pronotum normal for genus, disk flattened. Lateral carinae prominent, divergent on anterior 1/6 of disk. Lateral lobes of pronotum strongly declivent, deep, the posterior margin concave. Only one transverse sulcus, weakly defined, located on anterior 1/5 of pronotum. Median carina of pronotum present only on posterior 1/3 of disk. Tegmina exposed for a distance less than half length of pronotum, stridulatory vein not exposed. Main stridulatory veins strong with a few veinlets on distal portion of tegmina. Prosternum unarmed.

Fore and middle tibiae armed with 6 spines on anterior and posterior on ventral margin. Fore tibiae armed dorsally with 3 widely spaced spines on posterior margin. Middle

tibiae armed dorsally with 4 posterior and 2 anterior spines. Hind tibiae with 4 apical spurs, inner pair half as long as external spurs. Fore and middle femora spineless. Hind femur with a few scattered spines on internal and external ventral margin. Genicular lobes unarmed.

Last abdominal segment with moderately broad excavation, lateral margins as broad triangular projections. Cercus of male stout, no more than three times as long as basal width, broadest distally. Outer "finger" of cercus located on posterior third, broad, triangular. Distal portion of cercus abruptly turned inward. Cercus of female elongate, more than 3 times longer than broad, abruptly tapering in distal 1/4, covered with long hairs. Subgenital plate of male broad with very shallow V-shaped incision; length of one of styles of subgenital plate greater than length of lateral margin of incision. Ovipositor of female half length of the hind femur, nearly straight.

Titillators of male genitalia with base nearly straight, twisted in the mid-lateral portion. Apical portion of base broadly acute, not produced. Arms of titillators fused, extending dorsally perpendicular from base, straight, parallel to apical 1/4, at that point arms abruptly divergent forming an acute angle. Dorsal tongue elongate, narrow, decreasing in length from base and half again as long as fused arms of titillators, apex sharp. Surface of tongue smooth, in some instances mildly tuberculate in basal portion.

Coloration as in other species of the genus, ranging from light brown to dark brown. A few specimens are of a light brown with a broad yellow-brown dorsal stripe along the dorsum of the abdomen. The majority of specimens also have the dorsal portion of the lateral lobes of the pronotum dark brown, but this coloration is completely lacking in some specimens. Fore and middle tibiae and femora with indistinct subapical annuli. Hind tibiae with a rather distinct annulus in basal portion with a distinct yellow stripe arising at right angles to the dorso-median portion of the annulus and continuing to the base of the hind tibia.

RECORDS. CALIFORNIA: EL DORADO COUNTY: near Applegate, 3-V-1961, matured VII-1961 (D. C. Rentz, 1 male, 4 females, DCR). Old Shingle Road, between Shingle Sprs. and Latrobe, 22-X-1965 (D. C. Rentz, 1 male, 3 females, on road at night, DCR). PLACER COUNTY: Loomis, 2 mi. W., 20-VI-1961, matured VII-1961 (D. C. Rentz, 10 males, 11 females, DCR). Meadow Vista, 18-VIII-1961 (J. O. Wilson, 1 female, CDA). Towle, 15-X-1932, 3,000 feet elevation (E. O. Essig, 1 female, CIS).

DISCUSSION. Some confusion has existed because the male of this species was unknown. We now have specimens of both sexes from near the type locality and the females fit well

the description of the holotype. Although this species is the type of the genus and was known only by the females, they were sufficiently distinctive to permit several additional species to be described. None were synonymous with *I. brunneus*.

Specimens from Loomis were collected during the day as nymphs from grasses along an irrigation ditch. They were very abundant and easily collected. The specimens from Old Shingle Road were collected on the road at night along with *I. incurvus*. Capture of a disproportionate number of females by use of this method seems to indicate that they wander more freely than do the males.

I. brunneus can be most easily confused with *I. similis* but is somewhat smaller and distinguished by the characters used in the key.

Idionotus similis Caudell
(Figs. 27L, 27M, 29, Table 8)

1934. *Idionotus similis* Caudell, Pan-Pac. Ent., 10: 152, Figs. 3, 4.

Type locality: Caribou, Plumas County, Feather River, California

DIAGNOSIS. Distribution (Fig. 33). Nearest relative *I. brunneus* Scudder. Slightly larger. Last abdominal segment with sulcation broader than in *I. brunneus*. Outer "finger" of cercus more distinct (Fig. 31M). Titillators with arms with apical portion bent at right angles to main stem. Fleshy membrane at basal portion of tongue of titillators with many granular tubercles (Fig. 27L).

DESCRIPTION OF SPECIES. This species was adequately described by Caudell (1934) with the exception of the titillators which are described below. No material of this species additional to the original series has been discovered.

Titillators (Fig. 27L) with base undulant, lateral portions produced, narrowed with pointed apical quarter, apex sharply pointed. Arms of titillators fused extending dorsally perpendicular from base only for basal 1/4 distance, thence arms abruptly bent at right angles to the stem, continuing straight and parallel throughout, apices not divergent but lying straight, parallel. Dorsal tongue short, broad, only half as long as the fused arms, slightly more than 2 times longer than basal width, apex broadly rounded. Dorsal surface of tongue with many raised, pointed tubercles, greater in number distally. Ventral portion of tongue smooth. Fleshy membrane of titillators with many granular tubercles at base of tongue.

SPECIMENS STUDIED. CALIFORNIA: PLUMAS COUNTY: Caribou (F. H. Wymore, 1 male, paratype, CAS).

Idionotus tehachapi Hebard
(Figs. 28A, 28B, 28C, 29, Table 8)

1934. *Idionotus tehachapi* Hebard, Trans. Amer. Ent. Soc., 60: 52, Pl. 2, Fig. 5; Pl. 3, Figs. 9, 10.

Type locality: Paradise Valley, Tehachapi Mts., Kern County, California.

DIAGNOSIS. Distribution (Fig. 29). Size large for genus. No known close relatives. Cercus of male cylindrical, tapering to apex which is bent inward slightly more than a right angle (Fig. 28A). Tenth tergum of male broadly concave, latero-posterior angles hardly produced. Subgenital plate of male broadly incised, styles elongate. Titillators of male (Fig. 28B) with base more expanded than found in other species, without ventral tongue. Arms arising from base, thence abruptly turned at right angles and tapering to apex.

SPECIMENS STUDIED. CALIFORNIA: KERN COUNTY: Kern River Canyon, Dougherty Crk., 9-VI-1961 (E. L. Kessel, 2 males, 2nd instar nymphs, DCR). Paradise Valley, Tehachapi Mts. 7-VIII-1931 (E. R. Tinkham, 2 males, 1 female, paratypes, UMMZ, ANSP). SAN BERNARDINO COUNTY: Lake Arrowhead, 14-VI-1958 (P. Paige, 1 immature female, UCD).

DISCUSSION. We have not collected this species which is the southernmost known species of the genus. Coloration of all of the specimens at hand is light brown without any dark patterns. Outer pagina of hind femur with slightly darker brown, longitudinal stripe, very broad basally.

Idionotus tuolumne Hebard
(Figs. 28G, 28H, 28I, 29 Table 8)

1934. *Idionotus tuolumne* Hebard, Trans. Amer. Ent. Soc., 60: 50, Pl. 3, Figs. 8, 12.

Type locality: El Portal, Mariposa County, California, 2,000 feet elevation.

DIAGNOSIS. Distribution (Fig. 29). Size small for genus. Nearest relative *I. incurvus*. Cercus of male tapering and slightly incurved (Fig. 28G). Some specimens possess a small internal tooth. Tenth tergum of male less broad than that of *I. incurvus*, corners well produced, subgenital plate deeply incised. Cercus of female (Fig. 28I) incurved. Tenth tergum of female (Fig. 28I) with median depression to which the supra-anal plate is fused, corners produced. Subgenital plate of female rather well incised.

DESCRIPTION OF SPECIES. This species was quite adequately described by Hebard (1934) with the exception of the titillators which are described below. He apparently had no male specimens with an inner tooth of the cercus such as shown by males which we have seen which were collected very near to the type locality.

Basal 1/5 of arms of titillators swollen, thence with arms hairlike (Fig. 28H), over 2 mm long and extending beyond tip of abdomen. Arms of titillators extending at nearly right angles from base. Ventral "tongue" of male genitalia broad, apex broadly rounded and extending slightly beyond apex of swollen base of arms of titillators. Surface of tongue minutely tuberculate.

RECORDS. CALIFORNIA: MARIPOSA COUNTY: Coulterville, (1/2 mi. north Mary Harrison Mine) 11-VIII-1957, 1,900 feet elevation (T. J. Cohn, 1 female, UMMZ). El Portal, 1/2 mi. W., 20-VII-1957, 2,000 feet elevation (T. J. Cohn, 1 male, UMMZ). Mariposa, 11-12 mi. SW., 10-VIII-1957, 1,250-1,350 feet elevation (T. J. Cohn, 1 male, 1 female, UMMZ). Mt. Bullion, 2.2 mi. E., 11-VIII-1957, 2,500 feet elevation (T. J. Cohn, 1 female, UMMZ). Planada, 14 mi. NE., 10-VIII-1957, 1,200 feet elevation (T. J. Cohn, 3 males, 2 females, UMMZ). Wawona, 6-VIII-1937, 4,500 feet elevation (Rehn, Pate, Rehn, 2 females, ANSP).

DISCUSSION. This species has not been collected by us, but according to the notes accompanying the original description it occupies a habitat similar to that of other species.

Idionotus incurvus Rentz and Birchim, new species
(Figs. 28D, 28E, 28F, 29, Table 8)

DIAGNOSIS. Distribution (Fig. 29). Nearest relative *I. tuolumne* Hebard. Incision of supra-anal plate (Fig. 28D, 28F) broader than in that species; titillators (Fig. 28E) of male genitalia with arms divergent, shorter than in *I. tuolumne*, tongue broad basally, narrowing mesad, apex bulbate, spined; cerci slender, elongate, spine-like (Fig. 28D), distal half greatly turned inward; subgenital plate with V-shaped incision in male, subgenital plate of female deeply incised.

TYPE LOCALITY; 8 miles east of Oakdale on Hwy. 120, Stanislaus County, California.

DEPOSITION OF TYPES. Holotype and allotype to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. Size medium for genus, form moderately robust. Head moderately deep, fastigium of vertex broad, not sulcate, slightly less than twice width of first

antennal joint. Frontal costa with minute transverse sulcus extending from base of antennae; face slightly punctate.

Pronotum moderately long for genus, disk flattened. Lateral carinae moderately prominent, divergent on anterior margin of disk, converging anterior to median portion of disk. Transverse sulci of pronotum weakly defined, two in number, anterior one nearly straight, bowed slightly to posterior in median portion; posterior sulcus with lateral arms beginning from lateral carinae at middle of pronotum, thence abruptly directed posterior to median carina of pronotum. Median carina of pronotum only faintly indicated by thin line. Lateral lobes of pronotum strongly declivent, deep, posterior margin but slightly concave. Tegmina exposed for distance less than half length of pronotum, stridulatory vein not exposed. Main stridulatory veins strong with many veinlets on distal portion of tegmina. Prosternum unarmed.

Genicular lobes all unarmed. Anterior coxa with spine half as broad basally as length of spine itself, directed anteriorly. Femora and tibiae with spines as in Table 8. Posterior femora with minute dorsal punctures on anterior half. Fore tibia with 3 spines on anterior dorsal margin, ventral margin with 6 spines. Middle tibia with 2 spines on anterior dorsal margin, 4 spines on posterior margin. Ventral surface with 6 spines on anterior and posterior margin. Posterior tibia with many spines on corner and external margins. Posterior tibia with 2 apical spines on ventral margin, 2 shorter spines on dorsal margin.

Tenth tergum broadly excavate (Fig. 28D), lateral margins triangular, pointed projections with their margins slightly incurved. Cerci long (Fig. 28D), distal half nearly at right angles to basal portion; cerci broadest basally, thence decreasing in diameter to apex which is indicated as a very fine spine. Subgenital plate broad, with V-shaped median incision to depth of approximately 1/5 length of plate itself; styles of subgenital plate single-segmented, slightly longer than length of lateral margin of V-shaped incision.

Titillators (Fig. 28E) joined at base and for a distance of 1/3 length of arms of titillators, thence diverging for distance no greater than half diameter of one titillator arm; ventral part of arms with apices acute. Triangular projection above titillators with very broad unspined base, narrowing greatly mesad to bulbate apex which bears moderately stout spines.

Coloration brown, darker dorsally and with dark brown or blackish portion along lateral carinae of pronotum and on posterior half of outer face of hind femora. Eyes dark brown.

ALLOTYPE FEMALE. Differs from male in following characters: tegmina projecting as two pads, slightly overlapping for distance less than 1/2 length of pronotum; all veins of tegmina heavy. Tenth tergum with broad U-shaped incision. Cerci long, incurved in distal portion, not to as great an extent as in male; apex of cerci sharply pointed. Subgenital plate deeply incised for distance approximately half length of plate itself. Ovipositor nearly straight, slightly curved upward, apex sharp, unserrated; ovipositor shorter than the length of the posterior femora, slightly longer than half that length. See Table 8 for measurements.

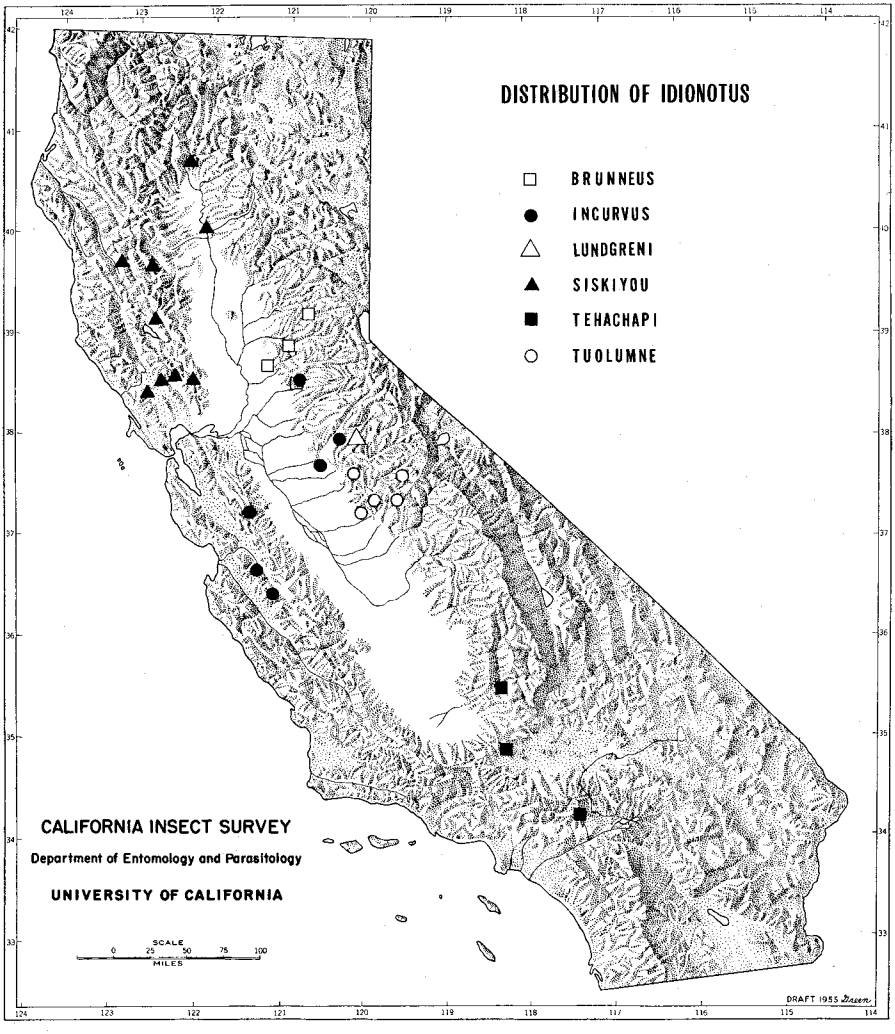

Fig. 29. Known distribution of *Idionotus* in California.

DERIVATION OF NAME. This names describes the abrupt incurving of the cerci of this species.

SPECIMENS STUDIED. 23; holotype, allotype, 21 paratypes.

RECORDS. CALIFORNIA: EL DORADO COUNTY: Old Shingle Road, between Shingle Springs and Latrobe, 22-X-1965 (D. C. Rentz, 4 females, DCR). SAN BENITO COUNTY: Cienaga and Lime Kiln Rds., 2 mi. W. jct., 18-IV-1964, matured 7-VIII-1964 (D. C. & K. A. Rentz, 2 males, 2 females, DCR). Pinnacles National Monument, 30-V-1960 (D. C. Rentz, 1 male, DCR); Chalone Camp, 18-IV-1964, matured 6-VIII-1964 (D. C. & K. A. Rentz, 1 female, DCR). SANTA CLARA COUNTY: Mt. Hamilton, 24-V-1961, matured VII-1961 (D. C. Rentz, 1 female, DCR), 13-VI-1964, matured VIII-1964 (D. C. & K. A. Rentz, 2 females, DCR), 3-X-1964 (D. C. & K. A. Rentz, 1 female, DCR), 17-VIII-1965 (D. C. & K. A. Rentz, 2 females, DCR). STANISLAUS COUNTY: Oakdale, 8 mi. E., on Hwy. 120, 8-V-1961, matured 28-VII-1961 (D. C. Rentz, 3 males, 3 females, includes holotype and allotype, DCR, ANSP). TUOLUMNE COUNTY: Columbia, 29-VIII-1963 (W. J. Turner, 1 male, DCR).

DISCUSSION. *I. incurvus* Rentz and Birchim, new species, is commonly collected in the spring of the year in grasslands. Large numbers of nymphs can be taken to the laboratory and reared to maturity. Like other members of the genus, this species inhabits grassy, open areas of oak woodlands. Specimens can be collected at night on little-traveled roads.

Genus *Steiroxys* Herman

1874. *Steiroxys* Herman, Verhandl. der k. k. Zool.-Bot. Gesellsch. Wein, 24: 207.

Type of the genus: *Steiroxys trilineatus* (Thomas) by monotypy.

Members of this diurnal genus have always been baffling to systematists at the specific level. Great variation in the shape of the cerci occurs even among individuals from a single locality. Only study of large series will show the true relationships. It is further believed that study of the titillators (Fig. 26J) of the male genitalia and the calling songs of males will be the key to the solution of the problem.

The authors have what appear to be several species from northern California. One species from near Bartle, Siskiyou County was found to be quite common in green, open meadows. Groups of specimens of both sexes could be easily found at the bases of large composite plants (probably Mule's Ears,

Wyethia). The cerci of most of the male specimens were different from any yet described. They seem to be reminiscent of the antlers of deer and are greatly decurved. Another species, likely *S. borealis* Scudder, was found in the Cedar Pass area of Modoc County, California. Specimens were found abundant in sagebrush *(Artemisia tridentata)* on south facing slopes. They were rather easy to collect as they made little effort to escape or even to stop stridulating.

Steiroxys borealis Scudder

1894. *Steiroxys borealis* Scudder, Canad. Ent., 26: 182.

Type locality: Northern California. Lectotype here designated: male from original Scudder series, in Museum of Comparative Zoology, Harvard, drawn by Caudell (1907, Fig. 94).

Steiroxys pallidipalpus (Thomas)

1872. *Decticus pallidipalpus* Thomas, Ann. Rept. U. S. Geol. Surv. Terr., Pt. 5: 442.
1876. *Decticus pallidipalpus* Thomas, Proc. Davenp. Acad. Nat. Sci.,I: 262.
1901. *Decticus pallidipalpus* Scudder, Index to North American Orth.: 95.
1894. *Steiroxys pallidipalpus*, Scudder, Canad. Ent., 26: 182.
1923. *Steiroxys hendersoni* Caudell, Proc. U. S. Nat. Mus., 62: 1, Fig. 1. Type locality: Dry Lake, Utah.
1934. *Steiroxys pallidipalpus*, Hebard, Trans. Amer. Ent., Soc., 60: 54.

Type locality: Copenhagen, Utah.

Steiroxys strepens Fulton

1930. *Steiroxys strepens* Fulton, Ann. Ent. Soc. Amer., 23(4): 627, Fig. 2.

Type locality: Top of Jackson's Hill, 6 miles north of Corvalis, Benton County, Oregon.

Steiroxys trilineata (Thomas)

1870. *Thamnotrizon trilineatus* Thomas, Proc. Acad. Nat. Sci. Phila.: 76.
1872. *Decticus trilineatus*, Thomas, Ann. Rept. U. S. Geol. Surv. Terr., Pt. 5: 443.
1893. *Dectes trilineatus*, Bruner, Publ. Nebr. Acad. Sci., 3: 31.

1900. *Steiroxys trilineata*, Herman, Verhandl. der k. k. Zool.-Bot. Gesellsch. Wein, 24: 207.

Type locality: Southeast Colorado (likely incorrect, see Hebard, 1934: 54).

Genus *Clinopleura* Scudder

1876. *Steiroxys*, (in part) Scudder, Ann. Report Chief Eng.: 500.
1894. *Clinopleura* Scudder, Canad.Ent. 26: 182.

Type of the genus: *Clinopleura melanopleura*, by monotypy.

This genus consists of similar looking species distinguished from each other chiefly by genitalic structures. *Clinopleura* is found only in California west of the crest of the Sierra Nevada. Specimens are active by day but appear to be most active at night. They inhabit open grasslands and some are associated with tarweed *(Hemizonia, Holocarpha)*. This may be only superficial because in certain areas tarweed is the only large, green, succulent plant present in late summer. Specimens may take refuge in it to avoid dessication.

Some difficulty has arisen trying to identify correctly *C. minuta* Caudell. Apparently two morphological kinds may be found at a single locality. One is large with cerci and titillators differently shaped from those of the smaller form. Only additional field work with large series from single localities will clarify the situation.

As an aid to identification, the cerci and titillators of all species and of both forms of *C. minuta* are presented below. Locality data are also given.

Key to the Species of *Clinopleura*

(The measurements given below are averages of numbers of specimens; some individuals may not seem to fit the measurements perfectly.)

1. Size large (pronotum 5-7 mm long). Hind femur 24 mm or more in length. Cercus of male greatly incurved (Figs. 30C, 30H, if not incurved then swollen basally (Fig. 30A).....2

   Size much smaller (pronotum 5 mm or less in length). Hind femur 23 mm or less in length. Cercus of male not as above, (Figs. 30E, 30J), relatively straight, apex slightly incurved.....4

2. Cercus of male short, not greatly incurved, apex tipped with black (Fig. 30A). Titillators of male genitalia (Fig. 30B).....*Clinopleura flavomarginata* Scudder (p. 148)

   Cercus of male longer, distinctly incurved, black tip more extensive.....3

3. Cercus of male gracefully curved inward (Fig. 30D). Titillators of male genitalia (Fig. 30C) with apex relatively blunt.....*Clinopleura melanopleura* Scudder (p. 150)

   Cercus of male abruptly curved inward (Fig. 30H). Titillators of male genitalia (Fig. 30G) with apex more attenuate.....*Clinopleura infuscata* Caudell (p. 149)

4. Size relatively larger (Table 9). Cercus of male attenuate, often with a "crystalline," subapical tooth (Fig. 30E). Titillators of male genitalia (Fig. 30F) with an elongate apex, not greatly curved inward.....*Clinopleura minuta* Caudell (larger form) (p. 150)

   Size relatively smaller (Table 9). Cercus of male more blunt, with or without subapical tooth (Fig. 30J). Apex of titillators (Fig. 30I) more extensively curved inward.....*Clinopleura minuta* Caudell (smaller form) (p.150)

Table 9. Size variation in species of *Clinopleura*. The size (N) is listed first followed by the range (R). Means (M) are based on original values. All measurements are in millimeters as measured with an ocular micrometer.

Species		*flavomarginata*		*infuscata*		*melanopleura*
		Male	Female	Male	Female	Male
Total length	N	1	2	5	5	1
	R	20	23-24	21-24	20-26	24
	M		23.50	21.20	23.20	
length pronotum	N	1	2	5	5	1
	R	6.9	7.2-7.6	5.6-6.7	5.5-6.3	7
	M		7.4	5.92	5.84	
width pronotum	N	1	2	5	5	1
	R	2.6	2.5	2-2.3	2-2.1	3
	M		2.5	2.16	2.02	

Species		*flavomarginata*		*infuscata*		*melanopleura*
		Male	Female	Male	Female	Male
length posterior femur	N	1	2	5	5	1
	R	26	27.5-28	23-26	23-25	26
	M		27.75	24	23.90	
length ovi-positor	N		2		5	
	R		21.5		15-18	
	M		21.5		17	

Species		*minuta* (large)		*minuta* (small)	
		Male	Female	Male	Female
Total length	N	5	5	4	5
	R	19-22	20-23	16-18	17-19
	M	19.20	21.40	15.75	18.0
length pronotum	N	5	5	4	5
	R	4.6-6	5.3-5.8	4.4-5	4.3-5.3
	M	4.82	5.56	4.50	4.78
width pronotum	N	5	5	4	5
	R	1.8-1.9	1.6-2	1.3-1.5	1.2-1.4
	M	1.86	1.80	1.42	1.30
length posterior femur	N	5	5	4	5
	R	20-23.5	21-25	20-21	20-23
	M	21.40	23	20.50	21.60
length ovi-positor	N		5		5
	R		15-18		13-15
	M		17.0		14.40

Clinopleura flavomarginata Scudder
(Figs. 30A, 30B, Table 9)

1900. *Clinopleura flavomarginata* Scudder, Canad. Ent., 32: 332.

Type locality: Ceres, Stanislaus County, California.

RECORDS. CALIFORNIA: TULARE COUNTY: Lindsay, 21-VI-1910 (J. R. Horton, 1 male, on orange, USNM); 11-VIII-1910

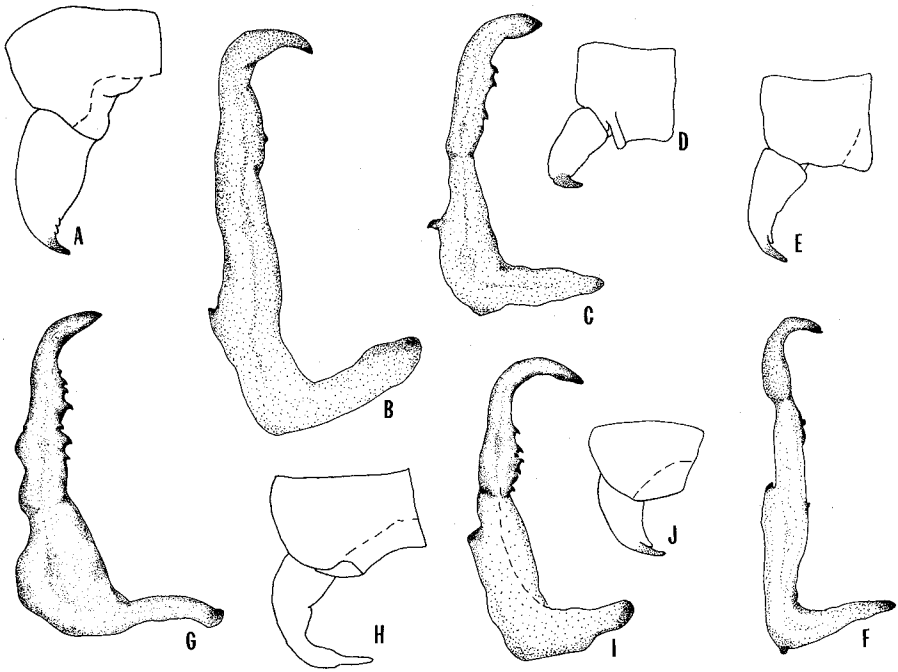

Fig. 30. Terminalia and titillators of males of *Clinopleura*. A, left cercus and portion of last abdominal segment, B, titillators of male *C. flavomarginata*. C, titillator. D, left cercus and portion of last abdominal segment *C. melanopleura*. E, left cercus and portion of last abdominal segment. F, titillator, *C. minuta*, large form. G, titillator, H, left cercus and portion of last abdominal segment *C. infuscata*. I. titillator, J, left cercus and portion of last abdominal segment *C. minuta*, small form.

(J. R. Horton, 2 females, USNM). Strathmore, 23-V-1910 (J. R. Horton, 1 female nymph, on orange, USNM).

Clinopleura infuscata Caudell
(Figs. 30G, 30H, Table 9)

1907. *Clinopleura melanopleura* variety *infuscata* Caudell, Proc. U. S. Nat. Mus., 32: 401.

Type locality: Valley Springs, Calaveras County, California.

RECORDS. CALIFORNIA: FRESNO COUNTY: Mercy Mines, near Mercy Hot Springs, 16-VIII-1958 (D. C. Rentz, C. Cushner, 2 males, 2 females, DCR), 26-VIII-1962 (D. C. Rentz, E. W. Kirschbaum on tarweed *Holocarpha virgata* (Gray), 4 males, 22 females, DCR). MERCED COUNTY: Dos Palos, 25-VI-1937 (C. C. Wilson, 1 male, 1 female, USNM). SAN JOAQUIN COUNTY: Tracy, 20-VII-1931 (C. C. Wilson, 1 male, 1 female, USNM).

Clinopleura melanopleura Scudder
(Figs. 30C, 30D, Table 9)

1876. *Steiroxys melanopleura* Scudder, Ann. Rept. Chief, Eng., 500.
1894. *Clinopleura melanopleura*, Scudder, Canad. Ent. 26: 182.

Type locality: Los Angeles (or) Santa Barbara Counties, California (Label on Scudder's unique male type).

RECORD. CALIFORNIA: LOS ANGELES COUNTY: Los Angeles (1 male, USNM).

Clinopleura minuta Caudell (both forms)
(Figs. 30E, 30F, 30I, 30J, Table 9)

1900. *Clinopleura flavomarginata* Scudder (in part), Canad. Ent. 32: 332.
1907. *Clinopleura minuta* Caudell, Proc. U. S. Nat. Mus., 32: 402.
1912. *Clinopleura minuta*, Caudell and Hebard, Proc. Acad. Nat. Sci. Phila: 167.

Type locality: Calaveras County, California.

RECORDS. CALIFORNIA: COLUSA COUNTY: Arbuckle, 25-VII-1918 (T. D. Urbahns, 2 males, 2 females, USNM). CONTRA COSTA COUNTY: Antioch, 22-VII-1960, 5-VIII-1965 (D. C. Rentz, 3 males, DCR). Mt. Diablo State Park, Juniper Camp, 13-VIII-1965, 2,900 feet elevation (D. C. and K. A. Rentz, 1 male, 4 females, DCR). Russelmann Park, 16-V-1959, 29-VII-1961 (D. C. Rentz, 1 male, 1 female, DCR). EL DORADO COUNTY: Old Shingle Road, between Shingle Sprs. and Latrobe 22-X-1965 (D. C. Rentz, C. W. O'Brien, 4 males, 21 females, DCR). FRESNO COUNTY: Winkler, 25 Mi. E., 1-IX-1965 (L. B. O'Brien, 2 males, 5 females, DCR). LAKE COUNTY: Clear Lake, 27-VI-1961 (D. C. Rentz, J. R. Helfer, 3 females, DCR, JRH). Lake Pillsbury, 26-VII-1961 (J. R. Helfer, 1 male, JRH); Oak Flat Camp, 20-VI-1964, matured VIII-1964 (D. C. and K. A. Rentz, 1 male, DCR). Oasis, 5 mi. W., 27-VII-1961 (D. C. Rentz, 1 female, DCR). MARIN COUNTY: Alpine Lake, 1 mi. N., 3-VII-1960 (F. J. Radovsky, R. Garcia, 1 male,

DCR). Lake Lagunitas, 6-VII-1958 (D. C. Rentz, 1 male, DCR). Novato, VII-1962, 10-VII-1965 (D. C. Rentz, 1 male, 6 females, DCR). MARIPOSA COUNTY: Mormon Bar, 6 mi. E., 4-VII-1960 (G. I. Stage, R. R. Snelling, 1 male, DCR). MENDOCINO COUNTY: Willets, 23-VII-1958 (J. R. Helfer, 1 male, DCR). MONTEREY COUNTY: Monterey, 1925, (J. B. Parker, 1 female, USNM). NAPA COUNTY: Pope Valley 9 mi. SE., on Chiles-Pope Valley Rd., 20-VII-1965 (D. C. Rentz, 4 males, 3 females, DCR). SANTA CLARA COUNTY: Mt. Hamilton, 3-X-1964, 17-VIII-1965 (D. C. Rentz, 2 males, 8 females, DCR). TRINITY COUNTY: Ruth, 2 mi. S., 19-IX-1962 (G. M. Buxton, F. L. Blanc, 8 males, 10 females, CDA). TUOLUMNE COUNTY: Columbia, 29-VIII-1963 (W. J. Turner, 1 female, DCR). La Grange, 12.4 mi. E., 19-VIII-1962 (H. B. Leech, 1 female, CAS). YOLO COUNTY: Davis, VIII-1937 (J. J. Dubois, 1 male, CIS).

Genus *Metrioptera* Wesmael

1835. *Micropteryx* Stephens (in part), Ill. Brit. Ent., 6: 12.
1838. *Metrioptera* Wesmael, Bul. Acad. Sci. Bruxelles, 5: 592.
1852. *Platycleis* Fieber (in part), Lotos, 3: 149.
1853. *Metrioptera* Fischer, (in part), Orth. Eur.: 273.
1906. *Chelidoptera* Wesmael (in part), Kirby Syn. Cat. Orth., 21: 203.
1908. *Metrioptera*, Caudell, Gen. Insect., 72: 30.
1941. *Roeseliana* Zeuner, Trans. Roy. Ent. Soc. Lond., 91: 46.

Type of the genus: *Gryllus brachypterus* Linnaeus

Although with many species in Europe, *Metrioptera* is represented in the Nearctic Region by only two species, one of which is adventive. The genus shows some similarities with *Decticita*.

Metrioptera roeselii (Hagenbach)
(Fig. 1A, 2A, 2B)

1822. *Locusta roeselii* Hagenbach, Symb. Faun. Inst. Helv.: 39, Fig. 24.
1846. *Decticus sinuatus* Fischer-Waldheim, Nouv. Mem. Soc. Imp., Moscou, 8: 170, Pl. 29, Fig. 6.
1853. *Platycleis roeselii*, Brunner, Prodr. eur. Orth.: 359.
1899. *Platycleis raia* Burr, Ent. Rec., :19.
1906. *Chelidoptera roeselii intermedia* Zacher, Ent. Jahrb.: 176.
1917. *Platycleis roeselii* variety *prisca* Zacher, Geradfl. Deutschl.: 233.
1922. *Metrioptera roeselii*, Chopard, Faune de France, 3: 84.

1941. *Roeseliana roeselii*, Zeuner, Trans. Roy. Ent. Soc. Lond., 91(1): 46.

Type locality: Basle, Switzerland.

Distribution. Spain, France, England, central, east and southeast Europe, Mugadshany (southern Ural Mts.), Tomsk, Siberia. Introduced into southern Canada, see Kevan (1961).

M. roeselii was first recorded from North America by Urquhart and Beaudry (1953) from Montreal and Ville St. Laurent. It is native to central and southern Europe and western Siberia where it is normally brachypterous. It has spread as far south as southern New York and likely occurs in Pennsylvania. The species occurs in both a macropterous and brachypterous phase.

Vickery (1965) noted the possibility that macropterism occurs as a dispersal phase, even though almost all of the first recorded specimens were brachypterous. Recent data shows a decrease in the macropterous condition which reached a peak in 1959. Since 1959 macropterism has steadily decreased.

Metrioptera sphagnorum (F. Walker)

1869. *Decticus sphagnorum* F. Walker, Cat. Derm. Salt. Brit. Mus., 2: 258.
1906. *Orchelimum sphagnorum*, Kirby, Syn. Cat. Orth., 2: 274.
1907. *Idionotus brevipes* Caudell, Proc. U. S. Nat. Mus., 32: 396. Fig. 81. Type locality: Arctic America.
1907. *Platycleis fletcheri* Caudell, Proc. U. S. Nat. Mus., 32: 403, Fig. 87. Type locality: Calgary, Assiniboia, Canada.
1941. *Sphagniana sphagnorum*, Zeuner, Trans. Roy. Ent. Soc. Lond., 91: 43.

Type locality: St. Martin's Falls, Hudson's Bay. (Martin Falls Trading Post on the Albany River, Northern Ontario, Canada).

Records of this species are not all common in the literature. Caudell (1907) lacked series of specimens from single localities and described the male as *Idionotus brevipes* and the female as *Platycleis fletcheri*. It lives in the grassy areas adjacent to sphagnum bogs.

Genus *Platycleis* Fieber

1853. *Platycleis* Fieber, Lotos, 3: 149.

1906. *Chelidoptera* Wesmael (in part), Bull. Acad. Brux., 5: 591.

Type of the genus: *Decticus intermedius* Serville.

Platycleis is widely distributed in Europe. The species are quite similar and possess a comparatively short, blade-like ovipositor. Zeuner (1941) split the genus into an array of many genera. His view is not held by many authorities today. Only one species of the genus is found in the Nearctic Region and that one was introduced from Europe.

Platycleis tessellata (Charpentier)
(Figs. 1B, 2C, 2D)

1825. *Locusta tessellata* Charpentier, Hor. Ent.: 121, Pl. 3, Fig. 4.
1922. *Metrioptera tessellata*, Chopard, Faune de France, 3: 83.
1941. *Tessellana tessellata*, Zeuner, Trans. Roy. Ent. Soc. Lond., 91: 36.

Type locality: "Gallia-meridionalis, Luisitania."

Distribution. Canaries, Morocco, Algeria, Spain, Portugal, south France, northwest Germany, Italy, Sardinia, Balkan Peninsula, south Russia, Turkey, Palestine. Introduced into western California. See Rentz (1963).

This species was introduced into California probably in the late 1940's or early 1950's. It normally inhabits the Circum-Mediterranean region of Europe. It was first collected near Placerville, California and was thought to have been accidentally introduced in nursery stock. Rentz (1963b) gave additional distributional data on the species in California. *P. tessellata* is definitely established in the Sierra foothills of California and seems to be extending its range at a fairly rapid rate.

P. tessellata is a fully alate species in both sexes. No brachypterous form is known. The species is diurnal in habits, individuals commonly taken in stridulation during the day. *P. tessellata* is most commonly found in grassy clearings in the foothills where there is moisture enough to maintain it. It does not extend very far into the hot, dry Central Valley. Females oviposit in grass stems (Rentz, 1963b), the eggs being cylindrical and placed in linear sequence in the hollow stem. The female frequently chews a spot on the stem facilitating insertion of the ovipositor. Eggs hatch in spring and nymphs are adult by the middle of June.

Genus *Decticita* Hebard

1907. *Eremopedes* (in part only), Caudell, Proc. U. S. Nat. Mus. 32: 336.
1939. *Decticita* Hebard, Trans. Amer. Ent. Soc., 65: 179.

Type of the Genus: *Decticita brevicauda* (Caudell) by original designation.

The genus *Decticita* is now known to include three species of diurnal katydids which reach maturity in spring. The genus shows strong affinities with the European genera *Metrioptera* and *Platycleis* and is the only native Nearctic genus with a short, blade-like ovipositor.

Decticita is confined to central California west of the crest of the Sierra Nevada. Any green area with grass and scattered oaks in the range might be expected to harbor these katydids. The short occurrence from mid-spring to early summer probably accounts for the scarcity of specimens in collections. Apparently the members of the genus are not tolerant of warmer weather and have largely disappeared by mid-July.

The short blade-like ovipositor has been shown (Rentz, 1963) to be used to place the cylindrical egg within the hollow stems of various grasses. Young nymphs are colored differently from last instar nymphs and from adults. They are deep brown to black and possess a white streak on the posterior portion of the lateral lobe of the pronotum. Their activity suggests mimicry of certain ichneumonoid wasps which are found in the same habitat.

Key to the Species of *Decticita*

1. Cercus of male elongate, more than 2 1/2 times longer than broad (Fig. 31A). Titillators of male genitalia expanded at base; arm elongate, narrow, apex curved inward, spined (Fig. 31B). Subgenital plate of male not greatly produced. Small species. Distribution mainly Sierran (Fig. 32).....*Decticita yosemite* Rentz and Birchim, new species (p. 155)

Without the above combination of characters.....2

3. Pronotum with distinct lateral carinae, especially in males. Cercus of male robust, incurved (Fig. 31E). Distribution southern (Fig. 32).....*Decticita balli* Hebard (p. 157)

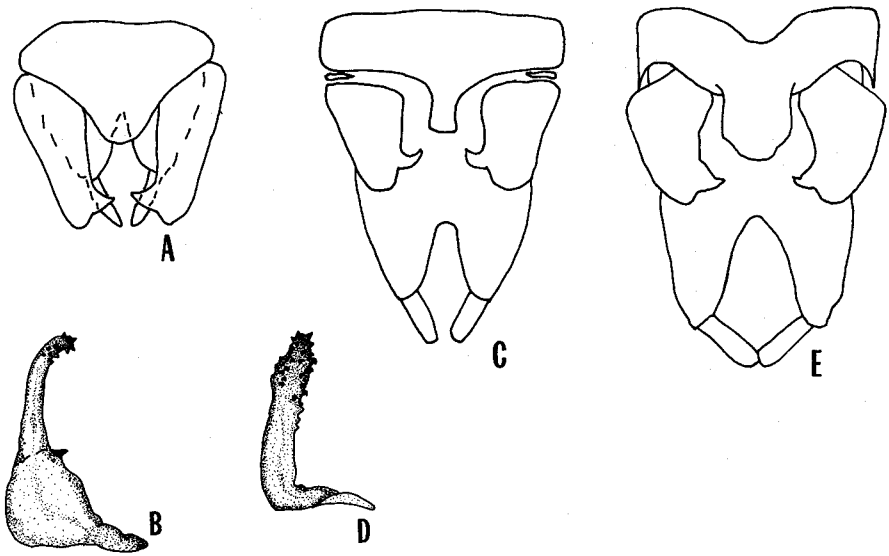

Fig. 31. A, terminalia and right portion of titillator (B.) of male *Decticita yosemite*. C, terminalia and right portion of titillator (D.) of male *D. brevicauda*. E, terminalia of male *D. balli*.

Pronotum without any indications of lateral carinae. Cercus of male robust, not as greatly incurved (Fig. 31C). Titillators (Fig. 31D). Distribution northern (Fig. 32).....*Decticita brevicauda* (Caudell) (p. 158)

Decticita yosemite Rentz and Birchim, new species
(Figs. 31A, 31B, 32, Table 10)

1939. *Decticita balli* Hebard, (in part), Trans. Amer. Ent. Soc., 65: 183.
1939. *Decticita brevicauda*, Hebard, (in part), Op. Cit.: 181.

DIAGNOSIS. Size small. Pronotum with slight to no indication of lateral carinae. Cercus of male (Fig. 31A) elongate, straight, more than twice as long as broad. Titillators of male genitalia (Fig. 31B) with base broad, arm very elongate, apex spined, incurved.

Type locality: Near Rush Creek Camp, on California State Highway 120, Tuolumne County, California, 4,500 feet elevation.

DEPOSITION OF TYPES. The holotype and allotype are to be deposited in the Academy of Natural Sciences of Philadelphia.

HOLOTYPE MALE. Size small for genus, form slender. Vertex of head produced, not to as great an extent as in other species. Eye dorso-ventrally elongate. First antennal segment less than half as broad as apex of fastigium; second segment more than half the length of the third.

Pronotum as in other species with following exceptions: more produced, hood-like in anterior median portion, apex more broadly rounded. Median and lateral carinae slightly indicated. Tegmina nearly completely concealed beneath pronotum. Prosternum unarmed.

All femora spineless. Fore tibia with 3 widely spaced, dorsal spines on posterior margin. Ventral portion of fore and middle tibia with 6 spines on internal and external margin. Dorsum of median tibia with 2 spines on anterior margin, 4 spines on posterior margin. Hind tibia with 2 apical spurs, the inner spur slightly longer than external spur.

Abdomen slender. Little indication of median carina. Tenth tergum broadly produced. Cercus with shaft elongate, cylindrical, more than 2 1/2 times longer than broad. Apex of cercus acutely rounded. Subapical tooth of cercus moderately produced. Subgenital plate of male much less produced than in other species, deeply incised in median portion. Styles of subgenital plate dorso-ventrally flattened, less than 1/4 as long as incision of plate.

Titillators of male genitalia with base broad, arm greatly elongate, apex curved inward, spined.

ALLOTYPE FEMALE. Differs from male in following apsects: abdomen more robust, subgenital plate not produced, broadly rounded. Cercus very elongate, cylindrical.

Coloration of this species is not very different from that of the other two species in the genus with the exception that the males are generally lighter brown.

DERIVATION OF NAME. This species is named with reference to Yosemite National Park, which is not far from the type locality.

SPECIMENS STUDIED. 168; holotype, allotype, 104 paratypes.

RECORDS. CALIFORNIA: CONTRA COSTA COUNTY: Russelmann Park, north slope of Mt. Diablo, 16-V-1959 (D. C. Rentz, 3 males, 4 females, DCR); 14-VI-1962 (D. C. Rentz, 1 male, DCR). EL DORADO COUNTY: Shingle Springs, 13-VI-1959 (W. E. Simonds, 1 male, CDA). FRESNO COUNTY: Tollhouse, 4 mi. E., 24-VI-1961 (R. R. Snelling, 1 female, DCR). PLACER COUNTY; North short Folsom, 30-V-1960 (F. L. Blanc, 1 female, DCR). STANISLAUS COUNTY: Oakdale, 8 mi. E., 6-V-1961 (D. C. Rentz, 1 male, DCR). TUOLUMNE COUNTY: Ackerson Meadow, 3 mi. S. Mather, 11-VI-1960 (D. C. Rentz, 1 male, 6 females, paratypes). Rush Creek Camp, California State Highway 120, 23-VII-1965, 4,500 feet elevation (D. C. Rentz, 60 males, 37 females, holotype, allotype, paratypes).

DISCUSSION. Because of the similarity of females of species in this genus, Hebard (1939) was unable to recognize his female specimens from Yosemite Valley as different from *D. balli*. Detailed examination of the specimens he recorded from Giant Forest, Sequoia National Park will likely reveal that they too represent *D. yosemite*.

D. yosemite was collected at the type locality in a small, moist meadow surrounded by oaks and pines. Sedges (*Carex* spp.) were found beyond the margins of the marsh in the center which was somewhat flooded. The katydids were restricted to the periphery and were found on a variety of different plants. Specimens were most common on tarweed (*Hemizonia* sp.) and were frequently found mating. Stridulation of this species sounds similar to that of other species with the possible exception that it is not as loud.

Decticita balli Hebard
(Figs. 31E, 32, Table 10)

1939. *Decticita balli* Hebard, Trans. Amer. Ent. Soc. 65: 181.

Type locality: San Luis Obispo, California.

Hebard (1939) confused this species with *D. yosemite* herein described. Additional localities are presented below.

RECORDS. CALIFORNIA: SAN BENITO COUNTY: Hernandez Valley, 18-V-1960 (D. C. Rentz, 3 males, DCR). Paicines, 5 mi. E., 13-V-1965 (D. C. Rentz, 1 male, DCR). Pinnacles National Monument, Chalone Camp, 13-VI-1964 (D. C. and K. A. Rentz, 16 males, 2 females, DCR). Pinnacles, 7 mi. N., 15-IV-1961 (D. C. Rentz, 4 males, 3 females, all nymphs, DCR). San Benito River, 4 mi. NW. Bitterwater, 13-V-1961 (D. C. Rentz, 26 males, 21 females, DCR). San Benito, 2 mi. W. 13-V-1961 (D. C. Rentz, 6 males, 1 female, DCR). TULARE COUNTY: California Hot Sprs., 3.6 mi. W., (G. I. Stage, R. R. Snelling, 6 males, 10 females, DCR).

Decticita brevicauda (Caudell)
(Figs. 31C, 31D, 32, Table 10)

1907. *Eremopedes brevicauda* Caudell, Proc. U. S. Nat. Mus., 32: 336, Fig. 39.
1939. *Decticita brevicauda*, Hebard, ~~Proc.~~ Trans. Amer. Ent. Soc., 65: 179.

Type locality: Napa County, California.

Hebard (1939) gave many localities for this species. Additional localities are listed below.

RECORDS. CALIFORNIA: COLUSA COUNTY: Wilbur Springs, 22-VI-1961 (D. C. Rentz, 2 males, DCR). MARIN COUNTY: Alpine Lake, 1 mi. N., 30-VII-1960 (F. J. Radovsky, R. Garcia, 2 females, DCR). Bon Tempe Lake, 18-V-1958, 24-VI-1958 (D. C. Rentz, 2 males, DCR). Cypress Ridge (Carson Ridge), 14-IV-1960 (D. C. Rentz, 1 male, 1 female, DCR). Lake Lagunitas, 6-VI-1958, 3-VI-1958, 24-VI-1959, 10-V-1959, (E. W. Kirschbaum, D. C. Rentz, 3 males, 3 females, DCR). Novato, 17-VI-1962, 10-VII-1965 (D. C. Rentz, 28 males, 11 females, DCR). Phoenix Lake, 2-V-1962, (K. Hale, 1 female, DCR). MENDOCINO COUNTY: Mill Creek Dam, near Ukiah, 9-VI-1959 (D. C. Rentz, 3 females, DCR). NAPA COUNTY: Conn Lake, 9-VI-1965 (D. C. Rentz, 1 male, DCR). Pope Valley, 9 mi. SE., on Chiles & Pope Valley Rd., 20-VI-1965 (D. C. Rentz, #11, 1 male, DCR). SANTA CLARA COUNTY: Mt. Hamilton, 27-V-1961 (D. C. Rentz, 17 males, 9 females, DCR). SONOMA COUNTY: Camp Meeker, 28-VII-1950 (H. H. Keifer, 1 male, CDA). Pine Flat Rd., 2-V-1964 (D. C. & K. A. Rentz, 2 nymphs, DCR).

DISCUSSION. Mating, oviposition and peculiar habits of the nymphs of this species have been discussed by the senior author (1963). The remarks likely apply to other species in the genus. *D. brevicauda* is the largest species in size in the genus and inhabits moist, green areas, especially where there is an abundance of tall grass.

Table 10. Size variation in species of *Decticita*. The size (N) of the sample is listed first followed by the range (R). Means (M) are based on original values. All measurements are in millimeters as measured with an ocular micrometer.

Species		*balli*		*brevicauda*		*yosemite*	
		Male	Female	Male	Female	Male	Female
Total length	N	5	5	5	5	5	5
	R	16-20	18-21	13-15	17-20	13-15	13-17
	M	17.2	19.6	14.2	18.2	12.9	15.8

Table 10 - Continued

Species		*balli*		*brevicauda*		*yosemite*	
		Male	Female	Male	Female	Male	Female
length pronotum	N	5	5	5	5	5	5
	R	5.7-6.3	6.1-6.7	5.2-5.9	5.5-6.5	4.8-5	4.8-5.1
	M	5.94	6.36	5.5	6.16	4.96	4.96
width pronotum	N	5	5	5	5	5	5
	R	2-2.5	2.5-3	1.8-2	2-2.7	1.3-2	2
	M	2.24	2.66	1.96	2.3	1.60	2
length posterior femur	N	5	5	5	5	5	5
	R	14-14	15.5-17	11-13.5	12-18	9-10	11-12
	M	13.2	16.4	12.5	16.5	9.7	11.7
length ovipositor	N		5		5		5
	R		5-6		5-6.5		5-6
	M		5.8		5.8		5.40

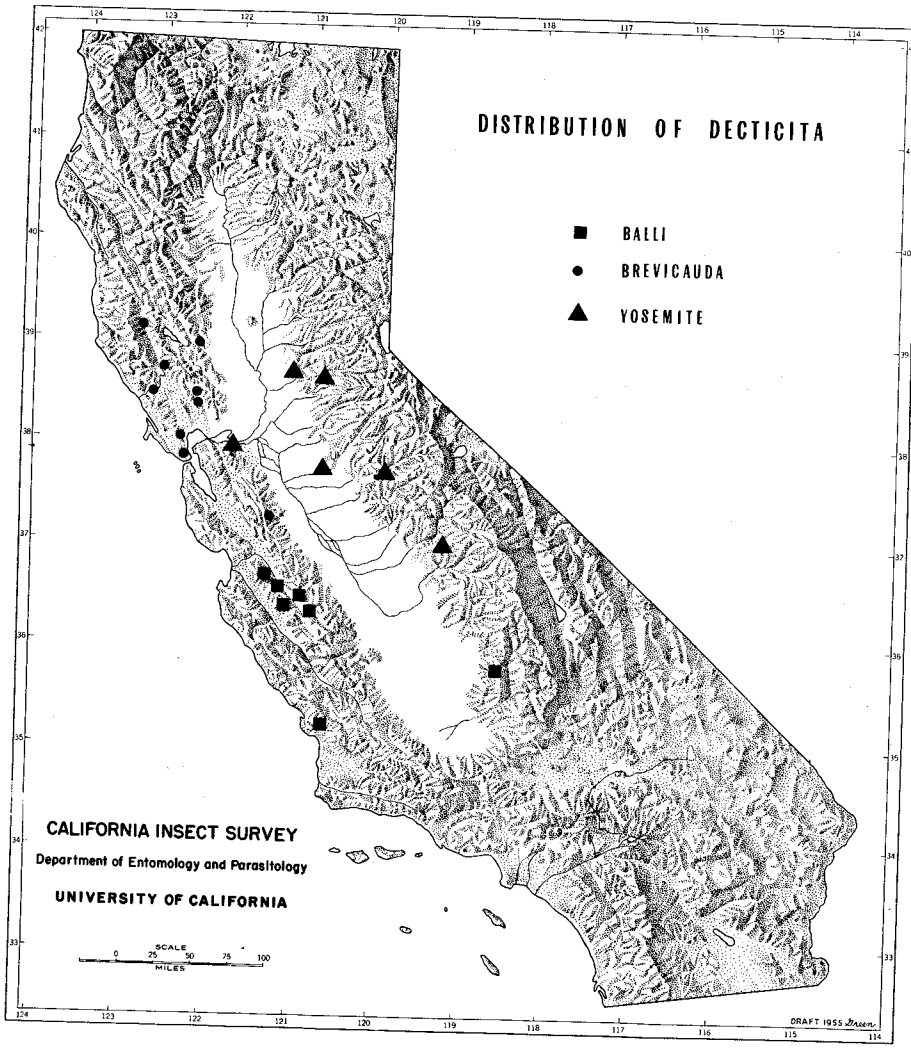

Fig. 32. Known distribution of *Decticita*.

TABULAR LIST OF THE GENERA AND SPECIES OF NEARCTIC DECTICINAE

The following list should prove helpful in arrangement of collections.

Genus *Capnobotes* Scudder

Capnobotes arizonensis (Rehn)
Capnobotes attenuatus Rentz and Birchim
Capnobotes bruneri Scudder
Capnobotes fuliginosus (Thomas)
Capnobotes granti Rentz and Birchim
Capnobotes occidentalis (Thomas)
Capnobotes spatulatus Rentz and Birchim
Capnobotes unodontus Rentz and Birchim

Genus *Neduba* Walker

Subgenus *Aglaothorax* Caudell

Neduba (Aglaothorax) diminutiva Rentz and Birchim
Neduba (Aglaothorax) gurneyi Rentz and Birchim
Neduba (Aglaothorax) morsei Caudell
Neduba (Aglaothorax) ovata armiger (Rehn and Hebard)
Neduba (Aglaothorax) ovata gigantea Rentz and Birchim
Neduba (Aglaothorax) ovata longicauda Rentz and Birchim
Neduba (Aglaothorax) ovata ovata (Scudder)
Neduba (Aglaothorax) ovata segnis (Rehn and Hebard)
Neduba (Aglaothorax) ovata tinkhamorum Rentz and Birchim

Subgenus *Neduba* Walker

Neduba (Neduba) carinata Walker
Neduba (Neduba) castanea Scudder
Neduba (Neduba) convexa Caudell
Neduba (Neduba) diabolica (Scudder)
Neduba (Neduba) macneilli Rentz and Birchim
Neduba (Neduba) sierranus (Rehn and Hebard)
Neduba (Neduba) steindachneri (Herman)

Genus *Cyrtophyllicus* Hebard

Cyrtophyllicus chlorum Hebard

Genus *Zacycloptera* Caudell

Zacycloptera atripennis Caudell

Genus *Plagiostira* Scudder

Plagiostira albonotata Scudder
Plagiostira gillettei Caudell
Plagiostira gillettei utahensis Tinkham
Plagiostira mescaleroensis Tinkham

Genus *Apote* Scudder

Apote notabilis Scudder
Apote robusta Caudell

Genus *Atlanticus* Scudder

Atlanticus americanus (Saussure)
Atlanticus americanus hesperus Hebard
Atlanticus calcaratus Rehn and Hebard
Atlanticus davisi Rehn and Hebard
Atlanticus dorsalis (Burmeister)
Atlanticus gibbosus Scudder
Atlanticus glaber Rehn and Hebard
Atlanticus monticola Davis
Atlanticus pachymerus (Burmeister)
Atlanticus testaceus (Scudder)

Genus *Pediodectes* Rehn and Hebard

Pediodectes ateloploides (Caudell)
Pediodectes bruneri (Caudell)
Pediodectes daedalus Rehn and Hebard
Pediodectes grandis (Rehn)
Pediodectes haldemani (Girard)
Pediodectes mitchelli (Caudell)
Pediodectes nigromarginatus (Caudell)
Pediodectes pratti (Caudell)
Pediodectes stevensonii (Thomas)
Pediodectes tinkhami Hebard

Genus *Anabrus* Haldeman

Anabrus cerciata Caudell
Anabrus longipes Caudell
Anabrus simplex Haldeman
Anabrus spokan Rehn and Hebard

Genus *Peranabrus* Scudder

Peranabrus scabricollis (Thomas)

Genus *Eremopedes* Cockerell

Eremopedes balli Caudell
Eremopedes balli pallidus Tinkham
Eremopedes bilineatus (Thomas)
Eremopedes covilleae Hebard
Eremopedes ephippiatus (Scudder)
Eremopedes ephippiatus sonorensis Tinkham
Eremopedes scudderi Cockerell
Eremopedes shrevei Tinkham
Eremopedes spinosa Hebard
Eremopedes subcarinatus (Caudell)

Genus *Inyodectes* Rentz and Birchim

Inyodectes pallida Rentz and Birchim

Genus *Oreopedes* Rehn and Hebard

Oreopedes cryptoptera Rehn and Hebard

Genus *Ateloplus* Scudder

Ateloplus coconino Hebard
Ateloplus herperus Hebard
Ateloplus luteus Caudell
Ateloplus minor Caudell
Ateloplus notatus Scudder
Ateloplus schwarzi Caudell
Ateloplus splendidus Hebard

Genus *Idiostatus* Pictet

Idiostatus aequalis (Scudder)
Idiostatus callimera Rehn and Hebard
Idiostatus elegans Caudell
Idiostatus fuscopunctatus (Scudder)
Idiostatus fuscus Caudell
Idiostatus herdersoni Hebard
Idiostatus hermanii (Thomas)
Idiostatus inermis (Scudder)
Idiostatus inyo Rehn and Hebard
Idiostatus magnificus Hebard
Idiostatus nevadensis (Scudder)
Idiostatus rehni Caudell
Idiostatus variegata Caudell
Idiostatus wymorei Caudell

Genus *Acrodectes* Rehn and Hebard

Acrodectes philopagus Rehn and Hebard

Genus *Idionotus* Scudder

Idionotus brunneus Scudder
Idionotus incurvus Rentz and Birchim
Idionotus lundgreni Rentz and Birchim
Idionotus similis Caudell
Idionotus siskiyou Hebard
Idionotus tehachapi Hebard
Idionotus tuolumne Hebard

Genus *Steiroxys* Herman

Steiroxys borealis Scudder
Steiroxys pallidipalpus (Thomas)
Steiroxys strepens Fulton
Steiroxys trilineata (Thomas)

Genus *Clinopleura* Scudder

Clinopleura flavomarginata Scudder
Clinopleura infuscata Caudell
Clinopleura melanopleura (Scudder)
Clinopleura minuta Caudell

Genus *Metrioptera* Wesmael

Metrioptera roeselii (Hagenbach)
Metrioptera sphagnorum (F. Walker)

Genus *Platycleis* Fieber

Platycleis tessellata (Charpentier)

Genus *Decticita* Hebard

Decticita balli Hebard
Decticita brevicauda (Caudell)
Decticita yosemite Rentz and Birchim

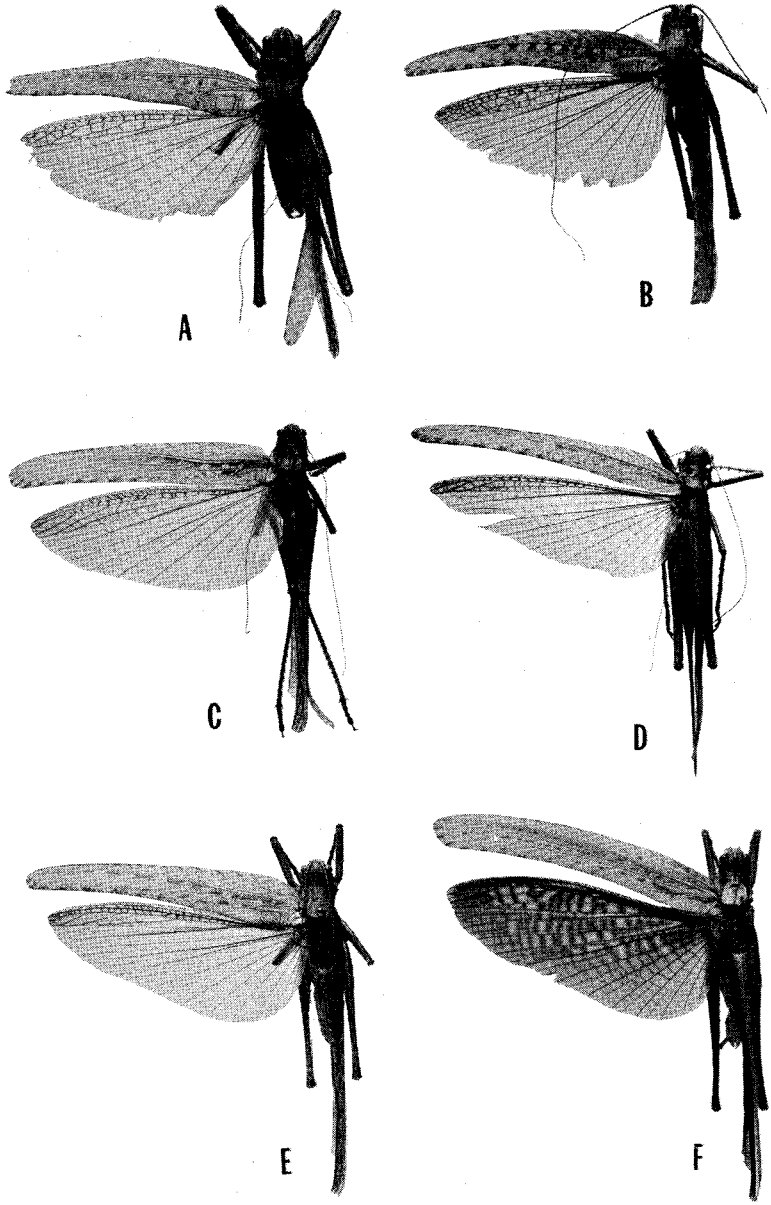

Fig. 33. Species of *Capnobotes* showing tegminal shape and degree of darkness of wing. A, *C. granti*. B, *C. spatulatus*, C, *C. occidentalis*, D, *C, attenuatus*, E,*C. bruneri*, F, *C. fuliginosus*.

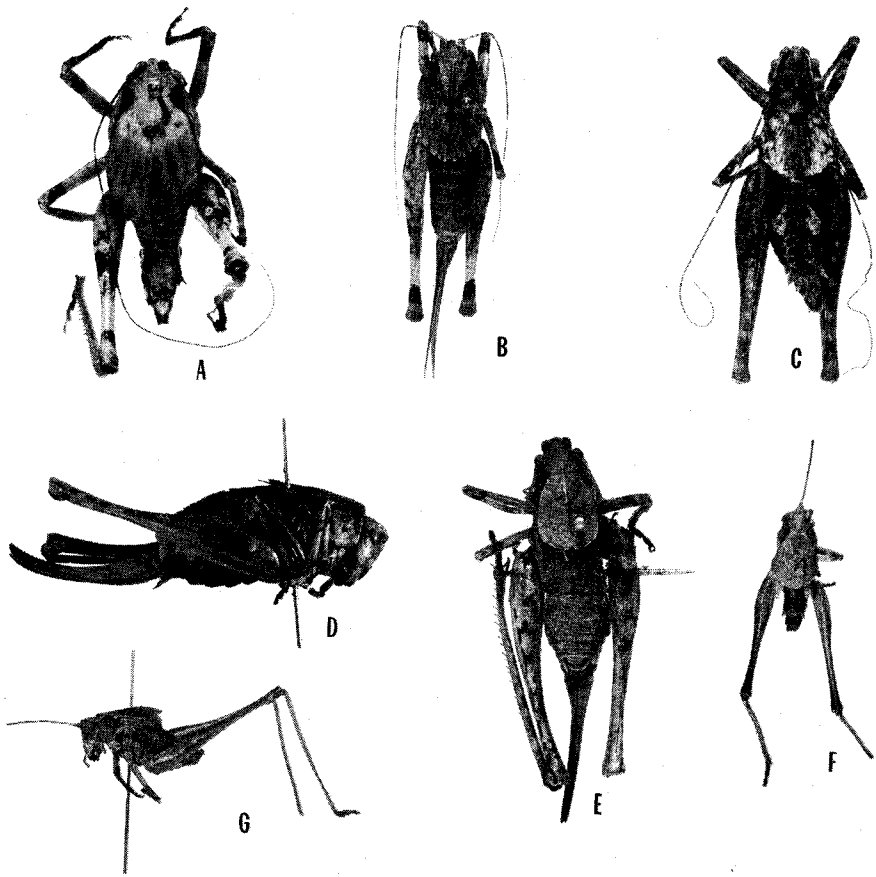

Fig. 34. Critical specimens in the subgenus *Neduba*. A, *N. castanea*, paratype. B, *N. macneilli*, paratype. C, *N. convexa*, topotype. D. Lateral, E, dorsal view *N. diabolica*, holotype. F, dorsal, G, lateral view *N. carinata*, holotype.

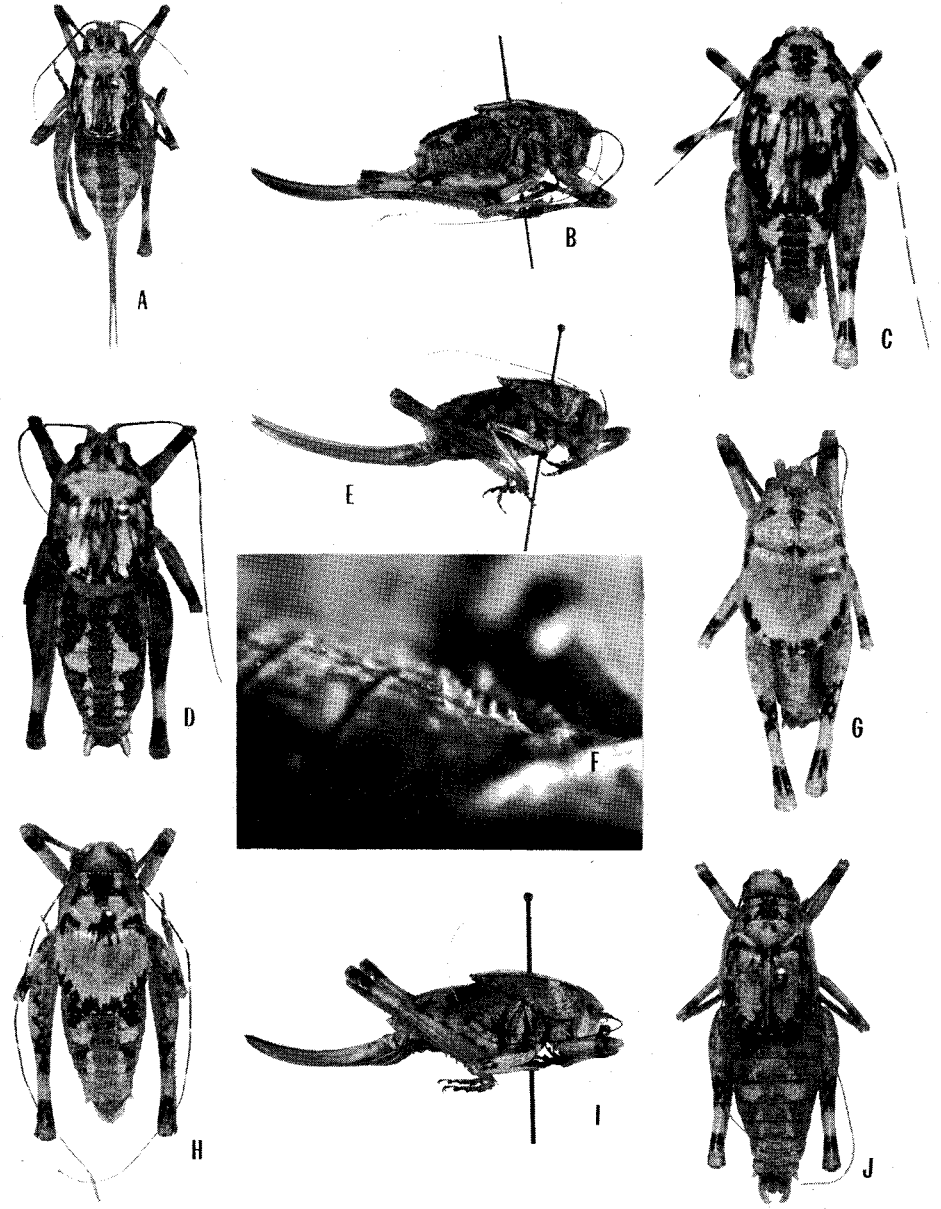

Fig. 35. A, female *N. o. ovata*. B, lateral view female, C. dorsal view male *N. o. gigantea*. D. intermediate between *N. o. longicauda* and *N. o. gigantea*, male. E, lateral view female, F, dorsum of abdominal terga 2, 3 female *N. o. longicauda*. G, male *N. o. tinkhamorum*. H, dorsal view male, I, lateral view female *N. o. armiger*. J, *N. o. segnis*.

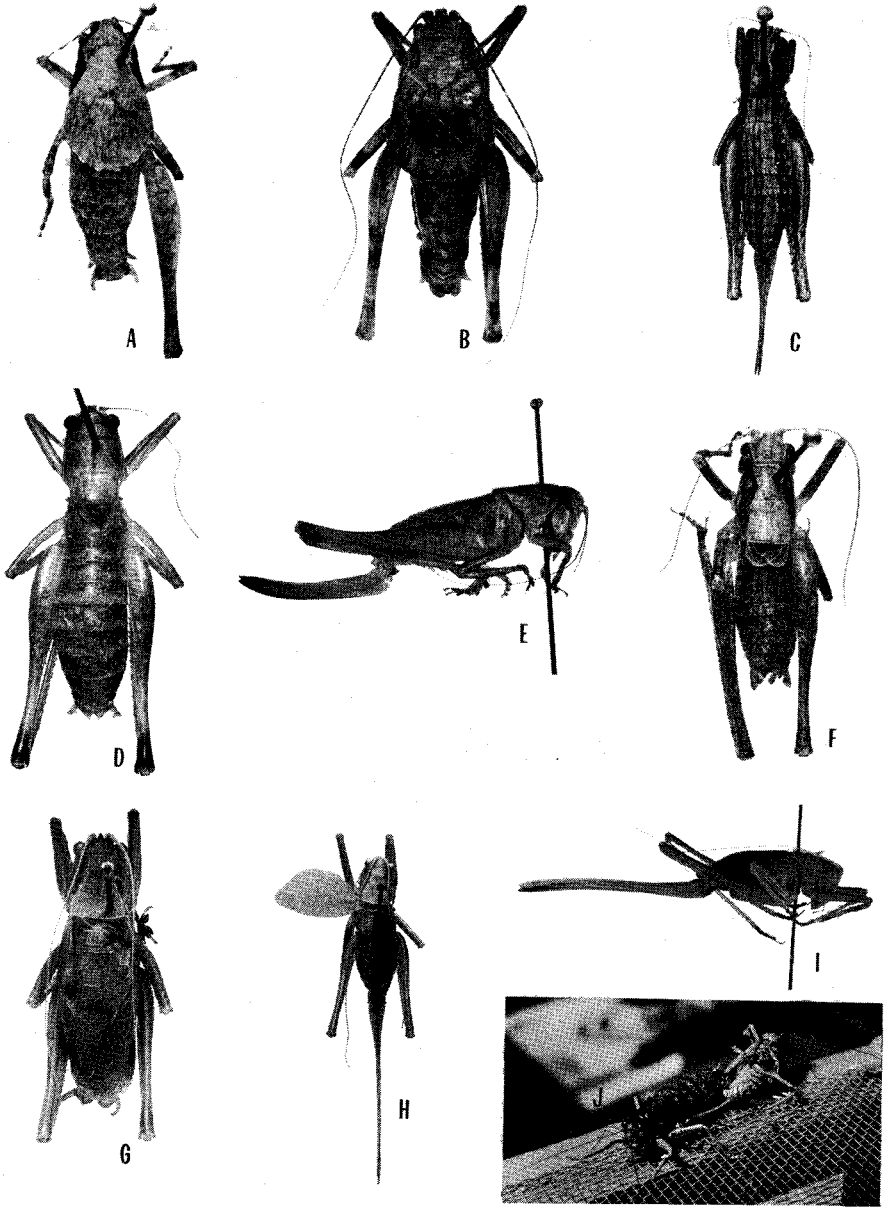

Fig. 36. A, *Neduba (A.) diminutiva*, holotype male. B, *N. (A.) gurneyi*, paratype male. C, *Ateloplus hesperus*, topotype female. D, *Inyodectes pallida*, holotype male. E, *I. pallida*, allotype female. F, *Oreopedes cryptoptera*. G, dorsal view male, H, dorsal view female, I, lateral view female, *Cyrtophyllicus chlorum*. J, mating pair *Acrodectes philopagus*.

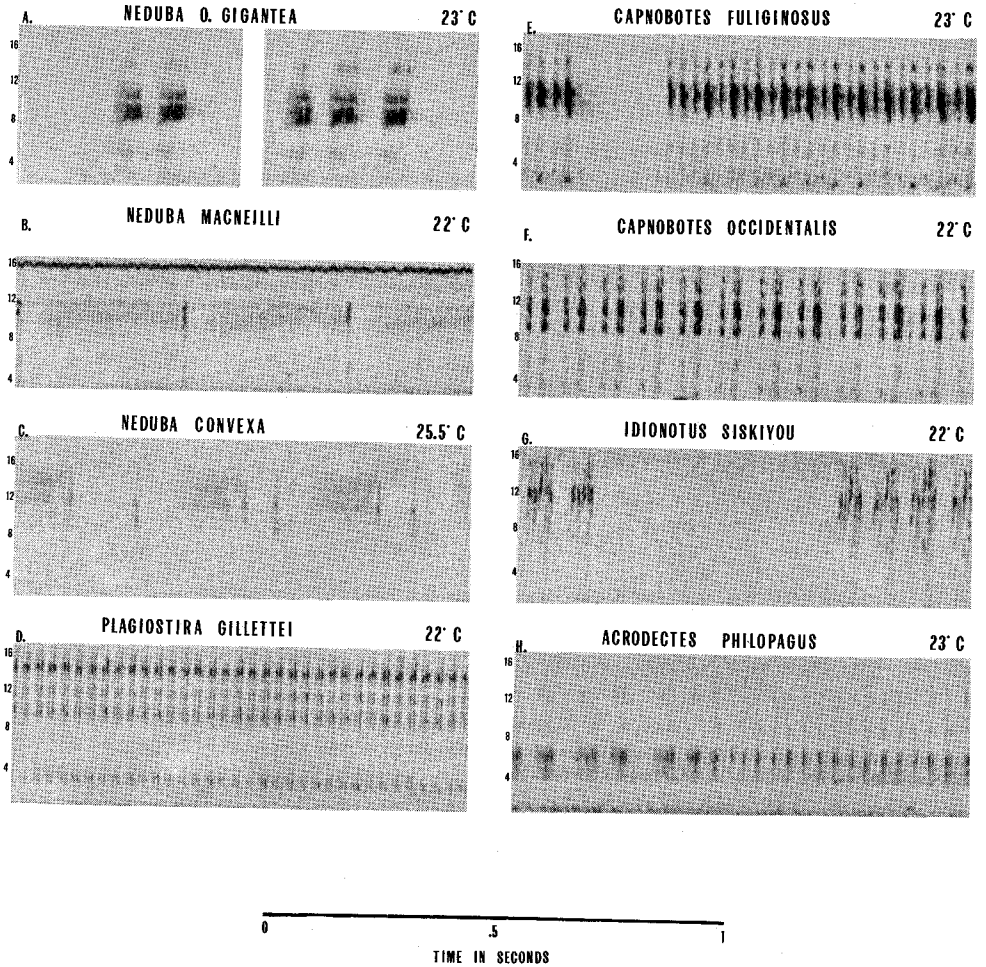

Fig. 37. Sonograms of the calling songs of some Decticinae. Vertical scale is kilocycles per second.

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